Outcome and Predictors of In-hospital 6-week Mortality Associated with Invasive Methicillin Resistant *Staphylococcus aureus* (MRSA) versus Methicillin Sensitive *Staphylococcus aureus* (MSSA) Infection

By

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Abstract

Background: *Staphylococcus aureus* (SA) infections are common and important within the hospital environment. The case fatality rate of invasive *Staphylococcus aureus* (SA) infections is between 20-40%. Whether the infection is due to methicillin resistant SA (MRSA) or methicillin sensitive SA (MSSA) may determine outcomes. Literature to date is inconclusive regarding whether antimicrobial resistance in SA affects patient outcomes. Host factors, infection-host interactions, and treatment-related factors may also influence case fatality.

Objectives: The purpose of this study was to determine if patients with MRSA invasive infections were more likely to die than those with MSSA invasive infections, and what factors were associated with death.

Methods: A retrospective matched case control study was designed, comparing cases of MRSA with controls of MSSA invasive disease from hospitals participating in the Canadian Nosocomial Infection Surveillance Program (CNISP). Two analyses were run: the first, to identify the variables associated with MRSA vs. MSSA infections, and the second, to determine the variables associated with death in invasive *Staphylococcal aureus* (*S. aureus*) infections. Backward logistic regression analysis was used for the MRSA vs. MSSA analysis and a hierarchical logistic regression model for assessment of risk factors for death.

Results: In the logistic regression MRSA model the variables: recent prior use of antibiotics, Charlson Comorbidity Index score > 2 and not having received appropriate empiric antibiotics were associated with MRSA vs. MSSA infections. The hierarchical model identified older age, higher CCI scores, immunosuppression, bloodstream infection, septic shock, neurological dysfunction and not receiving appropriate empiric antibiotic as associated with death. MRSA infection was not more likely to be associated with increased mortality than MSSA infection. Those with a resistant infection (MRSA) however, were less likely to receive appropriate empiric antibiotic treatment.

Conclusions: Appropriate empiric antibiotics are the most important and only modifiable risk factor identified. Elderly patients who are on immunosuppressive drugs and have chronic comorbid conditions need to be monitored and screened more often since they are more at risk for death than others.

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1 Chapter One - Introduction

1.1 Background

Staphylococcus aureus (*S. aureus*) is a bacterium that is a major human pathogen. It colonizes and infects both hospitalized patients with impaired immune systems and healthy people in the community. Most people are intermittently colonized with *S. aureus,* which is found primarily in the nasopharynx and skin. From these sites, *S. aureus* can affect other sites of the body or be spread to other surfaces or people through air or direct contact. When a person's skin or mucous membranes are altered through trauma or surgery, *S. aureus* can enter into the underlying tissue or bloodstream. Clinical manifestations caused by invading *S. aureus* include furuncles, cellulitis, pneumonia, septicemia, osteomyelitis, bactermia and vascular access device-associated infections.

Methicillin resistant *Staphylococcus aureus* (MRSA) was first recognized in the early 1960's, shortly after the introduction of the antibiotic methicillin for treatment of penicillin-resistant *S. aureus* infections.[1] Strains that are oxacillin and methicillin resistant are cross-resistant to almost all available beta-lactams. This resistance is due to a penicillin-binding protein coded for by a mobile genetic element termed the methicillin-resistance gene complex (mecA). The mecA gene complex alters a penicillin-binding protein (PCP-2a), preventing penicillins and cephalosporins from binding to the cell wall and allowing the bacteria to grow in the presence of these antibiotics. Generally, *S. aureus* isolates that are susceptible to the semi-synthetic penicillins, oxacillin, cloxacillin and methicillin are called methicillin sensitive *Staphylococcus aureus (*MSSA).

MRSA was first identified in Canada in 1981.[2] In 1995, the Canadian Nosocomial Infection Surveillance Program (CNISP) identified 0.5 of every 1,000 patient admissions were colonized or infected with MRSA.[3] This rate increased to 4.34 in 2001.[3] As overall rates increase the number of infections will increase and therefore the number of deaths may increase. MRSA is often found in patients who become more ill once infected and therefore is thought it may be more virulent than MSSA strains. Whether there is a difference in the virulence of MRSA

compared to that of MSSA is debatable. This study may be able to provide additional evidence to help determine this.

The Institute of Medicine (IOM) report on medical errors identified nosocomial infection surveillance as a model for voluntary patient safety reporting systems.[4] MRSA and other antimicrobial resistant organisms are important causes of hospital acquired infections. The acquisition of any nosocomial infection, including those due to MRSA, is considered an adverse event that poses a threat to patient safety. Declines in infection rates in intensive care units and surgical patients at hospitals in the National Nosocomial Infection Surveillance (NNIS) show that infection control efforts can reduce these adverse events, as described in the IOM report.[4]

Nurses play a key role in the management and prevention of nosocomial infections within hospitals. With the implementation of hand hygiene programs, the use of routine practices and additional precautions, and adherence to aseptic technique and other infection prevention practices in nursing care, the risk of acquiring a health care infection can decrease substantially. The outcomes that result from acquiring health care infections can result in increased lengths of stay, more use of antimicrobials and even death. A Harvard School of Public Health report[5] had identified measures of patient outcomes potentially sensitive to nursing (OPSN). The literature review and discussions with experts in the field and members of the Technical Expert Panel, found the vast majority of studies that met the criterion of OPSN were related to adverse patient outcomes. Length of stay and nosocomial infections, including hospital-acquired pneumonia, urinary tract infections (UTI), surgical wound infection, skin and soft tissue infection and shock were identified as adverse events, which if left untreated, could result in increased mortality. Patients' risk factors for experiencing these outcomes included variables such as age, sex, and presence of chronic diseases. The Harvard School of Public Health report listed 23 outcomes pertaining to nursing quality of care that were used in previous studies and references. Of these, pneumonia, urinary tract infection (UTI), nosocomial infection, sepsis, shock, surgical wound infection, mortality and length of stay were found to be associated with the acquisition of an antimicrobial resistant organism.[5] The focus of this report was on the associations between the OPSN and the nursing staffing variables. Each of the 23 OPSN identified were evaluated, with positive associations between

nursing hours/case-mix and urinary tract infections, skin pressure ulcers, pneumonia, length of stay, upper gastrointestinal bleeding, and shock. Interestingly, no associations were seen between nursing hours/case-mix and patient sepsis, surgical wound infection or mortality. Silber and colleagues[6,7] noted that these complications may be less associated with the hospital or nursing staff ratio or mix than they are with individual patient characteristics. In a recent article Needleman[8] did another analysis of inpatient hospital mortality and nursing staffing, where patient level measures including age, gender and chronic comorbidities were included as possible confounders. All but sex remained as significant factor in the model. Kane et al[9], in their systematic review and meta-analysis examining the association of registered nursing staffing levels and patient outcomes, concluded that additional research examining patient characteristics as a significant risk factor for mortality should be included in future studies.

Since individual patient characteristics can determine patient outcomes, it is important for nurses to identify patients who are at greater risk of the acquisition of a resistant organism such as MRSA, as well as those who are at greater risk of death from these organisms. Identification of these characteristics and/or precursors helps nurses to determine if any of these patient characteristics are "modifiable risk factors". Non-modifiable risk factors are risk factors like age or sex that cannot be modified. These non-modifiable risk factors help nurses identify the characteristics of patients who are at risk for increased mortality. Modifiable risk factors are risk factors that can be changed or altered, for example, moving a patient from a ward room to a single room or checking lab results to the medication chart to ensure the patient is on the correct antibiotic treatment. Nurses as first line healthcare workers need to know what the modifiable and non-modifiable risk factors associated with death are, in order for timely and appropriate nursing care and stringent infection prevention and control practices and measures to take place.

The IOM reported that preventable adverse patient events in the U.S., including nosocomial infections, are responsible for 44,000-98,000 deaths annually at a cost of $17-$29 billion.[4] A Canadian study[10] examining costing for MRSA within Canada found an attributable cost of $14,360 per patient. Assuming an infection rate of 10-20% it was determined the costs associated with MRSA in Canadian hospitals to be $42 million to $59 million annually. These costs will continue to rise as the incidence of MRSA increases. The costs were related to the

additional costs associated with the acquisition of the MRSA infection. The costs presented in this study are very conservative; this study was done over 10 years ago and MRSA rates in Canadian hospitals have climbed substantially since then. No other Canadian study examining MRSA costs have been done since this one and the actual dollar figures, not only the number of MRSA cases, will have changed significantly. As rising incidence occurs so will rising costs, and more importantly, rising mortality rates.

1.2 Problem statement

Whether invasive disease due to MRSA has a higher 6-week all cause case-fatality rate than invasive disease due to MSSA needs to be determined. Research is available to support both MRSA having higher mortality rates than MSSA, and that MSSA cases have higher mortality rates than MRSA cases. If the mortality rate of invasive MRSA is higher, it needs to be determined whether it is the MRSA organism itself that is associated with the increase death rate versus the demographic and treatment characteristics of the patients who are prone to get MRSA infections. Most of the present literature is from non-Canadian studies and may not necessarily reflect the same mortality rates seen in Canada. The incidence rates of MRSA in Canada are known to be different from the U.S. and other countries.[11] The fraction of *S. aureus* which is MRSA in the U.S., Latin America, and Great Britain is 50% or higher, while Canadian numbers are more similar to those of northern European countries such as Germany, Hungary and Austria at less than 20%, depending on the hospital or geographic region. Reasons for country-specific differences are unknown but may be due to more stringent practices in infection control in Canada, as well as the differences in the prescribing practices of antibiotics within Canadian health care facilities, as a consequence of the widespread implementation of hospital-wide antibiotic utilization protocols in Canadian hospitals. Although it is known that incidence and prevalence rates of MRSA differ between Canada and other countries, it is unknown if mortality rates differ as well. The patient characteristics and risk factors associated with mortality in cases of invasive *S. aureus* infections had not been determined within a Canadian context. This case-control study collected in-hospital outcome data from a large group of all inpatients from multiple hospitals throughout Canada within the years 2001 and 2002. Differences in 6-week mortality outcomes between patients with invasive MRSA (cases) and invasive MSSA (controls) were determined.

1.3 Objective

Objective 1:

To determine the risk factors and 6-week mortality differences between Canadian in-hospital patients with invasive disease due to MRSA and MSSA.

Objective 2:

To determine the risk factors associated with 6-week mortality amongst patients with invasive disease due to *S. aureus*.

2 Chapter Two - Literature Review:

2.1 The epidemiology of *Staphylococcus aureus* and MRSA in Canada – prior to 2003.

Staphylococcus aureus (*S. aureus*) is a leading cause of hospital-acquired infections. Infections with *S. aureus* are especially difficult to treat because of evolved resistance to antimicrobial drugs. Resistance to penicillin and newer β-lactamase–resistant penicillin antimicrobial drugs (e.g., methicillin, oxacillin) appeared soon after they were introduced into clinical practice in the 1940s and 1960s, respectively.[12,13] The first case of MRSA in Canada was reported in 1981.[2] CNISP reported that overall rates of MRSA increased from 0.95 per 100 *S. aureus* isolates in 1995 to 8.16 per 100 *S. aureus* isolates in 2001. Rates of infection per 1,000 patient admissions increased from 0.25 in 1995 to 4.34 in 2001.[14]

The National Nosocomial Infections Surveillance System (NNISS) in the United States found MRSA rates of 50.5% in intensive care units (ICU), 49.9% in non-ICU areas, and 24.1% in outpatient areas between 1998 to June 2001.[15] MRSA in the United States became endemic in the 1980s and early 1990s with rates of 40% in hospital settings in the overall inpatient population.[16] In Canada, MRSA was not considered endemic until the late 1990s. A high of 20% MRSA in *S. aureus* isolates was identified in only one of the CNISP sentinel sites with an overall Canadian average of only 6% in 1999. In Canada, the majority of cases at the time of this study were hospital-acquired (nosocomial) with fewer than 1% in-hospital cases reported to have come from the community. The community-acquired MRSA rate had remained stable from 1995 to 1999.

2.2 Changes in the epidemiology of MRSA in Canada since 2003.

MRSA is now considered endemic in many Canadian hospitals. More recent CNISP data spanning from 1995 to 2007 found a total of 37,169 hospitalized patients were newly identified as either infected or colonized with MRSA, and the overall incidence of combined

MRSA colonization and infection increased from 0.65 in 1995 to 11.04 cases per 10,000 patient-days in 2007.[17] Of these 37,169 patients, 11,828 (32%) had an MRSA infection, and the rate of infection increased over time as well from 0.36 to 3.43 cases per 10,000 patient-days. The overall incidence of both MRSA colonization and MRSA infection increased 17-fold in Canadian hospitals from 1995 to 2007.[17] The CNISP rate at the time of this study in 2001 was 4.34 cases per 1,000 patient admissions[3] and had increased to 8.62 in the year 2007.[18]

The rate of MRSA in Canada remains much lower than that in the U.S. (as described above). It is believed that these lower rates may be due to intense admission screening protocols and stringent infection control policies for antimicrobial-resistant organisms (AROs) within Canadian institutions. A Canadian survey examining infection control and antimicrobial restriction policies and practices for preventing the emergence and transmission of MRSA, vancomycin-resistant enterococci (VRE), and extended spectrum beta-lactamase (ESBL) producing *Enterobacteriaceae* was performed within Canadian teaching hospitals as part of the Canadian Nosocomial Infection Surveillance Program.[19] The majority of responding facilities (96.4%) conducted admission screening for MRSA and regular prevalence surveys were done for MRSA at 21.4 % of the institutions. Pre-emptive precautions were applied for MRSA by 60.7% of facilities. All facilities flagged patients previously identified with MRSA. Barrier precautions varied by ARO and patient-care setting. In the inpatient non-ICU setting, more than 90% of facilities required staff to wear gowns and gloves to care for patients colonized/infected with MRSA and 57.1% required the use of masks. Attempts to decolonize MRSA patients had been made by 82.1%, largely in order to place them in another facility. Policies restricting antimicrobial prescribing were reported by 21 facilities (75.0%). The hospitals that participated in the survey described above are the same hospitals that participated in this study.

To date, Canada has identified 10 epidemic MRSA strains.[20,21,22] Criteria for being an epidemic strain include a unique profile as determined by pulsed-field gel electrophoresis, significant potential to cause disease in patients, and identification in multiple hospital sites in three or more geographic regions in Canada. Case fatality rates by strain-type are not known. To date, there has not been any particular strain shown to more likely cause infection rather

than colonization, or to be more virulent in humans. However, in animal (mouse) models, the Community-acquired-MRSA (CMRSA) strain USA300 (CMRSA-10) is more virulent (more likely to kill the animal) than other strains. There is also some anecdotal evidence to suggest the CMRSA-10 strain may cause more severe infections in humans, but this is yet to be confirmed. Related to this, there is some evidence that strains of *S. aureus* (both MSSA and MRSA) possessing the Panton-Valentine Leukocidin (PVL) are more virulent, certainly in animal models, and possibly also in humans, especially as a cause of necrotizing pneumonia. The vast majority of CMRSA-10 (USA300) are PVL-positive in Canada. However, it is still unknown whether mortality in infections due to these strains is higher than mortality in infections due to other common Canadian strains (personal communication – Dr. Andrew Simor, April 1 2012).

As the rates of MRSA increase in Canada the proportion of strain types may also change. Canada has seen the emergence of new community strains (such as CMRSA-10 mentioned above) which are now being seen within Canadian hospitals. At the time of data collection for this study, community strains such as CMRSA-10 and CMRSA-7 were rare. Between 1995 and 1999 only 6 percent of the isolates in the CNISP surveillance program were the community strains, while from 2004-2007 the percentage increased to 21%.[17] Patients with the community strains are different than patients with hospital strains and are more likely to be males, under 65 years of age, infected (vs. colonized), and to have skin and/or soft tissue infections (vs. other sites of infection). Hospital strains from 1995-1999 were predominately CMRSA-1. This changed, with strains from 2004-2007 being predominately CMRSA-2, another hospital strain. These hospital strains are primarily found in the elderly with more colonizations than infections and when infection do occur, they are more likely to be bloodstream infections. The CMRSA-1 was the predominant strain during data collection for this study, and therefore it is likely that the patient population in the study will have similar demographic characteristic as those who typically have this strain. More recent Canadian rates found in the year 2011 found MRSA bloodstream infection 30 day mortality rates to be 24%.[23] One-third of the bloodstream infections were caused by community strains and older age was associated with increased mortality. As the epidemiology of MRSA changes within Canada, it is important to continue to monitor the effects of these changes on patients so that interventions can be implemented for those who are most vulnerable.

2.3 Studies comparing mortality in infections due to MRSA vs. MSSA

The identification of predictors of severe outcomes and risk factors for death is important for nurses, since the early identification of these can lead to interventions that may significantly influence the outcome for the patient. Early identification can also prompt pre-emptive infection control measures such as decolonization therapy, isolation or more stringent infection prevention and control practices. All published articles (Medline, EMBASE, Current Contents and the Cochrane Library for the period January 1978 to December 2001) on differences between MRSA and MSSA mortality were reviewed. The search was restricted to English, human subjects and used medical subject heading and free text words with the following keywords: "*Staphylococcus aureus*", "aureus", "methicillin resistance", "invasive disease", "mortality", "outcome" and "death". Citations were tracked until no other new articles could be found.

Of all the articles[24-45] reviewed, many had sample sizes as small as 25 (including both MRSA and MSSA cases), all were from single hospitals, many studies looked only at specific patient groups (e.g., ICU, burn patients) and only 6 studies performed a multivariate analysis. Appendix B Section 8.21 presents the studies[24-25,27-28,30-34,45] focusing on *S. aureus* bacteremia mortality comparisons between MRSA and MSSA. Several studies found greater mortality in MRSA versus MSSA bacteremia cases:[23,25,27,30,40] however, only three studies[25,27,30] found it in multivariate analysis. The three studies that found MRSA to be a predictor of death in the multivariate models controlled for age, days of hospitalization prior to infection, prior antibiotic therapy, prior surgery, indwelling urinary catheter, nasogastric tube, liver disease, heart disease, uropathy, inappropriate empiric therapy, hospital vs. community acquisition, lung as site of entry, septic shock, platelet count <100,000 cubic mm and total days of hospitalization. Other studies found no differences in mortality between MRSA and MSSA cases.[28,32,33,34,45] Studies which eliminated community-acquired cases did not agree[24,25]. Only two of the studies[31,32] had sample sizes that were adequate to determine a true difference in MRSA vs. MSSA mortality rates and only the Soriano study had a large enough sample to determine risk factors for death. The Soriano study[30] did find differences in mortality between

MRSA and MSSA patients in univariate but not in multivariate analyses where they controlled for shock, source of bacteremia, prognosis of the underlying disease, sex, age, acquisition of the infection in an ICU, and appropriateness of empirical treatment. The Soriano study and the Selvey study were the only studies in which the sample size was adequate to find true differences in overall mortality rates. However, overall MRSA was not found to be a statistically significant predictor in the Selvey[32] study in the univariate analysis, and in the Soriano study MRSA was not a predictor of death when other factors were included in the model. Other studies looked only at specific patient populations (e.g., surgical patients, ICU patients) with mortality statistics reflecting the expectations of these populations.[26,35,39]

The many variables previously associated with *S. aureus* mortality from the studies reviewed included: length of stay in hospital prior to infection, prior antibiotic therapy, MRSA, inappropriate empiric therapy, severe underlying disease (Y/N), age, gender, prior surgery, indwelling urinary catheter, nasogastric tube, liver disease, heart disease, meningitis, methicillin resistance, tracheostomy/ventilation, central venous catheter, diabetes mellitus, neoplasia, obstructive pulmonary disease, cerebrovascular disease, drug addiction, vascular disease, renal failure, severity of underlying condition, prior surgery, and shock. These risk factor variables listed were identified in the multiple studies reviewed; however, because most studies had very small sample sizes, only a few of these variables were included per study.

2.4 Meta-analysis of data prior to 2000

A meta-analysis was performed in 2001 by Whitby and colleagues[46] to explore mortality differences between MRSA and MSSA bacteremia patients in all published studies from 1978 to 2000. The meta-analysis looked only at mortality in bacteremic infections, not all invasive disease. The reason stated for this meta-analysis was that MRSA was found in patients who are severely ill and that there was a continuing perception that this organism was more virulent than MSSA. Also, since the studies prior to 2001 had conflicting results, they decided to combine them in a meta-analysis. None of the studies controlled for comorbid conditions. Seven[24,25,27,28,30,31,32] included inappropriate empiric therapy with only two finding a statistically significant difference in MRSA,[24,31] one for MSSA[27] and four were not-significant.[25,28,32,30] Older age, male gender, past history of MRSA, length of stay prior to

infection, prior surgery, immunosuppression, tracheostomy/ventilation, central venous catheter, indwelling urinary catheter, and nasogastric tubes were risk factors identified in MRSA bacteremia patients.[24,25,27,28,30-33] Most of the risk factors that are associated with MRSA vs. MSSA are also risk factors associated with death. The Whitby meta-analysis found that the relative risk for death for MRSA cases versus MSSA cases was 2.12, with a 95% confidence interval of 1.76-2.57.[46] The test for heterogeneity of relative risks showed no significant difference (p=0.11). Some conclusions discussed were that differences in pre-existing comorbid conditions may have affected outcomes. Also noted from these studies were that patients with MRSA infections had greater lengths of stay and prior treatment with antibiotics,[24,25,26,27-32] suggesting that those who end up with MRSA may be more seriously ill prior to their infections than those with MSSA infections. This meta-analysis did not include some important studies that showed no difference between MRSA and MSSA mortality. These studies were eliminated due to the inclusion criteria for the meta-analysis. Reasons for some relevant studies not being included in the meta-analysis were that the studies were published before 1978, or because the authors were unable to separate the community-acquired cases from the hospital acquired cases, which was an inclusion criterion for the meta-analysis.

2.5 Meta-analysis of data prior to 2003

Another meta-analysis in 2003 by Cosgrove and colleagues,[47] included 31 studies that contained data regarding the mortality associated with both MSSA and MRSA bacteremias. In this meta-analysis, 24 studies (77%) found no significant difference in mortality, seven studies (22.6%) found significantly higher mortality in MRSA infections, and no studies found lower mortality rates associated with MRSA infections. Eight of the studies in the Cosgrove meta-analysis were also in the Whitby[46] meta-analysis. The Cosgrove meta-analysis was broader and included material that was more recent. This more recent meta-analysis also found a significant increase in mortality associated with MRSA bacteremia compared to MSSA bacteria, with a pooled OR of 1.93 (95% CI, 1.54-2.42; $p<0.001$). Although their results were statistically significant there was a significant heterogeneity using the Q statistic test between studies' ($p=0.03$), suggesting that the studies are not estimating the single common effect of the impact of methicillin resistance on mortality for *S. aureus* patients. This significant heterogeneity was not found in the previous smaller meta-analysis which was much

stricter in its inclusion criteria. Many of the studies in the Cosgrove meta-analysis were also from single hospitals (where it may be assumed to have similar antibiotic utilization practices), single patient groups (e.g., surgical patients, ICU patient, burn patients only), or did not look at or control for inappropriate antibiotic treatment or comorbid conditions of cases. These systematic differences between studies can influence the results, thereby leading to heterogeneity between studies. The exclusion of these relevant confounders should influence how one interprets the results.

The design of the present study tried to control for the many variables that could have influenced the results of these previous studies, with the advantage of taking place in multiple hospitals and thereby having a larger sample size. This larger sample size allowed the PI to include more variables in the multivariate, variables that may have been affecting previous studies results. Particular areas of concern noted from the previous studies included in these meta-analyses were single population, single hospital, no use of a standardized comorbidities assessment, no information on treatment and the immunological state or chronic comorbid conditions of the patients acquiring the *S. aureus* infections. The purpose of this study was to collect the most clinically important variables to determine the risk factors associated with death and more importantly to identify the modifiable factors associated with death due to *S.aureus* infections.

3 Chapter Three - Methods

3.1 Study design

This study was a retrospective matched case control study comparing cases of invasive disease due to MRSA with matched controls of invasive disease due to MSSA, found in 17 participating sentinel CNISP hospitals in the years 2001 and 2002.

3.2 Study inclusion criteria

Patients who were admitted to a CNISP hospital, had an invasive MRSA or MSSA infection in 2001 or 2002 and were 18 years of age or over at the time of their infection were eligible for inclusion in the study.

3.3 Study exclusion criteria

Patients who were under the age of 18 years of age at the time of the infection and patients not admitted to hospital (e.g., emergency room and outpatients not admitted to hospital) were excluded from the study.

3.4 Matching criteria

The first MRSA isolate from a sterile site identified in each patient from the 2001 and 2002 laboratory databases of each hospital was matched to the first MSSA isolate from a sterile site identified in the same time period. The MSSA isolate was the next sterile site isolate identified in the laboratory database and therefore was the isolate closest in time (date) to the MRSA isolate. Cases (MRSA) were matched to controls (MSSA), by age (+/- 10 years), site of isolate (blood-to-blood, and "other" site of isolate to "other" site of isolate - see below for criteria) and presumed location of acquisition (community vs. hospital-acquired). Cases and control were age-matched because age is an important factor associated with mortality due to all infections. Cases were matched for bloodstream vs. other invasive infections because bloodstream infections are known to be associated with higher mortality, and cases were matched on hospital vs. community acquired disease because of the hypothesis that

community strains of *S. aureus* are more likely to contain the PVL gene and therefore may be more virulent than hospital strains. Matching on variables that are already known or postulated to influence outcomes helps to eliminate these confounding variables, and also helped this study to better focus on the other unknown variables in question.

In order to match cases and controls, the process started with a review of the 2001 and 2002 laboratory records/databases to help identify sterile site isolates for MRSA and MSSA. Once identified, they were matched as indicated below:

Category 1 (Invasive bacteremic patients)

Matched on:

1.) Blood culture with pathogen = MRSA matched with blood culture with pathogen = MSSA;

and

2.) Age +/- 10 years;

and

3.) Presumed location of acquisition (community acquired matched to community acquired and hospital acquired matched to hospital acquired -see definitions below).

Category 2 (Invasive non-bacteremic patients)

Matched on:

1.) If the isolate was *not a blood* culture then a patient with an MRSA was matched with another patient with a *non-blood* culture from any of the "other" acceptable sterile sites (listed below) and the pathogen was an MSSA. The match had to be a patient with an MSSA culture from any "other" acceptable sterile site, e.g., pleural fluid isolate patient matched with synovial fluid or tissue isolate patient;

and

2.) Age +/- 10 years;

and

3.) Presumed location of acquisition (community acquired matched to community acquired and hospital acquired matched to hospital acquired-see definitions below).

Acceptable sites for isolates:

Accepted invasive isolate specimens (obtained from a normally sterile site) for this study:

● blood ● pleural fluid ● joint/synovial fluid

● tissue (not sinus or skin) e.g., lymph node, brain, heart, liver, spleen, kidney, lung, pancreas or ovary

●cerebrospinal fluid (CSF) ● peritoneal fluid/ascites ● pericardial fluid

Criteria when more than 1 acceptable infected site was involved in the first episode:

● If blood is one of the positive cultures, then matched on blood;

● If 2 or more MRSA/MSSA "other" non-blood positive cultures were identified, then patients were matched to the patient with the next "other" non-blood positive culture from that hospital, conditional that they were one of the allowable sterile sites identified for this study.

● If >1 isolate, the isolates had to have been collected within 48 hours of each other.

3.5 Surveillance population

CNISP is the collaborative effort of the Canadian Hospital Epidemiology Committee (CHEC), a subcommittee of the Canadian Infectious Disease Society (CIDS) and the Division of Health Care Acquired Infections, Centre for Communicable Diseases and Infection Control at the Public Health Agency of Canada. CNISP began collecting MRSA incidence data in 1995

from 22 CHEC hospitals throughout Canada. These hospitals are located in all provinces except for Prince Edward Island. The number of CHEC hospitals had grown to 34 in 2002. The CNISP hospitals are primarily tertiary acute-care facilities. All CNISP hospitals have surveillance programs within their hospitals for MRSA. Laboratory surveillance for all *S. aureus* isolates was maintained in laboratory records kept by each CNISP site. These laboratory records were used to identify the MRSA and MSSA patients with positive sterile site isolates that occurred in the years 2001 and 2002. Infection Control Practitioners or laboratory personnel who work at the CNISP hospitals reviewed the laboratory reports in order to identify potential participants for the study. These personnel were trained over the phone by the primary investigator on:

a.) how to identify cases on the laboratory records (ensuring acceptable isolate sites were used), how to match appropriately (by age, isolate site and presumed location of acquisition) and the use of the definition for infection types (as per appendix A, section 8.1.4);

b.) data extraction from chart reviews. In addition, the extractors could call the Principal Investigator (PI) for all cases whenever questions needed to be answered.

Of the 34 CHEC hospitals that were part of the CNISP program in 2002, five provided care only for paediatric patients and were not approached for study participation. Participation in this study was voluntary and all CHEC hospitals (except the paediatric ones) were approached to participate. A total of 17 of the remaining 29 hospitals agreed to participate in this study. The other 12 sites were similar to the 17 that participated in that they were all acute-care tertiary hospitals with dedicated infection control physicians who were participating in the surveillance of nosocomial infections as part of CNISP.

3.6 Laboratory methods used to identify MRSA and MSSA cases

Isolates were identified as *S. aureus* by routine bacteriologic procedures performed at the CNISP hospital laboratories. MRSA was defined as an isolate of *S. aureus* with an oxacillin minimal inhibitory concentrations (MIC) greater than or equal to 4ug/mL (as determined by broth microdilution). Oxacillin resistance was then confirmed by polymerase chain reaction (PCR) detection of the mecA gene[20]. All isolates identified as MRSA were sent to the National Microbiology Laboratory in Winnipeg, Manitoba and then to Sunnybrook Health Sciences Centre, where they were confirmed as MRSA by detection of the *mec*A gene by polymerase chain reaction.

All susceptibility testing was performed at Sunnybrook Health Sciences Centre in Toronto. Resistance to oxacillin was confirmed by growth on oxacillin agar screen plates (Mueller-Hinton agar supplemented with 4% NaCl and oxacillin, 6 mg/ml) incubated at 35°C for 24 hours and additional testing was performed by broth microdilution. MSSA was defined as *S. aureus* susceptible to methicillin, oxacillin, cloxacillin and cephalosporins. Some isolates may have been susceptible to penicillin; however, most MSSA are penicillin-resistant.

3.7 Definitions

3.7.1 Case and control definitions

Cases were defined as patients 18 years of age and older, admitted to one of the study hospitals in the years 2001 or 2002 and were identified with an invasive methicillin resistant *Staphylococcus aureus* (MRSA) infection.

Controls were defined as patients 18 years of age and older, admitted to one of the study hospitals in the yeas 2001 or 2001 and were identified with an invasive methicillin sensitive *Staphylococcus aureus* (MSSA) infection.

3.7.2 Presumed location of acquisition definitions

Presumed location of acquisition - Hospital: The culture was positive for MRSA or MSSA and was identified at a minimum of 72 hours after date and time of admission, with no clinical evidence of infection (fever, leukocytosis, or other signs and symptoms) present on admission.

Presumed location of acquisition - Community: An infection that does not meet the definition for hospital-acquired. This means the patient was culture positive for MRSA or MSSA within 72 hours of admission and/or showed clinical evidence of infection at that time.

3.7.3 Type of infection definitions

The type of infection definitions were adapted from the Center for Disease Control and Prevention and the Centers for Disease Prevention and Control, Health Canada definitions for nosocomial infections. A booklet was created for the study that included all the infection type definitions that was used by the data extractors when extracting data for the study. Appendix A, section 8.1.4 is a copy of the contents of the booklet and lists all the infection types and the specific definitions for each one. Data extractors were trained prior to data collection to ensure that each specific infection type met the case definition outlined in the booklet.

3.7.4 Measures of immune system status definitions

Receiving immunosuppressive therapy: Therapies included chemotherapy, corticosteroids, azathioprine, cyclosporine, tacrolimus, sirolimus, cyclophosphamide, methotrexate and remicade.

Neutropenic: neutrophil count < 500 cells/mm^3.

3.7.5 Complications of Infection definitions

Renal insufficiency: a serum creatinine level of > 176 ug/ml (>2.0mg/dl or >200mMol/L) or double the baseline or dialysis initiated.

Hepatic dysfunction: a serum bilirubin concentration of >3mg/dl or increased aspartate aminotransferase of alanine aminotransferase levels more than twice the upper limit of normal, or twice the baseline if baseline was above normal.

Respiratory difficulty: new partial arterial 0_2 pressure of <60 mm Hg, new partial arterial CO2 pressure of > 50mm HG, or initiation of ventilatory assistance.

Neurological dysfunction: change in level of consciousness.

Septic Shock: sepsis associated with evidence of organ hypoperfusion and a systolic blood pressure < 90 or > 30 mm HG less than the baseline value or a requirement for the use of vasopressors to maintain blood pressure.

Coagulopathy: marked reductions in blood concentrations of platelets and coagulation factors in the peripheral blood or a physician reported disseminated intravascular coagulation (DIC) or coagulopathy in the chart.

3.7.6 Appropriate antibiotics definition

This was defined as the appropriate administration of a parenteral antibiotic that was active in vitro against the isolated strain of *S. aureus*.

Appropriate antibiotics for MRSA infections included:

- Vancomycin
- Teicoplainin
- Linezolid (Zyvoxam)
- Quinupristin-dalfopristin (Synercid)

Appropriate antibiotics for MSSA infections included:

- Cloxacillin
- all 1st and 2nd generation cephalosporins*
- trimethoprim/sulfamethoxazole (Septra/Bactrim)
- all 3rd generation cephalosporins** except ceftazidime
- Clindamycin
- Erythromycin/azithromycin

- Penicillin (if isolate was penicillin-susceptible)
- Vancomycin (if patient is allergic to penicillin)

*1st and 2nd generation cephalosporins included: cephalothin, cephalexin, cephradine, cefaclor, Cefadroxil, cephapirin, cefazolin, cefoxitin, cefuroxime, efamandole, cefmetazole.

** 3rd generation cephalosporins included: cefoperazone, cefotaxime, cefsulodin, cefotetan, ceftriaxone, cefixime, cefizoxime.

Appropriate empiric antibiotic not given:

This variable was created to determine if the appropriate antibiotic (as listed above) was not given between the time of the culture collection and the time that antibiotic susceptibility was first reported.

3.7.7 Other definitions

Devices - definition

The variable "Devices" was created and categorized into a dichotomous variable of Yes – devices present and No- no devices present. Devices included in this variable were indwelling urinary catheter, central venous catheter, and nasogastric tube or feeding tube. If one of these specific devices were used for the patient in the 7 days prior to the infection the variable devices was coded as 1 = yes and if not, then the variable was coded as 0 = no.

Measure of Comorbidity - definition

Comorbidities are diseases or disorders that may coexist with the infection or disorder under study. Comorbidities are important to collect since they may significantly affect the outcomes of a patient. Comorbidities, in fact, may be a primary predictor of outcome over other variables being studied. Therefore, with any mortality study a measure of comorbidities is necessary to include in the variables collected in order to determine whether the comorbidities that the patient has are associated with the outcomes. Most other studies that include comorbidities in their list of variables either include them as individual comorbid conditions or as a dichotomous variable of presence vs. absence of any comorbid conditions.[48-52]

In this study, a standardized comorbidity tool, the Charlson Comorbidity Index (CCI)[53] was used. This tool was designed to weigh the impact certain comorbid conditions have on mortality. This Index was originally designed as a measure of the risk of 1-year mortality attributable to comorbidity in a longitudinal study of general hospitalized patients.[53] The CCI is a multi-item scale consisting of 16 specified medical conditions, which are weighted by severity. Numerous studies have tested the validity and reliability of this method of measuring comorbidity, all with positive results for its use as a good indictor for predicting mortality in patients.[54-57] This Index had been validated as a good predictor of mortality in patients with *S. aureus* bacteremias and was recommended by the authors of one of the studies as a useful instrument to control for comorbidity in studies aiming to investigate risk factors for death due to bacteremias.[57] Comorbidity has also been shown to be a risk factor for colonization or infection with antibiotic-resistant bacteria.[58-61] The CCI helps for statistical reasons as well, since it provides a mechanism for adjusting for many different co-morbid conditions in a single variable. Using this index can also help nurses in predicting who is likely to acquire colonization or infections with an antibiotic resistant bacteria.[62-63] These predictions help to identifying patients early, who may benefit from more stringent infection control interventions such as isolation or more frequent surveillance cultures.

For the MRSA vs. MSSA analysis a dichotomous categorical CCI was created for patients. The two categories included those with CCI index scores of 0-2 and those with CCI scores of 3+. This was done since the CCI index score was significantly lower in MSSA cases with the majority of cases having scores < 3 (75% of the total MSSA cases). The cut-off of 3+ also was found in univariate analysis to be statistically different between the MRSA and MSSA patients ($p=0.002$). As will be discussed later, MRSA cases are believed to be more ill prior to infection which may be affecting the mortality rates for MRSA cases. By including the CCI index in the models we can see if MRSA and mortality is associated with CCI index scores and categories. For the mortality analysis the CCI index was left as a raw score since the distribution were more evenly distributed amongst those who died.

3.8 Study data extraction – collection of information

A pilot of the data extraction form was performed at two of the participating sites by the PI. Ten cases and ten controls for the years specified in the study were identified at each site and a chart review performed. Any potential problems in data extraction were noted to ensure that these issues were addressed during the telephone training with the data extractors. Items that were identified as possibly problematic in data collection were:

Problem 1 - How to know which positive culture to use if > 1 positive culture was identified?

Solution 1 – A strict protocol on what to do if > 1 positive culture identified was created and reviewed during the telephone training. This is defined in section 3.4.

Problem 2 – How do you make the decision on what the presumed location of acquisition was - hospital vs. community-acquired?

Solution 2 – Extractors needed to follow strict definitions for hospital and community acquired which were reviewed during the telephone training. Dates of first signs and symptoms of infection need to be subtracted from the date of admission to see where patients likely were when they were infected.

Problem 3 – How do the data extractors ensure they are identifying the correct infection types in the questionnaire for each of the invasive infections?

Solution 3 – A booklet called “the blue book” and titled “Guide for Definitions of Infections” was created and provided to all the data extractors, who had to ensure patient met the case definition for each infection prior to checking off the type of infection. This “blue book” is included in Appendix B, section 8.1.4.

Patients identified as a case or control through the laboratory records in 2001 and 2002 had their charts reviewed by an infection control professional or nurse employed at the institution in which the cases and controls had been admitted. These personnel in each CNISP site, abstracted data from hospital records using a standard questionnaire designed for this study (see Appendix A, section 8.1.1 and 8.1.2). Data collected included specimen/isolate

information, demographic characteristics, hospitalization and medical history, information on the MRSA/MSSA infection, including presumed location of acquisition and type of infection, other coinfections, devices, past history of MRSA, prior antibiotic therapy, empiric and post-culture antibiotic therapy, comorbid conditions (using the Charlson comorbidity index), severe outcomes and six-week mortality.

In order to determine whether the variable "appropriate empiric antibiotic given" was accurate, 22 antibiogram (a laboratory test for sensitivity for antibiotics) results from one hospital were compared to the variable "appropriate empiric antibiotic given," using the case definition described above. There was 100% concordance with the choice of antibiotic and the case definitions; that is, if an antibiotic was appropriate as per the case definition it was identified as "sensitive" in the antibiogram results. Although the laboratory results were only from one hospital the antibiogram methods are similar throughout all CNISP hospitals, and the comparison was primarily to test if the case definition for appropriate empiric antibiotics (which was based on which antibiotic was given) actually matched the antibiogram results. The 100% concordance helped to validate this definition.

3.9 Sample size calculations

The program Epi Info version 6.04d (Center for Disease Control - CDC, Atlanta Georgia) was used to determine the sample size. Based on the combined data from a meta-analysis,[45] there was an expected crude in-hospital mortality of 25% for MRSA bacteremia and 12% for MSSA bacteremia. Approximately 80-90% of all invasive *S. aureus* patients were likely to be bacteremia cases and therefore mortality due to MRSA/MSSA bacteremia estimates were used to calculate sample size. Assuming the proportion of deaths in the MSSA group is 12% (p_1 = 0.12) and the proportion is 25% in the MRSA group (p_2=0.25), with an α = 0.05 (two-sided), and a power = 80%, a ratio of controls to cases = 1.0, the sample size was calculated to be 154 cases and 154 controls. In the event that 25% of cases and controls were not traceable due to missing charts and unmatchable cases, an extra 38 MRSA and 38 MSSA controls were added to the sample sizes, increasing the necessary number to 192 invasive MRSA cases and 192 invasive MSSA controls.

3.10 **Patient confidentiality and ethics**

Infections Control Practitioners (ICP), study nurses or laboratory personnel who worked at each of the designated CNISP sites reviewed the laboratory records and performed the chart reviews. There were no interventions or patient contact associated with this study and therefore no risk of direct harm to the patient. Any information in the chart review that could identify a patient by name or any other personal identifiers were not collected on the data abstraction form. A non-identifying ID number was collected for each patient. The non-identifying ID number was used for matching the cases and controls only. All data were aggregated and no hospital identifiers were used in presentations and/or publications.

All CNISP sites received permission to conduct this study from their individual hospitals Research Ethics Board. Under the TriCouncil agreement, recognizing there were no patient interventions associated with this study, informed patient consent was not required. As well, the study was reviewed and approved by the University of Toronto's Research Ethics Board.

3.11 **Data management**

The central data entry and processing was done at the University of Toronto in a locked office. Data collection forms were held in a locked filing cabinet kept by the Principal Investigator (PI). Computer files were accessible only to the PI and were protected by personal and confidential passwords. Data were entered into Excel 97 software. Drop-down menus were created to ensure adequate data entry for all fixed options. Any queried result where the data entry person did not know what to include from the questionnaire was circled on the original questionnaire and reviewed by the PI. This occurred in approximately 20% of the questionnaires. Often the data extractors would write down additional clinical items they found could be of interest. Missing data for any of the questions were flagged and reviewed by the PI, who sent queries back to the data extractors. If significant amounts of relevant data were missing and could not be obtained, the patient and their matched control or case was removed from the database.

Data were double entered and the Data Compare program in Epinfo 2000 (Center for Disease Control - CDC, Atlanta Georgia) was used to identify any data entry differences. Any

differences found were corrected from the original. After the differences in the compare program were fixed every 10th entry was compared to the original sheet for data entry accuracy and also that the entries were valid and made clinical sense. Forty questionnaires were reviewed this way and no errors were found.

3.12 **Analysis**

Univariate analyses were done using Epi Info version 6.04c software and were used to compare the demographic variables, underlying diseases, bacteremic vs. non-bacteremic and outcome differences between the invasive MRSA and MSSA infections and between patients who died and those who remained alive at 6 weeks post-infection. Descriptive statistics included frequency analysis (percentages) for categorical variables and means for normally distributed continuous variables, or medians for not-normally distributed or skewed data. To compare the mean differences between continuous data in the MRSA and MSSA, or Died and Lived groups a t-test was used. If the data was not normally distributed then the Mann-Whitney test was performed. For discrete categorical paired MRSA-MSSA data McNemar's test were used and Wilcoxon signed-rank for ordinal or data that were not normally distributed. Pearson's χ^2-tests were used for categorical variables for the died vs. lived analysis. Fisher's Exact (two-sided) tests were used for all comparisons of proportions in which at least one expected cell count was less than five. All data were visually inspected for completeness and correctness. Continuous data that were later categorized for further analysis were graphed and cut-offs were based on observed points of clinical or observational significance. Odds Ratios (OR) and 95% Confidence Intervals (CI) were calculated. P-values less than 0.05 were regarded as statistically significant. All variables with $p \leq 0.20$ in the univariate analysis and variables deemed clinically important by the PI were considered for the multivariate logistic regression analyses as per Lemeshow's guidance to keep those risk factors whose inclusion reached a reasonable liberal significance level.[64] A conditional backward stepwise logistic regression was used for the matched analysis of differences between MRSA vs. MSSA infections. A hierarchical logistic regression was used for the analysis of whether MRSA was a risk factor for death which was performed using SPSS version 19.0 (SPSS Inc., 2010, Chicago,IL, www.spss.com). Details on the multivariate analysis are described in section 3.12.1 and 3.12.2 below.

3.12.1 Comparison of MRSA and MSSA infections

All variables collected in the data extraction forms were analyzed using univariate analysis as described above. A conditional multivariate model was developed to assess predictors of MRSA infection. Although there is literature that supports certain variables as predictors of MRSA, most studies tested a very limited number of variables. Thus it may have been difficult to determine if in the other studies the variables were correlated with other known predictor variables and/or to identify interaction or known confounding variables. The sample size of this study permitted a larger number of potential predictor variables to be considered. The potential for discovery of new correlations or new predictors while controlling for confounding and interactions was the purpose of using this method.

The MRSA model included all the variables associated with having a MRSA vs. a MSSA invasive infection that were statistically significant at the ≤0.20 level. Variables in the MRSA Model included:

1. Patient was classified as Alive or Dead, 6 weeks after the date of the first sign or symptom of infection. Coded as 0 = alive and 1 = died;

2. History of antibiotic use in the previous 4 weeks – yes/no variable, coded at 0=no and 1=yes;

3. Appropriate empiric antibiotics not given – 1-yes (appropriate empiric antibiotics were not given) and 0= no (appropriate empiric antibiotics were given);

4. Within 48 hours of the first positive culture the patient went into septic shock. Categorized as a yes/no variable and coded as 0=no and 1=yes.

5. Within 7 days of the first positive culture the patient experienced hepatic dysfunction, coded as 0 = yes and 1 = no.

6. Within 48 hours of the first positive culture the patient experienced neurological dysfunction, coded as 0= yes and 1 = no.

7. Charlson Comorbidity Index score – categorized into scores of 3+ and 0-2. Coded as 0=0-2 and 1=3+.

8. Time to infection – continuous variable in days calculated from date of culture minus date of admission.

9. Patient had an indwelling urinary catheter, central venous catheter or a nasogastric or feeding tube in place in the 7 days prior to the date of the first positive culture. Yes/no variable called Devices coded 0=no and 1=yes.

10. Patient had previously been admitted to an ICU in the 30 day period prior to infection.

11. Dummy variable for the matched cases and controls based on the three matched variables: a.) age of patient at time of infection - this variable was matched for each case and control identified within ages plus or minus 10 years; b.) presumed location of acquisition, included either community-acquired or hospital-acquired; and c.) bloodstream infection vs. "other" non-bacteremic invasive disease infections.

3.12.2 Comparison of mortality in *S. aureus* infected patients

This analysis was the main analysis and purpose for this study. Three clinicians experienced in MRSA ranked each variable under consideration. The list provided to the clinicians included variables found to be significant at the ≤ 0.20 level, variables biologically plausible to be related to death and variables identified in the literature review. The clinicians chose and ranked the variables by importance as a predictor of death based on their experience and knowledge. This ranking was used to identify the variables to be included in the analysis. Three separate blocks were developed with the first block (Died block 1) examining the variables that were host-related. These *host-related* variables in block 1 were host specific and where identifiable pre-infection. The block 1 hierarchical model was entered as described below.

Block 1: the first block contained all the variables that were identified as clinically important and had a p-value of ≤ 0.20 and were identified as *host-related* variables.

The variables in block 1 (host-related variables) were entered in the following order:

1. Age – as a continuous variable.

2. Charlson comorbidity index score.

3. Patient had a device in place in the 7 day period prior to the positive culture – Yes/no variable.

4. On the day of the positive culture the patient was neutropenic – yes/no variable.

5. Patient had received immunosuppressive therapy in the previous 7 days – Yes/No variable.

The outcome measure was all cause mortality at six weeks after the date of the first positive invasive *S. aureus* culture. This first hierarchical model (model 1-host factors) was developed to determine the significance of certain variables that were *host-related* factors, including medical conditions/immune status, as well as history of device use. Block 1's secondary purpose was to determine variables that could be used to flag patients for more stringent infection control practices or surveillance cultures.

Block 2 included the following *infection-related* variables collected which were identified as clinically important and had p-values ≤0.20. These variables included:

1. *Staphylococcus aureus* type – either MRSA or MSSA.

2. Bacteremic vs. non-bacteremic infection - this is the infection type identified on the questionnaire and was dichotomized into 1= bloodstream infection (bacteremic) vs. 0 = (non-bacteremic) "other" infection.

3. Neurological dysfunction – coded as 0 if absent and 1 if present. This variable indicated a change in consciousness level within the 48 hour period

commencing at first sign or symptom of infection as defined in the definitions section.

4. Septic shock – coded as 0 if absent and 1 if present. This variable indicated whether or not the patient had sepsis associated with evidence of organ hypoperfusion and a systolic blood pressure <90 or > 30 mm HG less than the baseline value or a requirement of the use of vasopressors to maintain blood pressure.

5. Coagulopathy – coded as 0 if absent and 1 if present. This variable indicated whether the patient had a marked reduction in blood concentrations of platelets and coagulation factors in the peripheral blood or a physician reported Disseminated Intravascular Coagulation (DIC) or coagulopathy within 48 hours of the first sign or symptom of infection.

Interaction terms were entered in the model with the MRSA variable. These interactions terms were included in block 2 but removed in the final model since they were not statistically significant. These terms included MRSA*CCI score, MRSA*Age and MRSA*appropriate empiric antibiotic. The interaction term MRSA and septic shock was added to one of the models tested to determine whether MRSA was interacting with septic shock and was removed from the final block since it had no impact on the model and was not significant.

Certain variables used in this analysis were redefined since more than 10 events per predictor occurred. For instance, the variable "devices" was created because several devices were statistically significant at the ≤0.20 level and had similar odds ratios. These devices were collapsed into one variable which became a yes/no response for presence of a indwelling urinary catheter, central venous catheter or nasogastric or feeding tube.

Block 3 included the treatment related variables. These variables included appropriate empiric antibiotic not given and length of time to appropriate treatment. Note that these variables are modifiable risk factors and therefore could be important for interventions.

The two variables added to block 3 which were treatments related included:

1. Appropriate empiric antibiotic not given – yes/no variable

2. Length of time in days to appropriate treatment – this variable was numeric and measured in days.

The length of time in days to appropriate treatment variable did not meet criterion for having a p of ≤ 0.20, however it was included since it was deemed clinically relevant and was felt could be associated with the variable MRSA vs. MSSA.

The Likelihood Ratio Test was used to test the difference between block 1 and 2 and block 2 and 3, with block 1 a reduced model of block 2 and block 2 a reduced model of block 3. The computed chi-square was obtained by the difference in the log-likelihood (-2(ML) Log-Likelihood) for the three blocks, and degrees of freedom was calculated by the difference in the number of parameters between the two blocks.

4 Chapter Four – Results

A total of 414 data abstraction forms were submitted to the study. Forms were received from the following provinces: British Columbia, Alberta, Manitoba, Ontario, New Brunswick, Nova Scotia, Quebec and Newfoundland. Of these questionnaires, 16 (3.9%) were removed because they did not meet the case definition or because data were so sparce on the questionnaire that they would not have contributed to the analysis. A total of 398 patients with invasive disease due to *S. aureus* were included in the final analysis: 199 MRSA cases and 199 matched MSSA controls. Presentation of the analysis in this section will be done in the following order: 1.) univariate analysis comparing the differences between invasive infections due to MRSA and MSSA; 2.) backward conditional logistic regression analysis comparing invasive infections due to MRSA and MSSA; 3.) univariate analysis comparing differences between patients who died and those who remained alive at six weeks post infection; and 4.) hierarchical logistic regression analysis comparing 6-week all cause mortality amongst patients with invasive disease due to *S. aureus*.

4.1 Results of the MRSA vs. MSSA univariate analyses

Table 1 displays the numbers and percentages for the variables that were used in the matching of MRSA and MSSA patients. MRSA cases were matched to MSSA controls on sterile isolate site (blood to blood and "other" to other"), age (±10 years) and presumed location of acquisition (either hospital or community-acquired). The numbers and percentages for these three variables will therefore be similar.

The primary culture site for study participants was blood, with 81.4% of cases and controls having positive blood cultures (MRSA or MSSA). A mean age of 62 and a median age of 65 years were seen in both MRSA and MSSA cases, with ages ranging from 18 to 93 (IQR=28) for MSSA and 20-92 (IQR=27) for MRSA patients. Hospital acquired cases made up 78% of each of the MRSA and MSSA infections. Since matching was done based on invasive disease culture sites, approximate age and presumed location of acquisition, it was expected that no significant differences would be seen.

Table 1: MRSA and MSSA infections by age, site of isolate and presumed location of acquisition (matching variables)

	MRSA N=199		MSSA N=199		p-value
Age					
mean - (SD)	62.5	(±17.2)	62.4	(±17.1)	
median – (IQR)	65.0	(28)	65.0	(27)	0.96
Site of Isolate	#	**%**	#	**%**	
Blood	160	80.4%	160	80.4%	
Other sites* (# of patients)	39	19.6%	39	19.6%	1.0
Site affected* Synovial fluid	3	1.0%	11	5.5%	
Pleural fluid	13	6.5%	7	3.5%	
Pericardial fluid	1	0.5%	0	0.0%	
Ascites/Peritoneal fluid	10	5.0%	7	3.5%	
Tissue (not sinus or skin)	24	12.1%	21	10.6%	
Cerebrospinal fluid	2	1.0%	4	2.0%	0.95
Presumed location of acquisition					
Hospital acquired	156	78.4%	156	78.4%	
Community acquired	43	21.6%	43	21.6%	1.0

* *note: the number of sites infected will be more than the number of patients infected since some patients had > 1 positive culture site. The percent reflects the number of patients with that site having a positive culture.*

Table 2 is a comparison of the epidemiological features between those with MRSA and MSSA infections. The mean and median number of days in hospital for MRSA and MRSA infected cases, from time of admission to time of infections, was somewhat longer for MRSA cases (mean = 16.1 days versus 12.8 days, p=0.13*)* with a median of 7 (IQR=49) vs. 6 (IQR=30) days. These differences were not statistically significant. MRSA infected patients were also somewhat more likely to be admitted to hospital from a long-term care/nursing home or rehabilitation facility than from home, although not statistically significant (p=0.14). The majority of cases were admitted to hospital from home (88.9% MRSA vs. 94.4% MSSA). No differences were seen in gender and service the patient was on at the time of initial signs and symptoms of infection.

Table 2: MRSA and MSSA demographics and pre-infection history

	MRSA		MSSA		p-value
	#	%	#	%	
Male	136	68.3%	127	64.1%	
Female	63	31.7%	71	35.9%	0.37
Length of stay					
mean days (SD)	44.1	(42.7)	39.9	(56.6)	0.41
median (IQR)	32	(49)	21	(30)	
Number of days in hospital to *S. aureus* infection					
mean days (SD)	16.1	(22)	12.8	(20.9)	0.13
median (IQR)	7.0	(22)	6.0	(13)	
Home (private residence)	176	88.9%	184	94.4%	
Long term care/ nursing home	19	9.6%	10	5.1%	
Rehabilitation facility	3	1.5%	1	0.5%	0.14
Service patient on at onset of symptoms					
ICU	43	21.6%	38	19.1%	
NON-ICU	117	58.8%	119	59.8%	
Outpatient	34	17.1%	41	20.6%	0.63
Unknown*	5	2.5%	1	0.5%	

**unknown not included in analysis*

Table 3 displays a comparison of the types of invasive disease infections between MRSA and MSSA cases. Primary blood stream infections comprised 45.7% of MRSA and 45.2% of MSSA. Secondary blood stream infections comprised 35% of both the MRSA and MSSA cases, for a total of 80.4% of all cases having either a primary or secondary blood stream infection. Other non-bloodstream infections accounted for the remaining 19.6% of the cases. The only infection site that was statistically significantly different between MRSA and MSSA infections was in bone and joint infections where infections were more common with MSSA infections (N=11, 5.5%) than MRSA infections (N=3, 1.5%), (p=0.03). Of the MSSA cases with secondary blood stream infections due to surgical wound infections, cases were more likely to be MSSA (42.0%) than MRSA (23.2%). Secondary blood stream infections due to infections other than pneumonia or a surgical wound infection were more likely to be MRSA (63.8%) than MSSA (33.3%). Important to note here is that all of the infections were identified as being an invasive infections with a positive sterile site isolate, so Table 3 needs to be interpreted knowing that each case was evaluated to ensure that it was an invasive infection

and it was associated with a positive sterile site culture. For example, gastrointestinal infections were identified through isolates obtained from the peritoneal fluid, lower respiratory tract infections were from pleural fluid (chest fluid or thoracentesis fluid), the reproductive infection was identified through an isolate from the ovaries, and the cardiovascular infections were from isolates obtained from vascular tissue. All invasive infections in the absence of a positive blood culture were confirmed as "invasive site infections", although some misclassification may have occurred. The extent of the misclassification would have been minimal since few cases occurred without good clinical data to support it. For the non-bacteremic cases there is the possibility that some of these cases were actually secondary blood stream infections; however, no blood cultures were obtained on them. Other infections classified as "non-bacteremic" also could have already started antibiotics prior to the taking of the blood specimen and therefore the blood culture may have come back negative, since the antibiotic had already started working. The strict case definition ensured that all cases and controls in the study were true invasive disease cases with positive cultures (to identify the organism) from sterile sites.

TABLE 3: MRSA and MSSA by infection types

	MRSA N=199		MSSA N=199		p- value
	#	%	#	%	
Blood stream infections					
Primary blood stream	91	45.7%	90	45.2%	0.99
Secondary blood stream	69	34.7%	70	35.2%	0.99
Pneumonia	17	8.5%	17	8.5%	
SWI	16	8.0%	29	14.6%	
Other infections	44	22.1%	24	12.1%	0.007
Non-blood stream infections					
Pneumonia	5	2.5%	3	1.5%	0.36
Bone and/or joint	3	1.5%	11	5.5%	0.03
Osteomyelitis	3	1.5%	2	1.0%	
joint/ bursa	0	0.0%	8	4.0%	
vertebral disk space	0	0.0%	1	0.5%	
Cardiovascular system	0	0.0%	1	0.5%	
Endocarditis	0	0.0%	1	0.5%	
Central nervous system	2	1.0%	4	2.0%	0.68
Gastrointestinal system	5	2.5%	4	2.0%	0.50
Lower respiratory tract* (excluding pneumonia)	5	2.5%	3	1.5%	0.36
Reproductive tract	1	0.5%	0	0.0%	
Skin & soft tissue	5	2.5%	5	2.5	1.0
Surgical wound	14	7.0%	9	4.5%	0.28

**includes infections such as bronchitis, tracheobronchitis, bronchiolitis, tracheitis, lung abscess, and empyema.*

Table 4 compares the present and past clinical differences between patients with MRSA and MSSA infections. Devices that patients had in place in the seven days prior to the *S. aureus* infection included indwelling urinary catheter (MRSA 48.7% vs. MSSA 37.2%; p=0.02), and nasogastric or feeding tube (MRSA 28.1% vs. MSSA 20.1%; p=0.06). Having a device in place has previously been identified in the literature review as being associated with MRSA infections. Devices themselves are portals for organisms to enter the body, but also those patients with devices are generally more ill, thereby more likely to acquire infection and therefore more likely to be exposed to antibiotics. Prior antibiotic use as documented in Table 7 was identified as a risk factor for MRSA vs. MSSA infection. In the six months prior to the *S. aureus* infection, MRSA cases were more likely to have had a previous MRSA infection or colonization (MRSA 31.2% vs. MSSA 0.5%; p<0.001). *Clostridium difficile* co-infections

were more likely to occur in MRSA as compared to MSSA infected patients (6.0% MRSA vs. 1.5% MSSA; p=0.02). MRSA patients were also somewhat more likely to have been cared for in the ICU in the previous 30 days than MSSA patients (33.8% MRSA vs. 25.5% MSSA; p=0.07).

Table 4: MRSA and MSSA pre-infection clinical features

	MRSA N=199		MSSA N=199		p-value
Patient History - Devices (7 day period prior to *S. aureus* infection)					
	#	%	#	%	
Indwelling urinary catheter	97	48.7%	74	37.2%	0.02
Mechanical ventilation	39	19.6%	30	15.1%	0.23
Central venous catheter	86	43.2%	70	35.2%	0.20
Nasogastric tube or feeding tube	56	28.1%	40	20.1%	0.06
Tracheostomy	11	5.5%	9	4.5%	0.64
Peritoneal dialysis	8	4.0%	3	1.5%	0.22
Other devices	33	16.6%	38	19.1%	0.60
Six month period prior to *S. aureus* infection					
Positive MRSA culture	62	31.2%	1	0.5%	<0.001
Colonization	35	17.6%	1	0.5%	
Infection	18	9.1%	0	0.0%	
Infection & Colonization	8	4.0%	0	0.0%	
Positive MSSA culture	16	8.0%	16	8.0%	1.00
Colonization	9	4.5%	5	2.5%	
Infection	5	2.5%	11	5.0%	
Infection & Colonization	1	0.5%	0	0.0%	
Positive VRE culture	1	0.5%	2	1.0%	0.56
Colonization	1	0.5%	2	1.0%	
Infection	0	0.0%	0	0.0%	
At the time of *S. aureus* infection (coinfections or concurrent conditions)					
VRE	0	0.0%	2	1.0%	0.49
Colonization	0	0.0%	2	1.0%	
Infection	0	0.0%	0	0.0%	
Clostridium difficile	12	6.0%	3	1.5%	0.02
ESBL	2	1.0%	2	1.0%	0.61
Colonization	0	0.0%	1	0.5%	
Infection	2	1.0%	1	0.5%	
Patient in ICU in previous 30 days	67	33.8%	51	25.6%	0.07
Number of days in ICU mean, ±SD median and IQR	 11.3 6.0	 (±13.7) (12)	 9.8 4.0	 (12.0) (7)	0.56
Surgery in previous 30 days	81	41.1%	73	36.7%	0.42
7 days prior to positive culture					
Immunosuppressive therapy	31	16.0%	32	16.3%	0.96
Neutropenic	9	4.6%	6	3.1%	0.59
Neutropenic days mean and ±SD of neutropenic days median and range of neutropenic days	 3.6 4.0	 (1.6) (1-5)	 4.5 5.0	 (2.5) (1-7)	0.52
Dialysis	27	13.7%	21	10.6%	0.41

Table 5 compares the differences in comorbid conditions between MRSA and MSSA infected patients. The Charlson Comorbidity Index (CCI) was used as a weighted index that took into account the number and the seriousness of comorbid conditions for each patient in this study. The individual comorbid conditions used in the CCI are listed in Table 5 along with the number and percent of patients that had that specific comorbid condition for the MRSA and MSSA cases.

MRSA cases were more likely to have peripheral vascular disease (16.6% vs. 9.5%; p=0.04); pulmonary disease (22.1% vs. 12.1%; p=0.007); dementia (10.1% vs. 3.0%; p=0.004); paralysis (8.5% vs. 2.5%; p=0.01)*;* diabetes with end organ damage (11.1% vs. 6.0%; p=0.07); moderate to severe renal disease (21.1% vs. 13.1%; p=0.03); and mild liver disease (4.5% vs. 1.0%; p=0.03). MSSA cases were more likely to have had a myocardial infarction (19.6% vs. 10.1%, p=0.007) and metastatic cancer (9.0% vs. 3.5%, p=0.02) than MRSA cases. MRSA cases were more likely to have Charlson Comorbidity Index scores greater than or equal to 3 (MRSA 53.3% vs. MSSA 37.7%, p=0.002).

The CCI score is displayed at the bottom of Table 5. Scores ranged from 0-9 for MRSA and 0-12 for MSSA cases. The mean CCI score and standard deviation for MRSA was 2.8 and 2.1 and for MSSA cases was 2.5 and 2.6. The CCI score median and interquartile range was 3.0 and 3.0 for MRSA and 2.0 and 3.0 for MSSA patients. The chi-square test found a statistically significant difference between the CCI scores of the MRSA and the MSSA patients (p=0.008). MRSA infected patients were more likely to have CCI scores of 3 or greater than MSSA infected patients (OR 1.88, 95% CI 1.88, 2.87, p=0.002).

Table 5: Comorbid conditions using the Charlson Comorbidity Index between MRSA and MSSA infected patients

		MRSA N=199			MSSA N=199		p-value
Comorbid Conditions (Charlson Comorbidity Index)- (score)		#	%		#	%	
	Myocardial infarction – 1	20	10.1%		39	19.6%	0.007
	Congestive heart failure – 1	25	12.6%		30	15.1%	0.47
	Peripheral vascular disease – 1	33	16.6%		19	9.5%	0.04
	Cerebrovascular disease – 1	23	11.6%		20	10.1%	0.62
	Pulmonary disease – 1	44	22.1%		24	12.1%	0.007
	Dementia- 1	20	10.1%		6	3.0%	0.004
	Paralysis – 2	17	8.5%		5	2.5%	0.01
	Diabetes with end organ damage – 2	22	11.1%		12	6.0%	0.07
	Diabetes without end organ damage– 1	37	18.6%		41	20.6%	0.61
	Renal disease (moderate or severe) – 2	42	21.1%		26	13.1%	0.03
	Moderate to severe liver disease – 3	19	9.5%		18	9.0%	0.86
	Mild liver disease – 1	9	4.5%		2	1.0%	0.03
	Peptic/ duodenal ulcer – 1	12	6.0%		9	4.5%	0.50
	Tumour – 2	10	5.0%		16	8.0%	0.22
	Lymphoma – 2	6	3.0%		8	4.0%	0.59
	Leukemia – 2	3	1.5%		1	0.5%	0.61
	AIDS – 6	5	2.5%		1	0.5%	0.21
	Metastatic cancer – 6	7	3.5%		18	9.0%	0.02
	Rheumatologic disease – 1	8	4.0%		9	4.5%	1.00
Charlson Comorbidity Index score							
	0	27	13.6%		48	24.12%	
	1	36	18.1%		40	20.1%	
	2	30	15.1%		36	18.1%	
	3	41	20.6%		25	12.6%	
	4	25	12.6%		10	5.0%	
	5	17	8.5%		10	5.0%	
	6	11	5.5%		11	5.5%	
	7	7	3.5%		9	4.5%	
	8+	5	2.5%		10	5.0%	0.008
CCI score category							
	0-2	93	46.7%		124	62.3%	
	3+	106	53.3%		75	37.7%	0.002

Table 6 displays the history of antibiotic use for MRSA and MSSA infected patients in the four week period prior to the *S. aureus* infection. MRSA cases were more likely to have a history of antibiotic use by specific classes of antibiotics: penicillin (19.6% vs. 14.6%;

p=0.07), carbapenems (5.5% vs. 1.0%; p=0.02), aminoglycosides (13.1% vs. 4.0%; p=0.002), 2nd generation cephalosporins (6.0% vs. 0.5%; p=0.005), macrolides (8.5% vs. 1.0%; p<0.001), fluoroquinolones (48.2% vs. 19.1%; p<0.001), as well as the specific drugs clindamycin (12.1% vs. 2.0%; p<0.001), metronidazole (21.6% vs. 12.1%; p=0.02) and vancomycin (21.1% vs. 5.5%; p<0.001).

Table 6: History of antibiotic use in the 4 weeks prior to the MRSA or MSSA invasive infection

History of Antibiotic Use (previous 4 weeks)		**% is of # of patients on that drug**				
Antibiotic Class	**Antibiotic name**	**MRSA (n=199)**		**MSSA (n=199)**		
		#	**%**	**#**	**%**	**p-value**
Penicillin		39	19.6%	29	14.6%	0.007
	1. Amoxicillin	1	0.5%	5	2.5%	
	2. Amoxicillin/ Clavulanate	1	0.5%	2	1.0%	
	3. Ampicillin	10	5.0%	5	2.5%	
	4. Cloxacillin	8	4.0%	5	2.5%	
	5. Nafcillin	0	0.0%	0	0.0%	
	6. Penicillin G	4	2.0%	3	1.5%	
	7. Penicillin V	1	0.5%	0	0.0%	
	8. Piperacillin	2	1.0%	0	0.0%	
	9. Piperacillin/ Tazobactam	12	6.0%	8	4.0%	
	10.Ticarcillin/ Clavulanate	0	0.0%	1	0.5%	
Carbapenems		11	5.5%	2	1.0%	0.02
	11. Imipenem	7	3.5%	1	0.5%	
	12. Meropenem	4	2.0%	1	0.5%	
Aminoglycosides		26	13.1%	8	4.0%	0.002
	13. Amikacin	10	5.0%	0	0.0%	
	14. Gentamicin	10	5.0%	7	3.5%	
	15. Tobramycin	6	3.0%	1	0.5%	
Cephalosporins 1st generation		38	19.1%	44	22.1%	0.46
	16. Cefadroxil	0	0.0%	0	0.0%	
	17. Cefazolin	33	16.6%	36	18.1%	
	18. Cephalexin	5	2.5%	6	3.0%	
	19. Cephalothin	0	0.0%	2	1.0%	

History of Antibiotic Use (previous 4 weeks) - *continued*		**% is of # of patients on that drug**				
Antibiotic Class	**Antibiotic name**	**MRSA (n=199)**		**MSSA (n=199)**		
		#	**%**	**#**	**%**	**p-value**
Cephalosporins 2nd generation		12	6.0%	1	0.5%	0.005
	20. Cefaclor	0	0.0%	0	0.0%	
	21. Cefonicid	0	0.0%	0	0.0%	
	22. Cefoxitin	0	0.0%	0	0.0%	
	23. Cefuroxime	12	6.0%	1	0.5%	
Cephalosporins 3rd generation		38	19.1%	25	12.6%	0.08
	24. Cefixime	2	1.0%	0	0.0%	
	25. Cefotaxime	9	4.5%	5	2.5%	
	26. Ceftazidime	7	3.5%	7	3.5%	
	27. Ceftizoxime	4	2.0%	0	0.0%	
	28. Cefepime	0	0.0%	1	0.5%	
	29. Ceftriaxone	16	8.0%	12	6.0%	
Macrolides		17	8.5%	2	1.0%	<0.001
	30. Azithromycin	4	2.0%	0	0.0%	
	31. Clarithromycin	5	2.5%	1	0.5%	
	32. Erythromycin	8	4.0%	1	0.5%	
Fluoroquinolones		96	48.2%	38	19.1%	<0.001
	33. Ciprofloxacin	65	32.7%	28	14.1%	
	34. Norfloxacin	2	1.0%	0	0.0%	
	35. Levofloxacin	28	14.1%	9	4.5%	
	36. Gatifloxacin	1	0.5%	1	0.5%	
	37. Moxifloxacin	0	0.0%	0	0.0%	
Antifungal Medications		11	5.5%	6	3.0%	0.22
	38. Amphotericin B	1	0.5%	1	0.5%	
	39. Fluconazole	10	5.0%	5	2.5%	
	40. Itraconazole	0	0.0%	0	0.0%	
	41. Other antifungal medications	0	0.0%	0	0.0%	
Antituberculous Medications		3	1.5%	0	0.0%	0.25
	42. Ethambutol	0	0.0%	0	0.0%	
	43. Isoniazid	1	0.5%	0	0.0%	
	44. Pyrazinamide	1	0.5%	0	0.0%	
	45. Rifampin	1	0.5%	0	0.0%	
	46. Other antituberculous medications	0	0.0%	0	0.0%	

History of Antibiotic Use (previous 4 weeks) - *continued*		% is of # of patients on that drug				
Antibiotic Class	Antibiotic name	MRSA (n=199)		MSSA (n=199)		
		#	%	#	%	p-value
Tetracyclines		1	0.5%	0	0.0%	1.0
	47. Tetracycline	0	0.0%	0	0.0%	
	48. Doxycycline	1	0.5%	0	0.0%	
Others		126	63.3%	45	22.6%	
	49. Clindamycin	24	12.1%	4	2.0%	<0.001
	50. Chloramphenicol	0	0.0%	0	0.0%	
	51. Metronidazole	43	21.6%	24	12.1%	0.02
	52. Nitrofuratoin	0	0.0%	0	0.0%	
	53. Rifampin	1	0.5%	0	0.0%	
	54.Sulfamethoxazole / Trimethoprim (Septra/Bactrim)	8	4.0%	6	3.0%	0.59
	55. Vancomycin	42	21.1%	11	5.5%	<0.001
	56. Quinupristin-dalfopristin (Synercid)	0	0.0%	0	0.0%	
	57. Linezolid (Zyroxam)	3	1.5%	0	0.0%	
	58. Teicoplainin	0	0.0%	0	0.0%	
	59. Other	5	2.5%	0	0.0%	

Table 7 is a comparison of the frequency and mean/median number of antibiotics taken by patients with MRSA vs. MSSA in the 4 week period prior to their infections. MRSA cases were more likely to have received antibiotics in the prior four week period (61.1% MRSA vs. 47.7% MSSA; $p<0.001$) and MRSA patients were more likely to have received more antibiotics during that time (MRSA 2.1 mean number of antibiotic in the previous 4 weeks vs. 1.0 for the MSSA cases; $p<0.001$).

Table 7: Antibiotic use amongst MRSA and MSSA infected patients in the 4 weeks prior to the invasive infection

	MRSA N=199		MSSA N=199		p-value
Number of antibiotics patient on in 4 weeks prior to infection					
Mean, (SD)	2.1	(±1.9)	1.0	(±1.5)	
Median (IQR)	2.0	(3)	0.0	(2)	<0.001
Patient previously on any antibiotics in prior 4 weeks					
	149	61.1%	95	47.7%	<0.001

Table 8 includes the data on antibiotics given empirically to the patients. Empiric antibiotics are drugs given to treat infections prior to culture results which would identify the particular pathogen causing the infection. Nearly 40% (39.7%) of the MRSA patients were empirically treated with vancomycin as compared to 30.2% of the MSSA cases (p=0.05). Some of the MRSA cases received empiric drugs used to treat MSSA infections such as cloxacillin (9%), 1st generation cephalosporins (16.1%), 2nd generation cephalosporins (2%), trimethoprim-sulfamethoxazole (2%), clindamycin (6%), and 3rd generation cephalosporins except ceftazidime (11%).

Table 8: MRSA and MSSA empiric antibiotic therapy

Empiric antibiotic use		**(% is of # of patients on that drug)**				
		MRSA		**MSSA**		**p-value***
		#	**%**	**#**	**%**	
Penicillin		43	21.6%	49	24.6%	0.48
	1. Amoxicillin	1	0.5%	1	0.5%	
	2. Amoxicillin/Clavulanate	0	0.0%	0	0.0%	
	3. Ampicillin	12	6.0%	13	6.5%	
	4. Cloxacillin	18	9.0%	26	13.1%	
	5. Nafcillin	0	0.0%	0	0.0%	
	6. Penicillin G	0	0.0%	3	1.5%	
	7. Penicillin V	0	0.0%	0	0.0%	
	8. Piperacillin	1	0.5%	1	0.5%	
	9. PiperacillinTazobactam	11	5.5%	5	2.5%	
	10.Ticarcillin/Clavulanate	0	0.0%	0	0.0%	
Carbapenems		4	2.0%	2	1.0%	0.68
	11. Imipenem	2	1.0%	1	0.5%	
	12. Meropenem	2	1.0%	1	0.5%	
Aminoglycosides		17	8.5%	15	7.5%	0.71
	13. Amikacin	0	0.0%	0	0.0%	
	14. Gentamicin	15	7.5%	13	6.5%	
	15. Tobramycin	2	1.0%	2	1.0%	
Cephalosporins 1st generation		32	16.1%	47	23.6%	0.06
	16. Cefadroxil	0	0.0%	0	0.0%	
	17. Cefazolin	30	15.1%	43	21.6%	
	18. Cephalexin	2	1.0%	3	1.5%	
	19. Cephalothin	0	0.0%	1	0.5%	

Empiric antibiotic use - *continued*		**(% is of # of patients on that drug)**				
		MRSA		**MSSA**		**p-value***
		#	**%**	**#**	**%**	
Cephalosporins 2nd generation		4	2.0%	9	4.5%	0.26
	20. Cefaclor	0	0.0%	0	0.0%	
	21. Cefonicid	0	0.0%	0	0.0%	
	22. Cefoxitin	0	0.0%	0	0.0%	
	23. Cefuroxime	4	2.0%	9	4.5%	
Cephalosporins 3rd generation		27	13.6%	33	16.6%	0.40
	24. Cefixime	0	0.0%	0	0.0%	
	25. Cefotaxime	2	1.0%	11	5.5%	
	26. Ceftazidime	9	4.5%	7	3.5%	
	27. Ceftizoxime	1	0.5%	0	0.0%	
	28. Cefepime	0	0.0%	0	0.0%	
	29. Ceftriaxone	15	7.5%	15	7.5%	
Macrolides		1	0.5%	4	2.0%	0.37
	30. Azithromycin	1	0.5%	2	1.0%	
	31. Clarithromycin	0	0.0%	1	0.5%	
	32. Erythromycin	0	0.0%	1	0.5%	
Fluoroquinolones		50	25.1%	39	19.6%	0.19
	33. Ciprofloxacin	35	17.6%	26	13.1%	
	34. Norfloxacin	0	0.0%	0	0.0%	
	35. Levofloxacin	15	7.5%	13	6.5%	
	36. Gatifloxacin	0	0.0%	0	0.0%	
	37. Moxifloxacin	0	0.0%	0	0.0%	
Antifungal Medications		6	3.0%	3	1.5%	0.50
	38. Amphotericin B	0	0.0%	0	0.0%	
	39. Fluconazole	6	3.0%	3	1.5%	
	40. Itraconazole	0	0.0%	0	0.0%	
	41. Other antifungal medications	0	0.0%	0	0.0%	
Antituberculous Medications		2	1.0%	0	0.0%	0.50
	42. Ethambutol	0	0.0%	0	0.0%	
	43. Isoniazid	0	0.0%	0	0.0%	
	44. Pyrazinamide	0	0.0%	0	0.0%	
	45. Rifampin	2	1.0%	0	0.0%	
	46. Other antituberculous medications	0	0.0%	0	0.0%	
Tetracyclines		0	0.0%	0	0.0%	
	47. Tetracycline	0	0.0%	0	0.0%	
	48. Doxycycline	0	0.0%	0	0.0%	

Empiric antibiotic use - *continued*		**(% is of # of patients on that drug)**				
		MRSA		**MSSA**		**p-value***
		#	**%**	**#**	**%**	
Others		128	64.3%	107	53.8%	
	49. Clindamycin	12	6.0%	13	6.5%	0.83
	50. Chloramphenicol	0	0.0%	0	0.0%	
	51. Metronidazole	28	14.1%	27	13.6%	0.88
	52. Nitrofuratoin	0	0.0%	0	0.0%	
	53. Rifampin	2	1.0%	3	1.5%	
	54. Sulfamethoxazole/ Trimethoprim (Septra/Bactrim)	4	2.0%	3	1.5%	1.0
	55. Vancomycin	79	39.7%	60	30.2%	0.05
	56. Quinupristin-dalfopristin (Synercid)	0	0.0%	0	0.0%	
	57. Linezolid (Zyvoxam)	0	0.0%	0	0.0%	
	58. Teicoplainin	0	0.0%	0	0.0%	
	59. Other	3	1.5%	1	0.5%	

**Fisher exact was used if expected cell size < 5*

Table 9 compares the use and appropriateness of the empiric antibiotic given for MRSA and MSSA patients and whether and infectious disease physician was consulted post-culture result. A patient was more likely to have an infectious disease specialist consultation after a positive MRSA culture than after a positive MSSA culture (67% vs. 50.3%; p=0.001).

The algorithm for "appropriate antibiotics" for MRSA and MSSA infections was described in the methods section 3.7.6. This algorithm was used to classify cases as receiving "appropriate antibiotics" or not. One hospital sent in the antibiogram results (laboratory tests which provide antibiotic sensitivity results) and these were used to validate the algorithm for the variable "appropriate antibiotic". The results of the validation process found that 100% of the cases were categorized correctly using the algorithm for being given "appropriate antibiotic" when matched with their antibiogram results.

Overall, 79.4% of patients with MRSA infections were given empiric antibiotic(s), as compared to 81.9% of the MSSA cases (p=0.61). Empiric antibiotics were "appropriate" in 39.7% of the MRSA cases and 74.4% of the MSSA cases (p<0.001). Appropriate empiric or post-culture antibiotic were given to 84% of the cases with MRSA and 94.5% of the cases with

MSSA invasive disease (p=0.001*)*. Of the 31 MRSA cases who did not receive appropriate antibiotic treatment or who did not report treatment, five (16.1%) received no treatment (four died either on same day infection was identified or within 48 hours and one died two weeks later) and 10 died (32.3%) died within 4 days of first signs and symptoms of infection. The other 16 MRSA cases received a mix of other antibiotics; however, none were from the list of the drugs known to have activity against MRSA. There were no differences (p=0.58) in the length of time to appropriate antibiotic between MRSA (mean 3.1 days, median 2 days) and MSSA (mean 3.3 days and median 2 days) infected patients.

Table 9: Antibiotic therapy and infectious disease physician consultation for MRSA and MSSA invasive infections

	MRSA N=199		**MSSA N=199**		**p-value**
	#	**%**	**#**	**%**	
Empiric antibiotic therapy					
Given empiric antibiotic therapy	158	79.4%	163	81.9%	0.61
Given appropriate empiric antibiotics	79	39.7%	148	74.4%	<0.001
Length of time to appropriate antibiotic in days					
<1 day since 1st sign/symptom of infection	17	9.7%	19	10.2%	
1 day	36	20.5%	37	19.9%	
2-3 days	56	31.8%	53	28.5%	
>3 days	67	38.1%	77	41.4%	0.89
Mean (SD)- days	3.1	(3.4)	3.3	(3.7)	
Median (IQR)- days	2.0	(2)	2.0	(3)	0.58
Appropriate antibiotics					
Appropriate antibiotic therapy given	168	84.4%	187	94.5%	0.001
Infectious disease physician consultation					
After positive culture	130	67.0%	99	50.3%	0.001

Table 10 displays the severity of illness and outcomes which resulted from the MRSA and MSSA invasive infections. MRSA patients were not more likely than MSSA to experience any severe outcomes which included: ICU admission, renal insufficiency, hepatic dysfunction, respiratory difficulties, neurological dysfunction, septic shock or coagulopathy.

Within six weeks of the first symptom of infection, 34% of the patients with MRSA died, while 27% of the MSSA cases died (p=0.10). Seventy-nine percent (54/68) of the MRSA cases and 90% of the MSSA cases died before or during treatment (48/53), p=0.10. Twenty-one percent (21%) of the MRSA cases who died did so after completion of treatment and

within six weeks of the first positive culture, while only 9.4% (5/53) of the MSSA cases died after completion of treatment (p=0.10). MSSA cases were more likely than MRSA cases to be discharged while receiving antibiotic treatment (MSSA 39.7% vs. MRSA 24.1%. p=0.008).

Table 10: MRSA and MSSA outcome and severity of illness measures

	MRSA N=199	%	MSSA N=199	%	p-value
Indicators of severity of the Staphylococcal infection					
ICU admission	31	15.6%	19	9.5%	0.07
Renal insufficiency	33	16.6%	25	12.6%	0.25
Hepatic dysfunction	22	11.1%	14	7.0%	0.17
Respiratory difficulty	35	17.6%	26	13.1%	0.21
Neurological dysfunction	41	20.6%	31	15.6%	0.19
Septic shock	36	18.1%	24	12.1%	0.09
Coagulopathy	16	8.0%	11	5.5%	0.32
Severity of illness categories (0=none, 1+ = one or more)					
0	108	54.3%	137	68.8%	
1+	91	45.7%	62	31.2%	0.002
Timing of Death	**N= 68**	**%**	**N=53**	**%**	**p-value**
Died before or during treatment	54	79.4%	48	90.6%	
Died after completion of treatment	14	20.6%	5	9.4%	0.10
Outcomes of those who survived (at 6 weeks post-onset date of symptoms of infection)	**N=199**	**%**	**N=199**	**%**	**p-value**
Remained in hospital no longer receiving treatment	23	11.6%	20	10.1%	0.63
Remained in hospital still receiving antibiotic treatment	12	6.0%	7	3.5%	0.24
Discharged while receiving antibiotic treatment	48	24.1%	79	39.7%	0.008
Recovered and discharged	44	22.1%	37	18.6%	0.38
Discharged and readmitted because of the invasive infection	4	2.0%	3	1.5%	0.70
Outcome = Death	68	34.2%	53	26.6%	0.10

4.2 Results of the multivariate conditional backward logistic regression comparing factors associated with MRSA vs. MSSA infection

Table 11 displays the results of the backward multivariate conditional logistic regression analysis. Variables that were previously identified in the literature as associated with MRSA infections and with p-values of ≤0.20 were included in model. Variables not previously identified in the literature but with p-values of ≤0.20 that were included in the model were hepatic and neurological dysfunction. Variables entered in the model included: died vs. lived, previous use of antibiotics - four week period prior to infection, appropriate empiric antibiotics not given, Charlson Comorbidity Index, septic shock, hepatic dysfunction, neurological dysfunction, time in days from admission date to *S. aureus* infection, presence of devices in the 7 day period prior to infection, previous ICU admission and a dummy variable for the matched data (age, presumed location of acquisition of the infection and infection type).

The backward conditional logistic regression model showed that history of antibiotic use in the four weeks prior to the infection (OR 3.22, 95% CI 2.02-5.12, p<0.001), a Charlson Comorbidity Index score of > 2 (OR 1.68, 95% CI 1.07-2.64, p=0.02) and appropriate empiric antibiotics not given (OR 4.06, 95% CI 2.57-6.43, p<0.001) were associated with being an MRSA vs. an MSSA infected patient.

Table 11: Result of multivariable conditional backward logistic regression model for variables associated with MRSA vs. MSSA invasive infections

Variables	ß	SE	Odds Ratio	95% Confidence Intervals
History of antibiotic use in previous 4 weeks	1.17	0.24	3.22	(2.02, 5.12)
Charlson Comorbidity Index score > 2	0.52	0.23	1.68	(1.07, 2.64)
Appropriate empiric antibiotic not given	1.40	0.23	4.06	(2.57, 6.43)

4.3 Results of the univariate analyses to assess factors associated with death amongst invasive *S. aureus* patients

A comparison of the patients who died vs. those who lived is found in Tables 12-20. The tables include the univariate analysis comparisons for the patients who died versus lived in Tables 12-17 and the three blocks of the hierarchical logistic regression multivariate models developed for this study in Tables 18-20.

Table 12 displays the differences in clinical and epidemiological features of patients who died versus patients who lived. A total of 121 patients died (30.3%). Patients who died on average were older, at a mean age of 68.2 years (SD=15.6) and a median of 73 (IQR 23) versus a mean of 59.9 (SD=17.2) and a median of 62 (IQR 29) years of age for those who lived ($p<0.001$). The presumed location of acquisition of infection was more likely to be hospital acquired for those who died (83.5% vs. 76.2%, $p<0.001$) vs. those who lived, than community acquired. Of those who died 56.2% (N=68) were MRSA while 43.8% (N=53) were MSSA infected patients ($p=0.10$).

TABLE 12: Clinical and epidemiological features by mortality status for invasive *S. aureus* infected patients

	Died N = 121		Alive N= 277		P Value
	#	%	#	#	
Sex					
male	79	65.3%	184	66.4%	
female	42	34.7%	92	33.2%	0.79
Age					
mean (± SD)	68.2	(±15.6)	59.9	(±17.2)	<0.001
median (IQR)	73.0	(23)	62.0	(29)	
≥ 65 years old	82	67.8%	122	44.0%	<0.001
***S. aureus* area of acquisition**					
Hospital	101	83.5%	211	76.2%	
Community	20	16.5%	66	23.6%	<0.001
Organism					
MRSA	68	56.2%	131	47.3%	
MSSA	53	43.8%	146	52.7%	0.10
Days from admission to *S. aureus* infection:					
mean days (± SD)	17.2	(±22.6)	13.3	(±20.9)	0.10
median (IQR)	9.0	(23)	6.0	(15)	
Patient's previous residence					
Home (private residence)	108	90.8%	252	92.0%	
Long term care/ nursing home	10	8.4%	19	6.9%	
Rehabilitation facility	1	0.8%	3	1.1%	0.85
Hospital location of patient at onset of *S. aureus* infection (best judgment)					
ICU	31	25.6%	50	18.1	
Inpatient, not ICU	69	57.0%	167	60.3	
Outpatient	19	15.7%	56	20.2	0.32
Unknown	2	1.7%	4	14	

Table 13 displays the differences between those who died versus those who lived by type of *S. aureus* infection. Overall, patient who died were more likely to have had a positive blood culture (primary or secondary bacteremia) than those who lived (94.3% vs. 75.5%, p<0.001). This difference was primarily seen in those with primary blood stream infections (54.5% vs. 41.9% other infections, p=0.02) vs. those with secondary blood stream infections (39.7% vs. 32.5% other infections, p=0.17).

TABLE 13: Infection type by mortality status for invasive *S. aureus* infected patients

	Died		Alive		p-value
Infection Type	**N=121**		**N=277**		
Blood stream infection (BSI)	114	94.2%	209	75.5%	
vs.					
All "other" non-BSI infections	7	5.8%	68	24.5%	<0.001
Blood-stream infection type					
Primary blood stream	66	54.5%	119	41.9%	0.03
Secondary blood stream	48	39.7%	90	32.5%	
Pneumonia	14	29.2%	20	22.2%	
SWI	10	20.8%	36	40%	0.17
Other infections	24	50.0%	34	37.7%	
Other infection types					
Surgical wound	1	0.8%	22	7.9%	0.005
Pneumonia	2	1.7%	6	2.2%	0.54
Bone and/or joint	0		14	5.1%	
osteomyelitis	0		5	35.7%	
joint/ bursa	0		8	57.1%	
vertebral disk space	0		1	7.1%	
Cardiovascular system	0		1	0.4%	
endocarditis	0		1	100%	
Central nervous system	1	0.8%	3	1.1%	0.81
Gastrointestinal system	0		9	3.2%	
Lower respiratory tract	2	1.7%	6	2.2%	0.54
Reproductive tract	0		1	0.4%	
Skin & soft tissue	1	0.8%	9	3.2%	0.14

Table 14 compares the differences in medical history and current conditions between patients who died and those who lived. Those who died were more likely to have had an extended spectrum beta-lactamase (ESBL) infection (3.3% vs. 0%, p=0.01). Patients who lived were more likely to have had surgery in the previous 30 days (Alive 43.3% vs. Died 26.3%, p=0.01). In the seven day period prior to the positive *S. aureus* culture, patients who were on immunosuppressive therapy (Died 22.3% vs. Alive 13.4%, p=0.04), and those who were neutropenic (Died 7.6% vs. Alive 2.2%, p=0.02) were more likely to die.

Although none of the individual devices that were in place prior to the infection were found to be associated with patients who died (at the $p \leq 0.05$ level), 74% of the patient who died were more likely to have *a device* in place than patients who lived 61.7% ($p=0.009$). For the multivariate analysis a dichotomous variable was created that included all the devices with p-values of ≤ 0.20 vs. no device or those with p-values >0.20.

TABLE 14:
Patient histories by mortality status for invasive *S. aureus* infected patients

	Died N=121		Alive N=277		P-value
Patient history - devices (7 days prior to *S. aureus* infection)					
	#	%	#	%	
Indwelling urinary catheter	61	50.4%	110	39.7%	0.06
Mechanical ventilation	25	20.7%	44	15.9%	0.31
Central venous catheter	55	45.5%	101	36.5%	0.11
Nasogastric tube or feeding tube	37	30.6%	59	21.3%	0.06
Tracheostomy	6	5.0%	14	5.1%	0.83
Peritoneal dialysis catheter	4	3.3%	7	2.5%	0.91
Other devices	21	17.4%	50	18.1%	0.98
One or more devices listed above	90	74.4%	171	61.7%	0.009
Six months prior to *S. aureus* infection					
Positive MRSA culture	18	14.9 %	45	16.2%	0.84
Colonization	12	66.7%	24	54.5%	
Infection	5	27.8%	13	29.5%	
Infection & Colonization	1	5.6%	7	15.9%	
Positive MSSA culture	5	4.1%	27	9.7%	0.09
Colonization	4	80.0%	10	38.5%	
Infection	1	20.0%	15	57.7%	
Infection & Colonization	0	0.0%	1	3.8%	
Positive VRE culture	0	0.0%	3	1.1%	
Colonization	0	0.0%	3	100.0%	
Infection	0	0.0%	0	0.0%	
Related to same day as *S. aureus* infection					
Vancomycin resistant Enterococci	0	0.0%	2	0.7%	
Colonization	0	0.0%	2	100.0%	
Infection	0	0.0%	0	0.0%	
Clostridium difficile	4	3.3%	11	4.0%	0.97
Extended spectrum beta-lactamase	4	3.3%	0	0.0%	
Colonization	1	25.0%	0	0.0%	
Infection	3	75.0%	0	0.0%	
Other multi-drug resistant organism	0	0.0%	0	0.0%	
Patient in ICU in previous 30 days	34	28.1%	84	30.3%	0.72
Surgery in previous 30 days	34	26.3%	120	43.3%	0.01
7 days prior to positive culture					
Immunosuppressive therapy	27	22.3%	36	13.4%	0.04
Neutropenic	9	7.6%	6	2.2%	0.02
Dialysis	16	13.2%	32	11.6%	0.78

Table 15 compares the differences in empiric antibiotic use between patients who died and those who lived. Seventy-six percent (76%) of patients who died vs. 82.7% of those who lived received an empiric antibiotic; this difference was not statistically significant (p=0.61). Of more interest was that patients who died were less likely to receive *appropriate* empiric antibiotics than those who lived (Died 46.3% vs. Lived 61.7%, p=0.006). The mean and median time (in days) to appropriate antibiotic treatment for those who were given treatment and who died were 2.4 and 2 days, while for those who lived the mean and median days to appropriate antibiotic treatment were 2.9 and 2 days respectively. The length of time to appropriate treatment in days was not statistically different between invasive *S. aureus* patients who lived and those who died (p=0.42). Post-culture infectious disease physician consultation was received by 51.2% of the patients who died and 61.9% of the patients who lived (p=0.06).

TABLE 15: Antibiotic therapy and infectious disease consultation by mortality status for invasive *S. aureus* infected patients

	Died N=121		**Alive N=277**		**p-value**
Antibiotic Therapy					
Given empiric antibiotic therapy	92	76.0%	229	82.7%	0.61
Given appropriate empiric antibiotics	56	46.3%	171	61.7%	0.006
Length of time to appropriate antibiotics (days)					
Mean (SD)	2.4	(2.2)	2.9	(2.6)	
Median (IQR)	2.0	(1,3)	2.0	(1,4)	0.42
Infectious disease physician consultation received					
Post-culture consult given	62	51.2%	167	61.9	0.06

Table 16 compares the differences in comorbid conditions included in the Charlson Comorbidity Index (CCI) between those who died and those who lived. Those who died were more likely to have had the following comorbid conditions at the 0.05 level of significance: congestive heart failure (23.1% vs. 9.7%, p=0.0006); cerebrovascular disease (15.7% vs. 8.7%, p=0.05); pulmonary disease (24.0% vs. 14.1%, p=0.02); dementia (11.6% vs. 4.3%, p=0.01); moderate to severe liver disease (15.7% vs. 6.5%, p=0.006); lymphoma (6.6% vs. 2.2%, p=0.05); and metastatic cancer (9.9% vs. 4.7%, p=0.07). In Table 16 the scores by those who died vs. those who lived showed that those who died were more likely to have scores three and over using the CCI than those who lived (Died 65.3% vs. Lived 36.8%, p<0.001). The

individual scores for CCI ranged from 0-12 and the differences in scores between those who died and those who lived was significantly different ($p<0.001$).

TABLE 16: Comorbid conditions using the Charlson comorbidity index by mortality status for invasive *S. aureus* infected patients

	Died N=121		Alive N=277		p-value
Comorbid conditions used in the Charlson Comorbidity Index	**#**	**%**	**#**	**%**	
Myocardial infraction	22	18.2%	37	13.4%	0.27
Congestive heart failure	28	23.1%	27	9.7%	0.0006
Peripheral vascular disease	19	15.7%	33	11.9%	0.38
Cerebrovascular disease	19	15.7%	24	8.7%	0.05
Pulmonary disease	29	24.0%	39	14.1%	0.02
Dementia	14	11.6%	12	4.3%	0.01
Paralysis	9	7.4%	13	4.7%	0.38
Diabetes - end organ damage	10	8.3%	24	8.7%	0.94
Diabetes	24	19.8%	54	19.5%	0.95
Renal disease (moderate or severe)	23	19.0%	45	16.2%	0.59
Moderate to severe liver disease	19	15.7%	18	6.5%	0.006
Mild liver disease	2	1.7%	9	3.2%	0.57
Peptic/ duodenal ulcer	9	7.4%	12	4.3%	0.30
Tumour	9	7.4%	17	6.1%	0.79
Lymphoma	8	6.6%	6	2.2%	0.05
Leukemia	3	2.5%	1	0.4%	0.16
AIDS	0	0.0%	6	2.2%	0.23
Metastasis cancer	12	9.9%	13	4.7%	0.07
Rheumatologic disease	7	5.8%	10	3.6%	0.47
Charlson Comorbidity Index Score					
0	10	8.2%	65	23.5%	
1	13	10.7%	63	22.7%	
2	19	15.7%	47	17.0%	
3	29	23.9%	37	13.4%	
4	14	11.6%	21	7.6%	
5	11	9.1%	16	5.8%	
6	11	9.1%	11	4.0%	
7	6	4.9%	10	3.6%	
8	5	4.1%	2	0.7%	<0.001*
9	2	1.7%	2	0.7%	
10	0	0.0%	0	0.0%	
11	1	0.8%	1	0.4%	
12	0	0.0%	2	0.7%	
Charlson Comorbidity Index categories					
(score 0, 1 or 2)	42	34.7%	175	63.2%	
(score 3+)	79	65.3%	102	36.8%	<0.001

**p-value provided for comparison of scores 0-8+*

Table 17 compares the severe complication and outcome differences between those who lived and those who died. All of the measures of severity of illness were significantly more prevalent in the patients who died. Those who died were more likely to have ICU admission (22.4 vs. 8.9%, p<0.001); renal insufficiency (24.2% vs. 10.0%, p<0.001); hepatic dysfunction (16.8% vs. 6.7%, p<0.001); respiratory difficulty (32.5% vs. 8.5%, p<0.001); neurological dysfunction (44.6% vs. 7.0%, p<0.001); septic shock (39.5% vs. 4.6%, p<0.001) and coagulopathy (18.3% vs. 2.2%, p<0.001).

Overall, 30.4% of *S. aureus* infected patients (N=121) died. Eighty-four percent (84.3%) of those who died did so before or during treatment while 15.7% died after completion of treatment but within six weeks of first positive culture. Of the 277 (69.6%) patients who were alive at six weeks, 45.8% were discharged from hospital while still receiving antibiotic treatment, 29.2% had recovered and were discharged, 15.5% remained in hospital no longer receiving treatment, 6.9% remained in hospital still receiving antibiotic treatment, and 2.5% were discharged and readmitted because of the MRSA or MSSA infection.

Table 17: Outcomes and severity of illness measures by mortality status for invasive *S. aureus* infected patients

		Died N=121		Alive N=277		p-value
Severity of the Acute Staphylococcal Infection – ***not mutually exclusive categories***						
	ICU admission	26	22.4%	24	8.9%	<0.001
	Renal insufficiency	29	24.2%	27	10.0%	<0.001
	Hepatic dysfunction	19	16.8%	18	6.7%	<0.001
	Respiratory difficulty	38	32.5%	23	8.5%	<0.001
	Neurological dysfunction	53	44.9%	19	7.0%	<0.001
	Septic shock	47	39.5%	13	4.6%	<0.001
	Coagulopathy	21	18.3%	6	2.2%	<0.001
Outcomes						
	Died before or during treatment	102	84.3%			
	Died after completion of treatment	19	15.7%			
	Remained in hospital no longer receiving treatment			43	15.5%	
	Remained in hospital still receiving antibiotic treatment			19	6.9%	
	Discharged while receiving antibiotic treatment			127	45.8%	
	Recovered and Discharged			81	29.2%	
	Discharged and readmitted because of the invasive disease			7	2.5%	

The indicators used for measuring severity of illness of the *S. aureus* infection were more frequently observed in those patients who died vs. those patients who lived. The two most common severity indicators in those who died were neurological dysfunction (44.9%) and septic shock (39.5%). Of those who died 84.3% died before or during antibiotic treatment, while 15.7% died after completion of treatment. The seriousness of acquiring an invasive *S. aureus* infection can be seen in the overall mortality rate. Overall 30% of patients with an invasive *S. aureus* infection died within 6 weeks of onset of symptoms.

4.4 Results of the hierarchical multivariate logistic regression analysis for survival

4.4.1 Host-related factors associated with death

Table 18 is block 1 of the hierarchical multivariate logistic regression model for survival, which included all the host and pre-infection related factors associated with death that had p-values of ≤0.20 and were considered as clinically or biologically important. Variables entered into block 1 included: age (square root of age to transform data to a normal distribution with skewness and kurtosis within acceptable limits), the Charlson Comorbidity Index score (numeric), whether the patient had a device in place in the 7 days period prior to infection (dichotomized into device yes/no with yes including indwelling urinary catheter, nasogastric or feeding tube and intravascular device), receipt of immunosuppressive therapy (yes/no, in the seven day period prior to infection), and neutropenic (yes/no in the seven day period prior to infection).

The results in block 1 showed that the age, CCI score, having a device in place, receipt of immunosuppressive therapy and being neutropenic were the host and pre-infection related predictors of death.

Table 18: Block 1. Multivariate hierarchical logistic regression to determine the host-related variables associated with death amongst invasive *S. aureus* infected patients

Variables	ß	SE	OR	Confidence Intervals
Age*	0.51	0.12	1.66	(1.31, 2.09)
Charlson Comorbidity Index score	0.18	0.50	1.20	(1.08, 1.32)
Device in place in the 7 day period prior to infection	0.57	0.26	1.76	(1.05, 2.95)
Immunosuppressive therapy – in the 7 day period prior to infection	0.59	0.31	1.80	(0.98, 3.30)
Neutropenic – in the 7 day period prior to infection	1.35	0.58	3.84	(1.23, 11.97)

**square root of age was used to transform age into a normal distribution*

4.4.2 Infection-related variables associated with death

Table 19 is block 2 of the hierarchical logistic regression model and includes the addition of *infection-related* variables that were indentified in the univariate analysis with a p-value of ≤ 0.20 or deemed clinically or biologically significant. The infection-related variables included in block 2 were: MRSA vs. MSSA infection, bloodstream infection vs. "other" infection, septic shock, neurological dysfunction and coagulopathy. Renal insufficiency, hepatic dysfunction and respiratory difficulties were not included since an additional analysis examining death by severe complications showed after controlling for all severe complications, septic shock, neurological dysfunction and coagulopathy were the only complications that remained significant at the ≤0.20 level. The results in block 2 showed that age, CCI score, bloodstream infection, septic shock and neurological dysfunction were the infection-related predictors of death. Variables that were not significant in the model were: having a device, immunosuppressive therapy, being neutropenic prior to infection, MRSA and coagulopathy as a result of the infection.

A sub-analysis of just the cases with bloodstream infections found the exact same variables were predictive of death as were in the final model, and although those with bloodstream infections were more likely to die than non-bloodstream infection patients, the other predictor

variables remained the same when the non-bloodstream infection patients were removed from the analysis.

Table 19: Block 2. Multivariate hierarchical logistic regression with the host and infection-related variables associated with death amongst Invasive *S. aureus* infected patients

Variables	ß	SE	OR	Confidence Intervals
Age*	0.47	0.14	1.60	(1.23, 2.10)
Charlson Comorbidity Index score	0.14	0.06	1.15	(1.03, 1.29)
Device in place 7 days prior to infection	0.20	0.30	1.23	(0.68, 2.22)
Immunosuppressive therapy (within 7 days prior to infection)	0.60	0.35	1.82	(0.92, 3.60)
Neutropenic (within 7 days prior to infection)	0.30	0.72	1.35	(0.33, 5.60)
MRSA vs. MSSA	-0.22	0.27	0.80	(0.47, 1.36)
Invasive Blood Stream Infection (BSI) vs. Invasive non-BSI	1.18	0.43	3.27	(1.42, 7.58)
Septic Shock	1.69	0.41	5.41	(2.42,12.14)
Neurological dysfunction	1.34	0.36	3.82	(1.87,7.81)
Coagulopathy	-0.65	0.64	0.52	(0.15,1.83)

**square root of age was used to transform age into a normal distribution*

4.4.3 Treatment-related variables associated with death

Table 20 is block 3 which includes the addition of the *treatment-related* variables that were significant at the ≤0.20 level and identified as clinically or biologically plausible to be associated with death. The treatment-related variables included in block 3 were: patient had not received appropriate empirical antibiotics and the number of days to appropriate treatment. The results in block 3 showed that age, Charlson Comorbidity Index score, receiving immunosuppressive therapy in the 7 day period prior to infection, having a bloodstream infection, septic shock, neurological dysfunction and not being given appropriate empiric antibiotics were predictors of death. Variables that were not significant in block 3 of the model were: MRSA, length of time to appropriate treatment (days), being neutropenic, having a device in place in the 7 days period prior to infection and coagulopathy.

Table 20: Block 3. Multivariate hierarchical logistic regression with the host, infection and treatment-related variables associated with death amongst invasive *S. aureus* infected patients

Variables	ß	SE	OR	Confidence Intervals
Age*	0.45	0.14	1.57	(1.19, 2.07)
Charlson Comorbidity Index score	0.14	0.06	1.15	(1.29, 2.07)
Device in place 7 days prior to infection	0.23	0.31	1.25	(0.69, 2.29)
Immunosuppressive therapy (within 7 days prior to infection)	0.70	0.36	2.02	(1.00, 4.09)
Neutropenic (within 7 days prior to infection)	0.26	0.74	1.30	(0.31, 5.50)
MRSA vs. MSSA	0.15	0.30	1.16	(0.64, 2.09)
Invasive BSI vs. Invasive non-BSI	1.35	0.45	3.84	(1.61, 9.17)
Septic Shock	1.86	0.43	6.45	(2.79,14.91)
Neurological dysfunction	1.30	0.37	3.68	(1.78,7.61)
Coagulopathy	-0.76	0.65	0.47	(0.13,1.67)
Appropriate empiric antibiotic not given	0.97	0.31	2.63	(1.43, 4.85)
Length of time to appropriate treatment (days)	0.003	0.18	1.00	(0.70,1.43)

square root of age

4.4.4 Likelihood ratio test

The Likelihood Ratio Test for Died block 1 and 2 was statistically significant ($\chi^2 = 21.881$, df = 6, $p<0.0012$) indicating that the Died block 2 model with the additional infection-related variables, was significantly more likely to predict the dependent variable Death. The Likelihood Ratio Test for Died block 2 and 3 was statistically significant as well ($\chi^2 = 59.767$, df = 3, $p<0.0001$) indicating that the Died block 3 model with the additional treatment related variables, was significantly more likely to predict the dependent variable Death than model 2.

5 Discussion

The discussion section will be presented in the following format:

5.1 Introduction to the discussion

5.2 Strengths and Limitations

5.2.1 Strengths

5.2.1.1 Using multiple hospitals

5.2.1.2 Including the Charlson comorbidity index (CCI) score

5.2.1.3 Large sample size

5.2.1.4 Thorough inclusion of previously identified risk factors

5.2.2 Limitations and generalizability

5.2.2.1 Matching cases and control limits ability to include these variables in the MRSA vs. MSSA analysis

5.2.2.2 Data collection by retrospective chart review

5.2.2.3 Different data extractors

5.2.2.4 Time period since data collection

5.3 Factors associated with MRSA vs. MSSA infections

5.3.1 Prior antibiotic use as a risk factor for MRSA vs. a MSSA infections

5.3.2 Charlson comorbidity index (CCI) score associated with MRSA vs. MSSA infection

5.3.3 MRSA infected patients are more likely to not receive appropriate empiric antibiotics

5.4 Which variables were associated with death in patients with invasive disease due to *S. aureus*?

5.4.1 Host-related factors associated with death

5.4.1.1 Age as a host-related factor associated with death

5.4.1.2 Charleston comorbidity index score as a risk factor for death

5.4.1.3 Immunosuppressive therapy associated with death

5.4.2 Infection-related factors associated with death

5.4.2.1 Bacteremic infections are associated with death

5.4.2.2 Neurological dysfunction and septic shock associated with death

5.4.3 Treatment-related factors associated with death in patients with *S. aureus* invasive infections

5.4.3.1 Not being given appropriate empiric antibiotic treatment is associated with death

5.1 Introduction to the discussion

This discussion section starts by presenting the strengths and limitations of the study. This will be followed by a detailed discussion on the primary results that were found in the two multivariate analyses, with a focus on the variables that remained significant in the models and their relevance. The factors that were associated with being infected with MRSA vs. MSSA and those associated with death will be discussed.

5.2 Strengths and limitations

5.2.1 Strengths

A review of the literature identified factors that may have affected previous study results. Some of these include: only using one hospital site for recruitment of participants, not controlling for chronic comorbid conditions, small sample size, limited number of variables and no use of multivariate analysis. The inclusions of these factors in this study have strengthened the results and are discussed below.

5.2.1.1 Using multiple hospitals

Using multiple hospitals (17 in total) increased the sample size and the diversity of the groups of patients and ensured that hospital specific policies in infection control and prescribing practices were less likely to influence the final outcomes. Specific hospitals may have very stringent infection control practices for MRSA which would include pre-admission and floor screening of patients at risk. The more stringent the screening the more likely patients will be identified as colonized: such patients may be treated early with the correct antibiotics. Prescribing practices within hospitals and by individual physicians can also influence the final outcomes. Variation in the presence and intensity of antibiotic stewardship programs may also influence empiric antibiotics choices. If hospital protocol prevents the prescribing of vancomycin until the MRSA organism has been identified, outcomes may be more severe in these cases; alternatively, stewardship programs may more effectively identify changing resistance patterns, and increase the likelihood of appropriate antimicrobial therapy. Therefore, by using a multi-hospital study, these hospital specific practices will less likely

influence the final results. It would have been interesting, however, to collect individual hospitals' infection control screening policies for MRSA and antibiotic prescribing practices for infections and include that as a variable in the model to see if this influenced the outcomes of patients.

There were no significant differences (p=0.43) in mortality rates among the 17 participating hospitals, where the hospitals had contributed > 5 pairs of *S. aureus* infected patients to the study. Mortality rates ranged from 18.2% to 40% in these hospitals. The individual hospitals' data were combined and therefore provided a mortality rate that represented a wider scope of the population of patients who acquire *S. aureus* infections in Canada.

5.2.1.2 Including the Charlson comorbidity index (CCI) score

Most of the studies comparing outcome differences between MRSA and MSSA did not include assessment of comorbid conditions. The study by Lesens[57] showed the importance of including a standardized measure of comorbidity when examining risk factors for death amongst *S. aureus* bacteremic cases. In the Lesens study, cases with MRSA were not more likely to die than cases with MRSA, but cases with a CCI of 3 or greater were more likely to die within 3 months of the infection. The present study used the same comorbidity index as the Lesens study. To date the CCI is the only comorbidity index tested and validated to be effective in mortality studies amongst patients with *S. aureus* infections.

5.2.1.3 Large sample size

Although some of the previous studies also had large sample sizes, the combination of the large sample size and the use of multiple hospitals added additional strength to this study. The large recruitment by 17 hospitals resulted in 398 *S. aureus* invasive disease patients being recruited. A total of 121 deaths occurred and this large number provided the study with the statistical power needed to compare differences in many risk factors and outcomes. As noted in the literature review many of the previous mortality studies comparing MRSA and MSSA infections had small numbers of patients.

5.2.1.4 Thorough inclusion of previously identified risk factors

Through the large sample size this study was able to include a number of variables in the model that have previously been associated with death amongst *S. aureus* bacteremic patients. By including these, the model was able to control for variables which may have been confounding previous results or interacting with previously identified risk factors. All risk factors previously identified in the literature review were included in the questionnaire, analyzed and considered for inclusion in the final models.

5.2.2 Limitations and generalizability

There were limitations to the number of risk factor variables included in the final model. A decision was made to include only known risk factors (previously identified in the literature) that were statistically significant and risk factors identified as clinically relevant. This approach may have eliminated some risk factors that could have been associated with death if they had been included in the model. Also, there were variables that were not included in the model due to the incompleteness of their reporting. Variables which relied on the collection of historical information that occurred in a previous hospitalization or outside of the hospital environment were often incomplete. Some of the variables which included information on coinfections that the patient had in the 6 month period prior to this infection were eliminated due to poor response rate. These coinfection data and the antibiotics used to treat these infections would have been interesting to include in the analysis had sufficient data been available.

The limitation of using CNISP hospitals is that the results reflect the case-mix of patients in acute tertiary care facilities, which may have large ICUs, burn units and trauma wards. These types of facilities likely see more infections, as well as more *severe* infections than may be seen in community facilities. The mortality rate identified in this study may not be reflective of the population of *S. aureus* infected patients as a whole in Canada, and should only be considered as a good estimate of *S. aureus* mortality amongst acute tertiary care facilities. The generalizability of the results of this study should therefore be limited to acute care tertiary settings. The mortality rates found in this study of 34.2% amongst MRSA and 26.6%

amongst MSSA infected patients are similar to the rates found in other studies which looked at similar facilities.[47] These similar findings confirm that the rates of mortality amongst invasive *S. aureus* patient remains between 20-40%, and thus research into the risk factors, causes and preventative practices should remain a priority.

5.2.2.1 Matching cases and control limits ability to include these variables in the MRSA vs. MSSA analysis

Matching occurred at the beginning of the study, at the time of recruitment of cases and controls. Cases and controls were matched on three variables: age, blood-stream infection vs. "other" invasive infection and presumed location of acquisition of infection (hospital or community acquired). MRSA infections are known to occur more frequently in those in older age groups. By matching the cases on age, this variable was eliminated from being analyzed in the MRSA vs. MSSA analysis however; the PI was able to focus more on the other variables of interest.

The second variable matched on was the type of infection being either a blood stream infection vs. an "other" invasive infection, as described in the method section. This matching was done to ensure that MRSA cases and MSSA controls were matched on the type of infection, since bacteremic infections are known to have poorer outcomes than non-bacteremic infections. For example, many of the infections identified were bloodstream (80%) and the PI wanted to ensure that if the majority of MRSA infections were bloodstream than the same amounts of MSSA infections were bloodstream.

The last variable matched on was the presumed location of acquisition of infection, being classified as either community or healthcare acquired. At the time of this study the definition for health-care acquired infections included patients who were culture positive for MRSA or MSSA and whose testing was performed 72 hours after date of admission with no clinical evidence of infection (fever, leukocytosis, or other signs and symptoms) present at the time of admission. The definition for community-acquired infections was infections that did not meet the definition of health-care acquire. This meant that the patient was culture positive for MRSA or MSSA within 72 hours of admission and/or showed clinical evidence of infection on

admission, with no previous hospitalization within the previous 2 weeks. These definitions were the standard definitions used at the time the study's data collection occurred. However, more recently an additional definition has been included for presumed source of infection and it includes health-care *associated* infections. Health-care associated infections include infections that occur within the first 72 hours of admission but are related to a health-care exposure. These health-care exposures may include day surgery, dialysis treatment, cancer treatments, admission from a nursing home or rehabilitation centre, or emergency room visits. While health-care *acquired* patients are admitted to hospital, health-care *associated* patients are not admitted, but have had some type of exposure to the healthcare system. Because of the ambiguity and the matching, the interpretation of this variable could have been inaccurate and therefore it was not included in the final died vs. lived analysis.

The matching of this variable at the time of the study was done since strain types for healthcare and community strains differ[65] and the virulence of certain strains has been hypothesized to be stronger, the PI had hoped to control for this by matching. At the time of the study most community-acquired MRSA (CMRSA) cases were found in skin and soft-tissue infections, however since then, more and more invasive CMRSA cases are being identified.[66,67,68,69,70] In Canada, community acquired MRSA cases are generally the epidemic strains CMRSA-10 (USA300) and CMRSA-7 (USA400)[65] and their antimicrobial susceptibility and the types of patients who acquire the community strains are different than the patients who acquire the healthcare associated strains. Patients who acquire the community strains tend to have MRSA isolates that are more likely to be susceptible to erythromycin, clindamycin, tetracycline, trimethoprim-sulfamethoxazole, ciprofloxacin, gentamicin, rifampin, and fusidic acid and are more likely to have high-level resistance to mupirocin.[66] The types of patients who acquire CMRSA are different as well. A Canadian study in British Columbia which compared CMRSA cases to Healthcare-associated MRSA (HA-MRSA) cases found that CMRSA cases were more likely to be younger, have an abscess, be post-operative or have cellulitis (skin and soft tissue infection), be an injection drug user (IDU), and less likely to have previous antibiotic exposure, or have a recent hospitalization.[70] Another recent comparison in Canada of CMRSA and HA-MRSA by CARA (Canadian Antibiotic Resistance Alliance) found CMRSA cases to be younger, more likely to be found in Western Canadian provinces, more likely coming in through the emergency ward, and site

of infection more likely to be reported as wounds or IV sites.[71] New findings from an outbreak that recently occurred at the Henry Ford Hospital in Detroit, Michigan found that the USA600 MRSA strain type (which is the CMRSA1 strain in Canada) was more likely to occur in patients who are older and it was five times more likely to cause death than other strains.[72] This interesting finding emphasizes the need for more research looking at strain types as potential risk factors for mortality. Although this study attempted to control for strain types by matching on hospital vs. community acquisition it would have been better to have collected strain types and added this variable into the analysis.

5.2.2.2 Data collection by retrospective chart review

Studies examining the sensitivity and specificity of retrospective chart reviews have found that retrospective chart reviews which identify infections are sensitive at around 74%.[73,74] Bacteremias were the types of infections with the highest sensitivity at 99%. This is because bacteremias must have a positive blood culture and all blood cultures positive for a pathogen are deemed infections. Eighty percent (80%) of the cases in this study were bacteremias. The acquisition of a blood culture generally is standard protocol in hospital for patients with signs and symptoms of a bloodstream infection. The cases and controls in this study were first identified in the laboratories and then a retrospective chart review was done to confirm and identify the type of infection that was associated with the positive isolate from the laboratory record. Isolates obtained, whether blood or other, were confirmed as *S. aureus,* then as MRSA or MSSA as described in the methods section.

The most difficult information to collect in a retrospective chart review generally includes information on chronic comorbid conditions and historical information that occurred prior to the hospitalization. The identification of chronic comorbid conditions within the chart may be difficult if a thorough medical history has not been done or another more obvious condition takes precedent over other less severe conditions. For example, an HIV positive cancer case may not have detailed information on other chronic conditions and therefore these other conditions could be missed in a chart review. Cases like this would have CCI scores that are lower than they actually should be. Historical information, like the collection of antibiotic history in the chart review (includes what antibiotics patients were on prior to the infection) is

labour intensive. The antibiotics given in the 4 week period prior to infection may not have been recorded in the chart, and therefore this section may have been left blank. No mechanism was in place in this study for determining if an antibiotic was given but the name of the antibiotic was not known. These cases would have been misclassified as "not receiving antibiotics" when in actuality they were cases where simply the name of the antibiotic was unknown. This misclassification could lead to the wrong conclusions if MRSA vs. MSSA patients were more or less likely to not have this section completed. The PI was not able to determine this and therefore the interpretation of the result of prior antibiotic use should take this under consideration.

5.2.2.3 Different data extractors

Eleven nurses or infection control professionals performed the chart reviews. Although the individuals who did the chart reviews were all trained by the PI, there still may have been some inter-reviewer variability. All data extraction forms were reviewed by the PI for errors or to determine if too much data was missing and follow-up was necessary. This back-and-forth between the PI and the data extractors was quite intensive and particularly with the antibiotic history and infection type variables. This was why Appendix A, sections 8.1.4 and 8.1.5 were crucial in ensuring that the infections identified were properly classified and antibiotics were identified in the chart review. The data extractors were provided the study protocol and the case definitions "blue book". These documents were reviewed with each data extractor prior to the chart reviews. Generally chart reviews are not a nursing or infection control practitioners' job, and therefore this task took some trials to ensure consistent and valid classification of data collected. Judgment errors may have occurred. When written notes were in the margins of the questionnaires and it was difficult to determine whether cases and controls were meeting these definitions, teleconference calls were arranged to discuss the results and a decision was made during the call. If it was difficult to determine by the PI, the PI would ask one of the infectious disease (ID) physicians associated with the study or the CNISP site ID physician to review the results and confirm the diagnosis and data.

5.2.2.4 Time period since data collection

Data were retrospectively collected by chart reviews in the year 2003 for cases and controls who acquired a *S. aureus* invasive infection in the years 2001 or 2002. The results were analyzed and interpretations (discussion) of the results were written up in this dissertation in the year 2011 and 2012, nine to ten years post hospitalization. The time span between data collection and interpretation was considered by the PI as an important factor to address.

The mortality rate of *S. aureus* bacteremic patients in this study was similar to the rates found in more recent studies. Mortality rates may not be changing with time because most of the main risk factors associated with death occurred in "non-modifiable" risk factors like age, chronic comorbid conditions, whether the patient was immunosuppressed prior to the infection, and the type of infection (e.g., bloodstream). These non-modifiable risk factors generally will not change over time. The one "modifiable" risk factor identified in this study, however, likely did change with time. The risk factor was the prescribing of "appropriate empiric antibiotics". This risk factor likely is occurring at a greater frequency today than it did 10 years ago since hospitals in the past 10 years have been putting into place antibiotic prescribing guidelines. If this study were to be repeated today, we may find a larger number of cases receiving appropriate empiric antibiotics and we may also have found that this factor is no longer a significant predictor of death in *S. aureus* infections. The specifics related to this "modifiable" risk factor therefore needs to be interpreted with the consideration that changes in empiric antibiotic prescribing practices are different today than they were 10 years ago.

5.2.2.5 Lack of availability of isolates

The lack of availability of isolates to determine strain type, susceptibility results and other potential microbial virulence factors (e.g., MIC levels), would have strengthened the results and added addition knowledge to the findings. Information from the isolates could have provided data on strain type, vancomycin MIC levels or vancomycin heteroresistance, and these could have been tested to determine if they were associated with more severe outcomes, including death. Susceptibility testing results would have validated the variable "*appropriate empiric antibiotics given*" since the antibiogram results would have confirmed this. Two

hospitals did provide their antibiogram results. These two hospitals made up 28% (N=110) of the reported *S. aureus* infections and have a 100% concordance with the algorithm created for determining the variable "appropriate empiric antibiotic given". The collection of the isolates would have added additional information that could have answered some outstanding questions on pathogen derived factors that influence outcomes. Since this study did not collect this information it was not able to answer this question.

5.2.2.6 Time to appropriate antibiotics

The variable "time to appropriate antibiotics" was collected in days, and therefore was not an accurate variable for measuring the timeliness of appropriate antibiotics. This variable was calculated by subtracting the date the appropriate antibiotic was given, from the date of the first signs and symptoms of infection. A more appropriate measure for this would have been hours since it has previously been established in the literature that patients who are given appropriate antibiotics within the first 24 hours of symptoms are more likely to respond well to treatment.[162] Delays in the administration of appropriate antibiotic treatment beyond 24 hours were found in the Iregui et al[162] study to significantly increase the risk of hospital mortality.

5.3 Factors associated with MRSA vs. MSSA infections

The results of the multivariate analysis examining risk factors for MRSA vs. MSSA infection and outcome differences between these invasive infections found three variables that remained statistically significant in the final model. These variables were prior use of antibiotics, Charlson Comorbidity Index (CCI) score of three or more and not receiving appropriate empiric antibiotics. The variable death was not associated with MRSA infections any more than with MSSA infections. The three variables associated with MRSA are discussed below.

5.3.1 Prior antibiotic use as a risk factor for MRSA vs. MSSA infection

In the multivariate analysis, the use of antibiotics in the 4-week period prior to the *S. aureus* infection was associated with MRSA vs. MSSA invasive infections. The antibiotic classes and/or specific antibiotics that were used more frequently (p-values all <0.05) in the MRSA

patients in the 4-week period prior to infection were the ß-lactam drugs – penicillins (19.6% vs. 14.6%), 2nd generation cephalosporins (6.0% vs. 0.5%), carbapenems (5.5% vs. 1%), aminoglycosides (13.1% vs. 4.0%), fluoroquinolones (48.2% vs. 19.1%), macrolides (8.5% vs. 1%), metronidazole (21.6% vs. 12.1%), clindamycin (12.1% vs. 2.0%) and vancomycin (21.1% vs. 5.5%). The prior use of antibiotics is a well-known risk factor for MRSA.[53,75-82] Other studies which included specific antimicrobial classes had identified the prior use of cephalosporins[63,83-86], glycopeptides,[63,82,87] fluoroquinolones,[63,85,88-89] and other ß-lactams antibiotics [24,82,85-86,88-90] in particular, were risk factors associated with MRSA infections.

In a Belgian study[91] prior antibiotic use, particularly if the antibiotic was one that is used to treat *S. aureus* infections, was shown to occur more frequently before resistant strains were identified. That study showed an increased incidence of MRSA infections with increased use of ceftazidime and cefsulodin, amoxicillin-clavulanic acid, and quinolones. It still is not known whether antibiotic pressure (increased use of specific antibiotics leading to increased resistance to those antibiotics) can influence the incidence of resistant strains. If incidence is driven by the use of antibiotics, then antibiotic stewardship programs become important in controlling incidence rates. An antimicrobial stewardship program may include appropriate drug product selection, dosing, route of administration, and duration of antimicrobial therapy. The goals of antimicrobial stewardship are to optimize safe and appropriate use of antibiotics, enhance clinical outcomes while minimizing unintended consequences of antimicrobial use (e.g., toxicity, resistance), and reduce healthcare costs without adversely affecting quality of care.

A systematic review and meta-analysis by Tacconelli and colleagues[92] examined antibiotic exposure and risk of acquiring MRSA. This review included 76 studies, including 24,230 patients. Results of the review found a 1.8-fold increase of MRSA in patients with prior antibiotic use. This risk was almost three times greater after the use of quinolones and glycopeptides. The use of macrolides was not included in the sub-analysis; however, three studies[82,87,93] reported on macrolides and one of them found an association between macrolides use and MRSA.[82] One of the studies included in the systematic review by Pujol et al[33] reported that 60% of MRSA nasal carriers had received antimicrobials before colonization was identified. Another study[77] found that patients infected with MRSA not only were exposed to

ß-lactam antibiotics, cephalosporins, monobactams, and carbapenems, but also to greater doses and a mixture of different types of antibiotics.

The use of antibiotic medication in hospitals is generally extensive; however, antibiotic exposure to agents with antimicrobial activity also occurs by way of hand soap, environmental cleaning agents, and antibiotic impregnated catheters. Hospital patients and staff are thereby frequently exposed to antimicrobials other than medication and therefore the prior use of antibiotics is not the only mechanism for antimicrobial exposure. The treatment of infections with specific antibiotics can also affect the endogenous flora of patients and thereby select for organisms that are resistant to that drug. Antibiotic use therefore leads to the persistence of antibiotic resistant organisms (ARO) in patients, in staff exposed to those patients, and to the environments surrounding the patients and staff. Therefore, the prior use of antibiotics is not the only mechanism for exposure, and the hospital environment may also be influencing the prevalence of resistance within this environment.

The variable "prior use of antibiotics" has been used in prediction models for determining which patients are at risk for MRSA acquisition. A study by Morgan and colleagues[94] included deriving and evaluating the clinical efficacy of prediction rules for MRSA. The primary variable for predicting becoming an MRSA case was prior antibiotic use, which identified 51% of patients who later developed MRSA. The study suggested that patients with a prior history of antibiotic use are suitable candidates for additional testing with active surveillance culturing. In the study, the authors stated that this approach was likely to have substantial cost savings, compared with the practice of universal active surveillance.[94] Riedel and colleagues[95] also examined prediction models based on electronic administrative data already maintained in hospitals. Interestingly, they found electronic medical record (EMR) documentation of hospitalization during the past year to be the best rule, predicting 70% of MRSA colonization. Other research has examined various prediction models for MRSA using many variables in models that are more complex. In general, these models are not feasible for screening at admission in most facilities because of the large number of variables that they include.[94,95] As well, the history of antibiotic use would be primarily based on self-reporting, unless the patient had recently received antibiotics in the same hospital, and therefore likely would not be a reliable source for this variable.

Although prediction models should not be developed from information analyzed in case control studies, the information from this study provides additional evidence that supports that prior use of antibiotics is a predictor of MRSA. While this study included the 4 weeks period prior to infection, most other studies included longer periods, from 6 months up to one year. It would be interesting to evaluate in additional studies if there is a specific time period in which prior use of antibiotics is the "best" predictor of an antimicrobial resistant organism.

5.3.2 Charlson Comorbidity Index (CCI) score associated with MRSA vs. MSSA infection.

The second variable identified as a risk factor for MRSA vs. MSSA infection was the CCI score. A CCI score of 3 or greater increased the likelihood of being infected with MRSA vs. MSSA. Comorbid conditions such as diabetes and vascular disease are known to be among the many risk factors that contribute to the risk of infection with antibiotic-resistant organisms.[96-98] Risk factor studies of antibiotic-resistant bacteria often attempt to control for the risk attributable to comorbidity by including in their statistical models a dichotomous variable, such as either the presence or absence of *any* comorbid condition, or they will list each individual condition.[48-52,98-107] For statistical reasons, it is often difficult to include several comorbid conditions in one statistical model without the concern of overfitting.[108-113] This concern is particularly important when assessing risks for rare events, such as an infection with a single species of resistant organism, where the number of cases may be low, thus making it difficult to stratify or otherwise adjust for multiple variables.[113,114] A greater utility is likely found in using a single *aggregate* measure of a person's risk due to comorbid conditions.[115-118]

Three standardized scales were used in the studies reviewed, these included the Acute Physiology and Chronic Health Evaluation (APACHE)[120] McCabe classification[121] and the Charlson Comorbidity Index.[53] The APACHE score is a severity-of-disease score generally used in ICUs and requires many variables that are difficult to obtain outside the ICU setting. Although the APACHE[120] score have been shown to correlate well with mortality rates,[118] it was initially designed to assess patients with severe acute conditions in ICU. The McCabe classification[121] was used in two studies examining risk factors for mortality in *S. aureus* bacteremias.[25,31] The McCabe classification was developed in 1962 as a tool to control for

comorbidities and then later used in a study[122] analyzing mortality in patients with gram-negative bacteremias. Comorbid diseases were classified into three groups: rapidly fatal, ultimately fatal, and nonfatal. The classification of patients depends on the investigator's judgment of the underlying illness prognosis and thereby may introduce a bias in retrospective studies, since classification may be influenced by knowledge of the outcome. The McCabe classification[121] does not take into account the combination of comorbid conditions or assign a weight to the seriousness of the disease. Two studies to date,[57,123] other than the present one, included the CCI when determining differences in mortality rates of *S. aureus* infection. The Lesens[57] study looked primarily at the CCI and its role in mortality for *S. aureus* bactermias. Lesens and colleagues found that a score of 3 or more in the CCI (OR= 3; CI, 1.3-5.5; p = .006) was associated with death. This study concluded that comorbidity strongly contributes to death in patients with *S. aureus* bacteremia and that the CCI is a good predictor of death in this population. The second study[123] that used the CCI was in a more recent article examining risk factors and mortality of healthcare-associated and community-acquired *S. aureus* bacteremias. This study by Bassetti and colleagues found that CCI was a predictor of becoming a *S. aureus* healthcare-associated bacteremia case within hospital. The CCI was originally designed as a measure of the risk of 1-year mortality attributable to comorbidity in a longitudinal study of general hospitalized patients. It was then validated for in a cohort of breast cancer patients.[119] The CCI was later validated as a tool to investigate risk factors for death related to *S. aureus* bacteremias[57], which the majority of the invasive *S. aureus* infections were in this study. This scale was the only one available that was validated for use with *S. aureus* bacterimias[57] patients and therefore was the best tool available as a measure of comorbidity for this study. The CCI was chosen for this study as it was considered a good index for measuring comorbid conditions and for use with this particular population of patients.

5.3.3 MRSA infected patients are more likely to not receive appropriate empiric antibiotics

In the final multivariate model, MRSA cases were less likely to receive appropriate empiric antibiotics than cases of MSSA. Not administering the appropriate empiric antibiotic has been associated with excess mortality in patients with serious infections.[124-127] Escalating rates of antimicrobial resistance lead many clinicians to empirically treat critically ill patients with

presumed infections with a combination of broad-spectrum antibiotics, which can perpetuate the cycle of increasing resistance. However, escalating resistance also means that it is increasingly difficult to choose appropriate empiric antibiotics without using combination broad-spectrum antibiotics; a failure to do so results in increased patient mortality. During this study patients were often treated with inappropriate empiric antibiotics, with only 39.7% of the MRSA cases receiving appropriate treatment. Today, the increased incidence of MRSA bloodstream infections has affected empiric management, with vancomycin routinely being administered. If this study were to be repeated today the proportion of patient receiving appropriate empiric antibiotics would likely be much higher.

If the laboratory testing to identify the specific organism, and what antibiotics are appropriate to treat that organism, could be done quickly then *guessing* at what is the appropriate empiric treatment would not be necessary. Routine testing by culture requires 1-2 days to identify the species of bacteria causing an infection, plus another day for susceptibility testing results to determine which antibiotics the organism are sensitive to. In some laboratories the polymerase chain reaction (PCR) assay could be used to identify *S. aureus* in blood cultures and distinguish methicillin-resistant *S. aureus* (MRSA) and methicillin-susceptible *S. aureus* (MSSA) in less than 2 hours. Although to date no information is available evaluating the impact of this PCR technique on clinical or economic outcomes, one knows that if appropriate antimicrobial treatment is given earlier, better patient outcomes would occur. The cost for PCR testing is substantially more than traditional routine testing. However, if patients are less likely to progress to more severe outcomes (requiring ICU admission), increased lengths of stay, increased invasive procedures or even death, then the cost of the test is much less than the cost of the patients' hospitalization or death. It is recommended that future cost-effectiveness study be done to determine this.

A study was done by Rezende[128] and colleagues to determine which patients are the best candidates for MRSA vs. MSSA empiric antibiotic treatment. Patients with a prior hospitalization, prior antibiotic usage, nursing home residency and presence of an indwelling catheter, were at greater risk for MRSA vs. MSSA bacteremia. Ninety-seven percent (97%) of the MRSA patients had one or more of these risk factors vs. only 54% of the MSSA patients ($p<0.001$). The proportion of patients with MRSA isolates progressively increased when 1, 2,

3 or all 4 of these risk factors were present. Patients who had all 4 risk factors were all MRSA cases (100%). Eighty-nine percent (89%) of the MRSA patients had 3 risk factors, 54% had 2 risk factors, 22% had at least 1 risk factor and 5% had no risk factors. This study was useful for those trying to *predict* which patients will acquire a MRSA vs. a MSSA infection and thereby which empiric antibiotic to use. An additional consideration for predicting whom will become an MRSA infection was found in Table 4 which showed that of the MRSA cases, 31.2% had a previously identified positive MRSA culture within the six month period prior to the *S. aureus* infection, while only 0.5% (1 case) of the MSSA patients had this ($p<0.001$). The majority of the MRSA cases with previously positive MRSA cultures were colonization 56%, followed by infections 29% and those with both colonization and infections 13%. Having a past history of a positive culture for MRSA should be a considered for both screening and decision making for empiric treatment. Further research studies creating risk indexes for those most at risk for MRSA vs. MSSA infections can support decision making for proper empiric antibiotic practices as well as target more aggressive screening for those most at risk for infection.

The United Kingdom in 2008 developed guidelines for the prophylaxis and treatment of methicillin-resistant *Staphylococcus aureus* (MRSA) infections.[129] The guidelines were the joint work of the Party of the British Society for Antimicrobial Chemotherapy (BSAC), the Hospital Infection Society (HIS) and the Infection Control Nurses Association (ICNA). The document created recommendations for empiric treatment of MRSA based on a threshold of prevalence. The optimal threshold remains undefined through empirical evidence; however these experts state that it should be 10%. Therefore, if a specific floor or ward is experiencing MRSA colonization and/or infection rates of 10% or higher, nurses working on those floors should inform prescribing physicians of the threshold on the floor in order for physicians to make informed decisions on which antibiotics to prescribe to their patients. This would be conditional on the size of the ward and not applicable for small numbered wards/floors. The importance of nurses working as advocates for patients and collaboratively making decision on care is important for best outcomes.

5.4 Which variables were associated with death in patients with invasive disease due to *S. aureus*?

The primary objective of this study was to compare the differences in mortality (died vs. alive at 6 weeks post-infection) for *S. aureus* invasive disease patients. There were no statistically significant differences in mortality between MRSA and MSSA cases (MRSA 34.2% vs. MSSA 26.6%, p=0.10). The variable MRSA was included in the model and interactions terms were created and tested in order to determine if MRSA was modifying the association between mortality. The significant predictor variables that were associated with MRSA vs. MSSA invasive disease in this study were CCI, age and appropriate empiric antibiotic treatment. The following is a description of the results of the analysis to determine predictors of mortality amongst the *S. aureus* infected patients.

The hierarchical logistic regression analysis had identified seven variables associated with death for patients with *S. aureus* invasive infections. Three of the variables included variables associated with *host-related* characteristics, three variables were *host-infection-related* and one was *treatment-related*. The three variables associated with the host were age, Charlson Comorbidity Index (CCI) score and receipt of immunosuppressive therapy. These host-related variables are important patient characteristics that nurses should be knowledgeable about in order to make clinical decisions for appropriate screening and infection prevention and control precautions.

Three additional variables were associated with the infection-host interactions and these variables included whether or not the patient had a bloodstream infection (bloodstream vs. "other" infection), whether the patient progressed to septic shock as a result of the *S. aureus* infection, and whether the patient experienced neurological dysfunction as a result the infection.

The last variable that was associated with death was a treatment-related variable. The model found that cases of invasive *S. aureus* who were not given appropriate empiric antibiotics were at a higher risk for death. This variable is a modifiable risk factor. Modifiable variables are variables in which some sort of action or activity can be done to change (or modify) the

outcome. Since the outcome was death, actions or activities that affect the proper prescribing of empiric antibiotics should impact the rates of death.

5.4.1 Host-related factors associated with death

5.4.1.1 Age as a host-related factor associated with death.

Age is a well-known risk factor for death in *S. aureus* infections.[31,130-132] Age as a risk factor for mortality in infectious diseases is not unique to *S. aureus*, but has been described for many infectious diseases.[133-138] In a recent Canadian study this was noted in patients with *Clostridium difficile* infections where mortality rates in patients aged 60 and over were particularly high, especially for patients with the NAP1 strain of *Clostridium difficile*.[139] This had also been found in numerous other studies where age was identified as a risk factor for mortality in *Clostridium difficile* patients.[140-142] Age is a well-known, significant and independent risk factor for increase mortality in *S. aureus*, *Clostridium difficile* and other infections and should be controlled for in studies analyzing risks for mortality.

This study found that age was a risk factor for death; however, the study did not determine what long-term outcomes occurred in the elderly cases who survived. The effect of invasive *S. aureus* infections on the physical and mental functional status and long-term care needs of the elderly is not well known. Older adults may not only suffer higher mortality from *S. aureus* infections, but also experience longer recovery times and/or longer or permanent functional impairment leading to prolonged hospitalization, need for ongoing care, and higher healthcare costs. A study by Malani and colleagues[143] that found that being older was an independent predictor of mortality associated with *S. aureus* bacteremia, looked specifically at age cut-offs to determine incremental differences. They calculated that for every 10 years increase in age, the odds of dying within 6 months of *S. aureus* bloodstream infection doubled. They also found that continued care after discharge was needed in two-thirds of patients who survived hospitalization. Even in those who lived independently in the community before admission, more than half required care after discharge. The need for additional care in the community was predicted in this study by the age of the patient. Although there are multiple reasons why patients require subacute care post hospitalization, including antimicrobial administration and

wound care, the Malani study found significant impairments in mobility and cognitive function in patients who previously lived independently. Elderly people are more as risk of death, but they are also more at risk of changes to their quality of life and residential needs post severe *S. aureus* infection or post *any* severe infection. More research and follow-up studies are needed on the long-term effects of invasive *S. aureus* infections and other severe infections in the elderly, focusing on post-infection quality of life and the patients' ability to live independently post-infection.

A U.S. study[144] examining MRSA rate trends over 19 years in a specific hospital from 1990-2008 found that the mean patient age for MRSA infections was 67 years (range, 19-96 years) and there was a median CCI score of 2 (range, 0-9). Significant upward trends in age and comorbidities were observed as the proportion of patients aged older than 70 years increased from 35.8% in the first period (1990-1994) to 61.8% in the fourth period (2004-2008). The proportion of patients with a CCI score above 2 increased from 9.2% to 47.8% in the same time periods (p=0.01). This trend showed that hospitals are seeing older individuals with more chronic comorbid conditions as time progresses. As the baby boomers are aging the overall proportion of older people, over time, will get larger. With this in mind, our health care system will see the incidence of chronic comorbid conditions increasing over time, especially the chronic comorbid conditions associated with age (e.g., diabetes, heart disease). A U.S. study,[145] however, did not see a change in the mortality rates over time, with rates ranging from 26.2% in the years 2000-2004 and a high of 32.9% in the years 1995-1999 (p=0.73), for the 1990-2008 time period. The present study found an overall mortality rate of 30.4%, with 34.2% amongst the MRSA and 26.6% amongst the MSSA cases (p=0.10). This rate is similar to another large study[144] that determined mortality rates of 31.7% among 167 patients with MRSA bacteremias between 1999 and 2001. In a study by Soriano and colleagues[146] which included 414 episodes of MRSA bacteremias from 1991 to 2005, the 30-day mortality rate was reported as 28%. Another large study of 438 patients by Shurland and colleagues[147] found a 90-day mortality rate of 34.2%. The rate of 34.2% for MRSA infections in this study therefore is very similar to other large studies, with most rates ranging from 20-40%, and therefore this study likely provides a good estimate of *S. aureus* invasive disease mortality rates in Canadian acute-care hospitals.

5.4.1.2 Charleston Comorbidity Index (CCI) as a risk factor for death in invasive *S. aureus* infected patients

The meta-analysis by Cosgrove[47] and colleagues included 31 published studies comparing mortality rates among MRSA and MSSA bacteremia cases. The 31 studies had 24 studies with no significant differences in mortality and seven studies with higher mortality rates amongst MRSA cases. When the studies were combined in the meta-analysis, a significant increase in mortality was associated with MRSA bacteremia compared to MSSA bacteremia, with a pooled OR of 1.93 (95% CI, 1.54-2.42; p<0.001). These results were statistically significant; however, there was significant heterogeneity amongst the studies' results (p = 0.03). This means that the studies were dissimilar enough that the pooled results of this meta-analysis may be inappropriate or inaccurate. The 31 studies in the meta-analysis included outbreaks, non-outbreaks, nosocomial-acquired, community acquired and specific patient populations e.g. ICU, patients with endocarditis only. Adjusting for "severity of illness" at the time of the infection only looks at the severity that is present during the current disease episode and does not factor in chronic comorbid conditions that could significantly be affecting outcomes and mortality. Adjustment for chronic comorbid conditions should always be included in mortality studies since comorbid conditions are known to affect outcomes.[57,148,149] This study is unique since it included a large sample size, multiple hospital sites, the inclusion of a validated measure for comorbid conditions (the CCI score) and a measure of appropriate antibiotic treatment.

As noted previously, a study by Lesens and colleagues[57] demonstrated that the CCI was effective in controlling for comorbid conditions in mortality studies on *S. aureus* bacteremia. The Lesens study found that the CCI was able to predict overall mortality in *S. aureus* bacteremia cases. Specifically, when overall mortality was considered as the outcome, the variables found to be predictors for death in the model were the CCI score (3 or more points) (OR, 3.3; CI 95, 2-5.7; p < .001) and age (OR, 1.05; CI 95, 1.03-1.07; p < .001). The authors included inappropriate empiric antibiotic therapy in their model; however, this variable was not significant, with 30% of the patients who died and 27% of the patients who lived receiving inappropriate therapy (p=N.S.). The main conclusions from the Lesens study were that the

CCI and age were the best predictors of mortality in this population and should be controlled for in future studies examining risk factors for death due to *S. aureus* bacteremias.

The present study also found an increased CCI score was associated with death. It is an important consideration for future studies to include both age and a measure of comorbid conditions to help in model building.[57,117,128,144,150] Patients with a CCI of 3 or more were also more likely to have MRSA vs. MSSA infection; however, MRSA itself did not affect the outcome death. The outcome death was associated with an increased CCI score and not the MRSA vs. MSSA designation. The MRSA*CCI interaction term that was put in an iteration of the model (that was not used as the final model) proved not to be statistically significant or to have an impact on the CCI odds ratio. This interaction term was removed from the final model and we can conclude that although MRSA invasive infections occurred more frequently in patients with increasing CCI scores, its presence did not have a detectable effect on mortality.

5.4.1.3 Immunosuppressive therapy associated with death in patients with invasive disease due to *S. aureus*

The recent receipt of immunosuppressive therapy was associated with death amongst those with *S. aureus* infections. For the purpose of this study, immunosuppressive therapy was defined as having received immunosuppressive therapy in the 7 days prior to infection. The therapies included chemotherapy, corticosteroids, azathioprine, cyclosporine, tacrolimus, sirolimus, cyclophosphamide, methotrexate, and remicade. These drugs have the potential to cause immunodeficiency. Immunodeficiency may increase one's susceptibility to opportunistic infections such as *S. aureus* infections that may be ubiquitous in hospital environments and on the hands of health-care providers. In a study done by Forsblom and colleagues,[151] immunosuppressive therapy amongst *S. aureus* bacteremia patients was an independent risk factor, according to multivariate analysis, for a fatal outcome along with age, chronic alcoholism, severe sepsis and *S. aureus* pneumonia and endocarditis. Another study by Harbarth and colleagues[152] also identified prior use of immunosuppressive therapies as a risk factor for MRSA surgical site infections among patients with MRSA carriage. Immunosuppression occurs in patients receiving immunosuppressive therapy and amongst patients who have immunosuppressive chronic disorders (e.g., cancer). The results of this

study found that death was more likely to occur in those who were older, those receiving immunosuppressive therapy, and those who had higher CCI scores, with all three of these factors identified as *non-modifiable* risk factors. These are, however, flags for nurses to help to identify patients who are at risk for severe complications or death, and thereby strict infection control procedures and more frequent screening needs to be done with these patients.

5.4.2 Infection-related factors associated with death

5.4.2.1 Bacteremic infections are associated with death.

Patients who had *S. aureus* bloodstream infections were at greater risk of mortality (death) compared to patients with other invasive infections that were not bacteremic. Most of the published literature looking at risk factors for mortality amongst *S. aureus* infections only include those with bloodstream infections and do not include "other" invasive non-bacteremic infections. This study included all invasive infections, like deep wound surgical site infections and pneumonias, where the *S. aureus* isolates were taken from a normally sterile site (e.g., a deep wound tissue biopsy for a surgical site infection, pleural fluid or lung biopsy for pneumonias). The reason this study did not only want invasive blood stream infections was because the PI was interested in what the predictors of death were for all invasive *S. aureus* infections. The analysis found that those with invasive *S. aureus* associated with a bloodstream infection were more likely to die than those with "other" non-bloodstream *S. aureus* infections.

Another consideration when interpreting the results of this study is that some of the invasive disease infection types that were labelled as non-bacteremic could have been bacteremic. However, because there was no positive blood culture they were not deemed as a secondary blood stream infection and were categorized according to the "other" infection site identified. A few scenarios could have taken place for these non-bacteremic cases who may have been bacteremic. One scenario is that a blood culture was not taken when it may have been positive if it had been drawn. A second scenario is a blood culture was taken but did not grow anything although it may have been positive if redrawn. A third is that a blood culture was drawn after the antibiotics were initiated and might have been positive had it been drawn prior to antibiotic

administration. Therefore, the results need to be read with caution since the "other" non-bloodstream infections may have actually been secondary bloodstream infections, particularly since the study was examining invasive disease cases. It is unknown whether or not 20% of invasive disease infections do not involve the blood. However, since non-bacteremic infections were associated with better outcomes, presumably something different was occurring in these patients.

The hierarchical logistic regression model was run with *only* the *S. aureus* bloodstream infections (N=323), and the variables that were statistically significant in the final block of the model were exactly the same ones that were in the model that included all the *S. aureus* patients. This additional analysis was performed to determine if any differences in the final model would occur with only this subpopulation of patients.

Since patients with bloodstream infections are more likely to die, the important nursing interventions include prevention and early recognition of patients with bloodstream infections. Prevention is always the first line of defence in infection control and particularly so in the prevention of catheter-associated bloodstream infection. A study by Tsuchida and colleagues[153] that included the effectiveness of nurse-initiated preventive interventions to reduce catheter-associated bloodstream infections found that the rates of infection were reduced significantly from 4.0/1,000 device-days to 1.0/1,000 device-days when nurses were trained on skin preparation prior to insertion, stabilization of the catheter, use of maximal sterile precautions and use of disinfectant to reduce contact time. These nursing activities are preventative. For patients who already are infected, the nursing-initiated intervention is the early identification of infection, which will facilitate timely acquisition of blood isolates, timely identification of causative organism, and early and/or appropriate antibiotic treatment.

5.4.2.2 Neurological dysfunction and septic shock associated with death in patients with invasive disease due to *S. aureus*

The two severe complications that were associated with death in the multivariate model were neurological dysfunction (defined as a change in consciousness level within the 48 hour period commencing at first sign or symptom of infection) and septic shock (defined as sepsis

associated with evidence of organ hypoperfusion and a systolic blood pressure < 90 or > 30 mm HG less than the baseline value or a requirement for the use of vasopressors to maintain blood pressure). A larger percent of the cases who died experienced neurological dysfunction (44.9% died vs. 7% lived). Loss of consciousness is a common symptom seen prior to death due to reduced blood flow to the brain and therefore it can be expected that this variable would be more prevalent in cases who died. Altered mental status at onset of infection was found to result in greater mortality in MRSA bloodstream infected patients according to a study by Gomez and colleagues.[154] Some of the early symptoms of septic shock can be seen as neurological dysfunction including lethargy, agitation, restlessness and confusion and therefore these two complications may be observed together. Other studies have found that *S. aureus* infections, and primarily blood stream infections, are more likely to progress to septic shock than those with non-bacteremic infections and that those who experience septic shock are more likely to die.[31,123,154,155] Are patients then with MRSA infections more likely to progress to septic shock than MSSA infections? In the univariate analysis MRSA cases were not more likely to have septic shock as a complication of the infection than MSSA cases (18.4% vs. 12.2%, p=0.09); however, this variable was included in the final model and septic shock was not found to be statistically significant. One study examined this and included septic shock as well as the other variables, antibiotic use and CCI in their analysis.[123] This study by Bassetti included mortality risk factors for *S. aureus* bacteremias and the variables MRSA, septic shock, empiric antibiotic treatment and CCI. Many of the studies that found MRSA as a predictor of death did not include these variables, so the Bassetti study was unique in that it included both CCI scores and empiric antibiotic treatment. This study only included variables with p-values of <0.10 in their model and therefore age was not included in the final model. The Bassetti final model included septic shock, methicillin resistance and inadequate initial antimicrobial treatment as predictors of death. The variable CCI score did not remain in the final model. There may be several reasons why the Bassetti study's results are different that those of this study. First, the number of deaths in the Bassetti study was only 35 with a total of 130 survivors, and 11 variables were entered into the multivariate analysis. The general rule of thumb that logistic models should be used with a minimum of 10 outcome events per predictor variable as per Homer and Lemeshow's guidance[64] was not used in the Bassetti study. It is unknown whether with the small number of deaths affected the final

results of the study. The present study had a high number of deaths (N=121) and survivors (N=277) and therefore a larger number of variables were included in the final model. Differences in empirical prescribing practices and poor vancomycin efficacy[43,156,157] may explain some of the differences in the results. Ultimately, more research is needed to clearly define the reasons in variability in research for MRSA association with death, which likely are multifactorial.

The main information to take from these findings is that patients who progress to neurological dysfunction and septic shock due to their *S. aureus* invasive infection are at an increased risk for death. The recognition of these markers can help in preemptive preparation and counselling of families and loved ones of the potential outcomes of ill patients. When these risk factors are seen it is important for nurses to call families to the hospital so that if the patient dies, they will have the opportunity to be present and to participate in their final care.[158]

5.4.3 Treatment-related factors associated with death in patients with *S. aureus* invasive infections

5.4.3.1 Not being given appropriate empiric antibiotic treatment is associated with death in patients with *S. aureus* invasive infections

This study found that patients who did not receive appropriate empiric antibiotic treatment were at greater risk of death than those who did (OR 2.63, 95%CI 1.43-4.85, $p<0.05$). Adequate antimicrobial therapy is available for both MRSA and MSSA cases in Canada. Despite the availability of adequate therapy, cases of *S. aureus* infections were receiving inappropriate empiric antibiotic treatment, which in this study was associated with death.

Cosgrove and colleagues[47] in their meta-analysis found that MRSA bacteremia patients were more likely to die than MSSA bacteremia patients; however, it was noted that individual studies did not look at the appropriateness of antibiotic treatment differences between MRSA and MSSA cases. This study found in the MRSA vs. MSSA analysis, that MRSA cases were four times more likely to not receive appropriate empiric antibiotics compared to MSSA cases.

Although MRSA cases are more likely than MSSA cases to not be given appropriate empiric antibiotics, it is important to note that MRSA cases were not more likely to die than MSSA cases. The other important consideration is, the drugs used to treat MRSA typically have poorer efficacy when compared to the drugs that typically are used to treat severe MSSA infections.[156] Vancomycin is known to have slower bactericidal activity *in vitro* with invasive type infections,[156,159] and vancomycin may also have variable penetration.[160,161] Perhaps many of the studies that found that MRSA cases are more likely to die did not consider that the treatments drugs for MRSA were less effective, and it was not the virulence of the MRSA organism, but the inability of the antibiotics used to treat (e.g., efficacy and penetration) the MRSA infection that were affecting the outcomes. This may explain the variability in the mortality studies comparing MRSA and MSSA. As well, pathogen derived factors could affect outcomes. In a study by Haque and colleagues[190] the Vancomycin MIC was found to be associated with increase mortality, while Vancomycin heteroresistance had no association with mortality, but it was associated with clinical response. This study included appropriate use of empiric antibiotics as a variable in the model and subsequently the variable MRSA dropped out of the model. Mortality studies that are examining differences between MRSA and MSSA should always include the appropriate empirical treatment; otherwise the results should be read with caution. Future studies should also occur to determine whether antibiotic efficacy and penetration are affecting outcomes.

Not only should appropriateness of antibiotics be considered, but also the timeliness of appropriate antibiotic treatment. Iregui and colleagues[162] found that delays in appropriate treatment were a primary predictor of hospital mortality. Interestingly, the delays they found were primarily caused by delays in writing up the antibiotic order, inappropriate initial antibiotic prescription, and delays in the administration antibiotics after the initial order was given. Delays in appropriate treatment have been measured in the literature as 24[162] or 48 hours[190] after initial signs and symptoms of infection. In both these studies, delays were associated with and increase 30-day mortality in bacteremic patients. Nurses can facilitate the timeliness of treatment by communicating laboratory findings immediately to the attending physician and ensuring that delays in the administration of the appropriate antibiotics do not occur.

In this study, time to appropriate empiric treatment did not differ between those who died and those who lived (mean and median days to appropriate treatment in those who died were 2.4 and 2.0 days vs. 2.9 and 2.0 days, p=0.64 Mann-Whitney U test). These results were measured in days and therefore are a very rough estimate. Preferably time to antibiotic treatment should be measured in hours; however this was not collected in this study. In other studies a delay in starting an appropriate antibiotic for *S. aureus* has also been found not to be an important predictor of mortality in *S. aureus* bacteremia,[163,164] others have found that timely empirical therapy for *S. aureus* bacteremia is associated with reduced mortality.[165,166] This may be occurring because delays in appropriate empiric antibiotic treatment may not affect those who are severely unwell as much as those who are healthy; for example, patients who are already severely unwell due to their chronic comorbid conditions may not respond as well to antibiotic treatment as would more healthy individuals. A large study[167] of *S. aureus* bacteremia cases that supports this finding found a decreased mortality in patients with low severity-of-illness scores. This study by Kim et al, also found that appropriate empiric antibiotics within the first 48 hours resulted in outcome differences between invasive disease vs. non-invasive infections with mortality 3.1 times higher in those with invasive infections.

There are other studies now that support the finding that MRSA is not a predictor of death in *S. aureus* infections. A recent prospective cohort study by Turnidge and colleagues[168] found that MRSA infection was not a predictor of death and the authors commented that the increased mortality associated with this invasive infection may partly be due to inappropriate treatment. In another recent retrospective cohort study[169] examining *S. aureus* bacteremia in adults, empirical treatment was "inappropriate" significantly more often with MRSA bacteraemia patents than it was with MSSA bacteraemia patients (inappropriate empirical treatment: 21% in MSSA vs. 52% in MRSA cases; $p < 0.001$). In their analysis it was found that MRSA was not associated with increased mortality rates at 30 days.[169] Other factors should therefore be considered with poorer clinical outcomes, which may include efficacy, appropriateness and timeliness of treatment.

Since appropriate treatment is the only modifiable risk factor identified in this study, it is important to work towards education and interventions that will ensure appropriate treatment is received. Appropriate treatment is dependent on which organism (MRSA vs. MSSA) is

identified, and therefore it is important to first recognize the risk factors for those acquiring these organisms. As identified in this study, the risk factors for MRSA infections included the matched variables (age, infection type and presumed location of acquisition) plus the variables CCI score > 2 and prior antibiotic use. Early identification of patients at risk for specific organisms can guide prescribing practices and appropriate infection prevention and control measures.

The possession of all or some of the risk factors identified in this study should initiate a timely and appropriate response, first by the nurses and other health care professionals caring for these patients, which in turn may prevent deaths. Nurses need to be able to identify patients who are at risk for severe complications and/or death. The best line of defence is early recognition of the patient characteristics that make patients more susceptible to death. Once these patients are identified, particular attention need to be given to the prevention of infection in these patients. These preventive measures include: diligent hand cleaning, use of personal protective equipment such as gloves, gowns, and/or masks when caring for these patients and particularly when working with or putting in central lines and monitoring oneself and others to ensure that everyone is following the proper infection prevention procedures. Once a patient has signs and symptoms of an infection, it is important for nurses to obtain cultures (or advise others to) for rapid identification of the causative organism and organism antimicrobial sensitivity testing. Informing prescribing physicians of what is happening on that patients' floor, particularly if others are having MRSA infections or colonizations, and the threshold is 10% or greater, will facilitate in decision making on appropriate antibiotic prescribing. Another important practice, once laboratory results are available, is a rapid change to the prescribed antibiotics if the organism is not sensitive to the empiric antibiotic regimen already prescribed. The rapid actions needed include informing the attending physician of the laboratory results, ordering of the proper antibiotic, and administration of the antibiotic as soon as possible. With the combination of the knowledge of those at risk, proper infection control practices and appropriate and timely antibiotic administration, the risks for severe complications and/or death can be prevented.

6 Summary of Key Findings and Recommendations

6.1 Key Findings

- This study found that patients with invasive disease due to MRSA were not more likely to die than patients with invasive disease due to MSSA.
- In patients with invasive *S. aureus* the risk associated with MRSA versus MSSA were: a history of antibiotic use in the 4 week period prior to infection, a Charlson Comorbidity Index score of > 2 and not being given appropriate empiric antibiotic therapy.
- Invasive MRSA infected patients are less likely to receive appropriate empiric antibiotics.
- *S. aureus* invasive disease patients are more likely to die if they are older, had more chronic comorbid conditions evidenced by an increased Charlson Comorbidity Index score, are immunosuppressed, have a *S. aureus* bloodstream infection, develop septic shock or neurological dysfunction as a result of the infection, and were not given appropriate empiric antibiotics.
- The host-related factors associated with death were age, increased CCI score and being on immunosuppressive therapy prior to infection.
- Host-infection interactions associated with death included having an invasive *S. aureus* bacteremia infection (vs. an "other" non-bacteremic invasive infection), going into septic shock and having neurological dysfunction.
- Treatment related factors associated with death included those patients not being given an appropriate empiric antibiotic. This variable was the only modifiable risk factor identified.
- Mortality as a result of infection may be caused by many factors. These factors need to be controlled for in future studies in order to determine if MRSA is associated with mortality or not.
- When developing a multivariate model it is very important to consider variables that are both clinically and statistically significant. All statistically significant variables found in univariate analysis typically can not be put into a multivariate model without the risk of overfitting

the model. Therefore, a model using information from the literature and consultation with experts in the field will help facilitate better model building and therefore better conclusions.

- The decision on which variables to place in a hierarchical multivariate analysis is important. The use of clinical experts (e.g. infectious disease physicians), who are well versed in MRSA infections was advantageous to this study when determining the order of variables in the final hierarchical logistic regression models for death. Other studies should consider using a similar method in order to ensure that both clinical and statistical decision making are included in the model building.

- The inclusion of a standardized measure of comorbidity, which traditionally is not used in infectious disease mortality studies, is essential in helping to determine whether comorbid conditions are significantly influencing the mortality rates in that study. The Charlson Comorbidity Index is easy to use and had been validated as a good tool for use in infectious disease mortality studies.

- This study contributes to the body of science that helps better understand the predictors of mortality in *S. aureus* invasive disease patients, which will help in the management of this disease and optimize patient outcomes.

6.2 Recommendations

- A greater understanding of the predictors of mortality is needed by nurses who participate in decision-making for more "personalized care". Using information collected on host factors, host-infection interactions and treatment factors helps in decision-making that is more tailored to the needs of the patient.

- Host-related factors can be used to further screen patients in order to identify those who are at risk for MRSA infection. Prior use of antibiotics, older age and patient with multiple comorbid conditions are host factors. When a patient presents with these characteristics, nurses can decide to screen more often and ensure adequate infection control practices and measures are in place.

- MRSA cases are less likely to receive appropriate empiric antibiotics than MSSA cases. Nurses can advocate for patients if MRSA is circulating on the patients' floor (10% or greater threshold) or the patient has host-related factors. This advocacy includes informing prescribing physicians

about infections circulating on the floor and informing the physician that the risks for MRSA are higher in a specific patient due to their host-related risk factors.

- Both septic shock and neurological dysfunction occur as a result of the infection, so infection prevention through good routine practices is needed at all times, particularly with the more vulnerable of cases. Monitoring patients for early signs and symptoms of shock and/or neurological dysfunction is essential for decision making regarding ICU transfers or for preparations for potential death for the family and the patient.

- Although choice in the prescribed antibiotic falls under the attending physician duties, nurses can inform and participate in the decision making. Specifically, informing the physicians of the other infectious organisms that are circulating on the patients floor, infection thresholds and describing the patients risk factors for MRSA (past antibiotics, which ones, prior hospital admission). The timely reporting back of susceptibility testing results by the laboratory and timely administration of appropriate antibiotic, when inappropriate empiric antibiotics were prescribed, is an important intervention to help in the prevention of death in patients.

- The epidemiology of MRSA has changed since the data were collected for this study, and Canada is now seeing more community strains of MRSA occurring in hospital. The community strains have been more likely to be found in younger, healthier people who may not have the chronic comorbid conditions that we generally associate with increased mortality. It is recommended that a study similar to this be done in Canada taking into account the presumed source of the infection (hospital-acquired, hospital-associated or community-acquired) and also linking the cases with their isolates to determine stain type virulence. As the epidemiology of MRSA in Canada changes the risk factors for these subpopulations need to be considered individually and additional research to identify the specific risk factors for each sub-population should take place.

- Although the primary focus of this study was to identify the host and infection related risk factors for death amongst *S. aureus* invasive infections, future research could also include other environmental factors which may affect outcomes as well. These factors could include nursing workload, staffing mix, antibiotic prescribing practices, compliance with infection control measures, infection control screening policies, antibiotic efficacy and penetration and local epidemiology (resistance rates in the hospital, community, outbreaks).

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8 Appendices

8.1 Appendix A – Data extraction forms, data dictionary nosocomial infection definitions and antibiotic codes

8.1.1 CNISP/CHEC MRSA Outcomes Study Questionnaire

CASE Questionnaire (for MRSA invasive cases only)

1. CNISP/CHEC site id #_____ ***(e.g., 07A)***

2. Study ID_____
(start with #1, this number will be transcribed onto the questionnaire of its matched control)

Section A: Study Participation Criteria

3. This patient has a positive culture for: ___ MRSA

4. Please specify CNISP unique identifier given to this patient in the CNISP MRSA surveillance program
(e.g., 07A2001001) _____

5. The positive culture was obtained from a normally sterile site: ____ Yes _____ No

Section B: Specimen Information

6. Site of isolate ***(if the site is NOT listed below then this patient does not meet the criteria for participation in this study)***:

(Please check all that apply if > 1 positive culture taken on date of first positive culture date)

Invasive Isolate Specimen Type	Date of first culture (mm/dd/yyyy)
___ 1. Blood	
___ 2. Synovial fluid	
___ 3. Pleural fluid	
___ 4. Pericardial fluid	
___ 5. Ascites/peritoneal fluid	
___ 6. Tissue *(not sinus or skin)*	
___ 7. Cerebrospinal fluid *(CSF)*	

Definition of Date of first positive culture : **This is the date that the culture was collected or obtained from the patient and is NOT the date of the positive culture result.**

Section C: Patient Information

7. Date of Birth ____/____/_____ *NOTE: Patient must be at least 18 years of age to participate in this study*
mm/ dd/ yyyy

8. Patient had been admitted to hospital during this MRSA invasive infection
____ 1. Yes ____ 2. No

9. Gender: ___ **Male** ___ **Female** 10. Date of hospital admission: ___/___/_____
mm/dd/yyyy

11. Date of Discharge: ___/___/_____ 12.Date of Death: ___/___/_____
(if applicable) **mm/dd/yyyy** ***(if applicable)*** **mm/dd/ yyyy**

13. Information about the MRSA Infection ***(chart must be reviewed to collect the following information)***

A. Source

__ **Nosocomial** ***(see case definitions in data dictionary)***
__ **Community**

B. Type of MRSA Infection *(see appendix for infection definitions)*
(Check all that apply)- remember that cases may have > 1 MRSA of infection, **but at least one of the MRSA infections must be from one from the afore mentioned sterile sites and the 2nd infection must be within 7 days of the first positive culture.**

___ **1. MRSA Surgical wound infection**
___ **Incisional** ___ **Deep**

___ **2. Primary MRSA bloodstream infection**
(including catheter-associated bacteremia={culture + from site of tip)
___ **Primary bloodstream(no catheter no other focus)**
___ **Catheter associated (blood culture+catheter tip positive with MRSA)**

___ **3. Secondary MRSA bloodstream infection (positive blood culture + other focus)**

___ **4. MRSA Pneumonia**

___ **5. MRSA Urinary tract infection**

___ **6. MRSA Bone and/or joint infection**
_____ **Osteomyelitis** ___**Joint/bursa** ___**Vertebral disk space**

___ 7. Cardiovascular system MRSA infection
___ **arterial/venous** ___ **endocarditis**
___ **myocarditis or pericarditis** ___ **mediastinitis**

___ **8. Central nervous system MRSA infection**

___ 9. Eye, ear, nose, throat, and mouth MRSA infection

___ **10. Gastrointestinal system MRSA infection**

___ **11.Lower respiratory tract MRSA infection (excluding pneumonia)**

___ **12.Reproductive tract MRSA infection**

___ **13.Skin and soft tissue MRSA infection**

C. Any other infection *(see appendix for infection definitions) - other than an MRSA infection*

Did the patient have <u>other non-MRSA infections</u> at the same time (on the same date) as the MRSA infection was identified or within 7 days of identification of the MRSA infection? (Check all that apply- remember that cases may have > 1 of infection)

___ **1. Surgical wound infection**
___ **Incisional** ___ **Deep**

___ 2. Primary bloodstream infection
(including catheter-associated bacteremia={culture + from site of tip)
___ Primary bloodstream(no catheter no other focus)
___ Catheter associated {blood culture+catheter positive tip)

___ 3. Secondary bloodstream infection (positive blood culture + other focus)

___ 4. Pneumonia

___ 5. Urinary tract infection

___ 6. Bone and/or joint infection
_____ Osteomyelitis ___Joint/bursa ___Vertebral disk space

___ 7. Cardiovascular system infection
___ arterial/venous ___ endocarditis
___ myocarditis or pericarditis ___ mediastinitis

___ 8. Central nervous system infection

___ 9. Eye, ear, nose, throat, and mouth infection

___10. Gastrointestinal system infection

___11.Lower respiratory tract infection (excluding pneumonia)

___12.Reproductive tract infection

___13.Skin and soft tissue infection

14. Previous residing location prior to the admission.

___ Home (private residence) ___ Rehabilitation Facility
___Long term care/nursing home ___ Other, please specify
_____

15. Service Patient on at onset of symptoms of MRSA infection (best judgement call):

___ ICU ___ Outpatient
___Non-ICU (in hospital) ___ Unknown

Section D: Patient History

16. Please indicate if the patient has had any of the following devices in the 7 days prior to the date of the first invasive positive MRSA culture (*Check all that apply*)

___Indwelling urinary catheter ___ Tracheostomy
___Mechanical ventilation ___ Peritoneal dialysis catheter
___Central venous catheter ___ Other, specify
_____
___ Nasogastric tube or feeding tube

17. In the 6 months prior to the first invasive positive MRSA culture did the patient have (check all that apply):

___Positive MRSA culture ___ infection ___ colonization
___Positive MSSA culture ___ infection ___ colonization
___Positive VRE culture ___ infection ___ colonization

18. On the same day as the first invasive positive MRSA culture was the patient known to be colonized or infected with any of the following (check all that apply):

___ VRE ___ Colonized ___ Infected

___ *Clostridium difficile*

___ ESBL organism ___ Colonized ___ Infected

___ Other multi-drug resistant organism.
Specify organism_____ ___Colonized ___ Infected

19. From the date of first invasive positive MRSA culture, had the patient been in the ICU in the previous 30 days?

___ Yes, Number of days in ICU? _____ (days)
___ No

20. From the date of the first invasive positive MRSA culture, did the patient have surgery in the previous 30 days?

_____Yes ____ No

(if yes specify surgical procedure)

Surgical Procedure
1._____
2._____
3._____
4._____
5._____
6._____
7._____
8._____
9._____

21. From the date of first positive invasive MRSA culture, had the patient received immunosuppressive therapy in the previous 7 days?*(Therapies include chemotherapy, corticosteroids, azathioprine, cyclosporine, tacrolimus, sirolimus, cyclophosphamide, methotrexate, remicade)*

___ Yes
___ No

22. On the day of first positive invasive MRSA culture, was the patient neutropenic (neutrophil count < 500 cells/mm^3, granulocytes <1000/mm^3) or if no WBC count done on that day use your best judgement to decide whether patient was likely to be neutropenic.

___ Yes, Total number of days of neutropenia _____ days
___ No

23. From the date of first positive invasive MRSA culture, had the patient received dialysis in the previous 7 days?

___ Yes
___ No

24. Was there an ID consult after the first positive culture was identified for this episode of infection?

___ Yes
___ No

Section E: Antibiotic Use

25. History of Antibiotic Use

Please list all systemic antibiotics given to the patient in the 4 weeks prior to the date of the first invasive positive MRSA culture (Do not include topical or inhaled antibiotics).

Indicate the Antibiotic Code (one code per box) below: See Antibiotic Codes

Antibiotic Code (##)	Antibiotic Code (##)

26. Empiric Antibiotic therapy

Did this patient receive empiric therapy (antibiotics given between the time the culture was obtained and the first positive culture result for MRSA)

___ **Yes**
___ **No**

If Yes, Please list the empiric antibiotics given:

Antibiotic Code	Start date (mm/dd/yyyy)	Stop Date (mm/dd/yyyy)

27. Antibiotic Use <u>after</u> invasive MRSA positive culture

Please list all antibiotics and the start and stop dates given to this patient up to and including <u>28 days after the date of the first positive invasive MRSA culture was reported</u> (Do not include topical or inhaled antibiotics).

Antibiotic Code	Start date (mm/dd/yyyy)	Stop date (mm/dd/yyyy)

Section F: Comorbid conditions (Charlson Comorbidity Index)

28. At the time of admission was the patient identified with any of the following comorbidities or conditions?

Myocardial

___ Myocardial infarction **= 1 or more definite or probably event(s), hospitalization with ECG +/or enzyme changes (this includes past or present)**

___ Congestive heart failure **= patient with exertional or paroxysmal nocturnal dyspnea and who have responded symptomatically (or on physical examination) to digitalis, diuretics, or afterload reducing agents**

Vascular

___ Peripheral vascular **= patient with intermittent claudication or those who had a bypass for arterial insufficiency, those with gangrene or acute arterial insufficiency and those with an untreated thoracic or abdominal aneurysm (6cm or more)**

___ Cerebrovascular disease **= patients with a history of a CVA with minor or no residua and transient ischemic attacks**

Pulmonary ___ Pulmonary disease **= includes both mild** (dyspneic with moderate activity without treatment or those who are dyspneic only with attacks), **moderate (**dyspneic with slight activity, with or without treatment and those who are dyspneic with moderate ability despite treatment) **and severe (**dyspneic at rest, despite treatment, those who require constant oxygen, those with CO_2 retention and those with a baseline PO_2 below 50 torr)

Neurologic

___ Dementia **= patients with chronic cognitive deficit**

___ Paralysis **= patients with hemiplegia or paraplegia whether it occurred as a result of a CVA or other condition (past and present)**

Endocrine

___ Diabetes with end organ damage**= patients with retinopathy, neuropathy or nephropathy**

___ Diabetes = **patients with previous hospitalizations for ketoacidosis, hyperosmolar coma, or control and those with juvenile onset of brittle diabetics as well as other diabetes treated with insulin or oral hypoglycemics but not diet alone**

Renal

___ Renal disease (moderate or severe) = **patients on dialysis, those who had a transplant, those with uremia or with serum creatinines of > 3mg%**

Liver

___ Moderate to severe liver disease = **patients with cirrhosis, portal hypertension and a history of variceal bleeding (severe) or no bleeding (moderate)**

___ Mild liver disease = **cirrhosis without portal hypertension or chronic hepatitis**

Gastrointestinal

___ Peptic/duodenal ulcer = **patients who have required treatment for ulcer disease including those who have bled from ulcers**

Cancer/Immune

___ Tumour = **patients with solid tumours without documented metastases, but initially treated <u>in the last 5 years</u>, including breast, colon, lung, and a variety of other tumours**

___ Lymphoma = **includes patients with Hodgkins, lymphosarcoma, Waldenstrom=s macroglobulinemia, myeloma, and other lymphomas**

___ Leukemia = **patients with acute and chronic myelogenous leukemia, acute and chronic lymphocytic leukemia, and polycythemia vera**

___ AIDS = **patients with definite or probable acquired immune deficiency syndrome**

___ Metastatic cancer = **patients with metastatic solid tumours, including breast, lung, colon and other tumours**

Miscellaneous

___ Rheumatologic disease = **patients with systemic lupus erythematous, polymyositis, mixed connective tissue disease, polymyalgia rheumatica and moderate to severe rheumatoid arthritis**

IV Drug Use ___ **Was the patient know to use recreational intravenous drugs within the past year?**

Section G: Severity of the Acute MRSA Infection

29. To the best of your judgement, did the patient have any of the following as a result of this MRSA infection?

A. **Need for transfer to ICU within 48hrs before or after date of first positive invasive MRSA culture?**

___ **Yes** ___ **No**

B. **Renal insufficiency (a serum creatinine level of >176 ug/ml {>2.0mg/dl or >200mMol/L} or double the baseline or dialysis initiated)within 7 days of first positive culture.**

___ **Yes** ___ **No**

C. **Hepatic dysfunction (a serum bilirubin concentration of >3mg/dl or increased aspartate aminotransierase or alanine aminotransferase levels more than twice the baseline) within 7 days of the first positive culture.**

___ **Yes** ___ **No**

D. **Respiratory difficulty (new partial arterial 0_2 pressure of <60 mm Hg, new partial arterial CO_2 pressure of > 50mm HG, or initiation of ventilatory assistance) within 48 hours**

___ **Yes** ___ **No**

E. **Neurological dysfunction (change in consciousness level) within 48 hours.**

___ Yes ___ No

F. **Septic shock (sepsis associated with evidence of organ hypoperfusion and a systolic blood pressure <90 or > 30 mm HG less than the baseline value or a requirement for the use of vasopressors to maintain blood pressure)within 48 hours.**

___ Yes ___ No

G. **Coagulopathy (marked reductions in blood concentrations of platelets and coagulation factors in the peripheral blood or a physician reported DIC or coagulopathy in the chart) within 48 hours.**

___ Yes ___ No

Section H: Outcomes

30. Six weeks after the date of first positive invasive MRSA culture:

____ **Patient** died before or during treatment **for first invasive positive MRSA culture (e.g., patient died while on antibiotics for the infection);**

____ **Patient** died after completion of treatment **for MRSA infection but within 6 weeks of first positive invasive MRSA culture (e.g., patient died after completion of antibiotics);**

____ **Patient** remained in hospital alive **at 6 weeks after first positive invasive MRSA culture and was** no longer receiving treatment **for the MRSA infection;**

____ **Patient** remained in hospital alive **at 6 weeks after the first positive invasive MRSA culture and was** still receiving antibiotic treatment **for MRSA infection;**

____ **Patient was** discharged **from hospital** while receiving antibiotic treatment **for the MRSA infection with loss to follow-up before 6 weeks (no follow-up information available);**

____ Recovered and Discharged **from invasive MRSA infection 6 weeks after first positive invasive MRSA culture and** no longer receiving treatment.

____ Discharged and readmitted because of the invasive MRSA **within 6 weeks of the invasive MRSA infection culture date.**

8.1.2 CNISP/CHEC MSSA Outcomes Study Questionnaire

CONTROL Questionnaire (for MSSA invasive cases only)

1. CNISP/CHEC site id #_____ *(e.g., 07A)*

2. Study ID_____ *(start with #1, this number will be the same number as its matched case number)*

Section A: Study Participation Criteria

3. This patient has a positive culture for: ___ MSSA

4. Please specify whether MSSA lab isolate is still available to forward to Sunnybrook and Women=s college Health sciences centre:

___Yes isolate is available and will be sent _____ No isolate is not available

5. The positive culture was obtained from a normally sterile site: ____ Yes _____ No

Section B: Specimen Information

6. Site of isolate ***(if the site is NOT listed below then this patient does not meet the criteria for participation in this study)*****:**
(Please check all that apply if > 1 positive culture taken on date of first positive culture date)

Invasive Isolate Specimen Type	Date of first culture (mm/dd/yyyy)
___ 1. Blood	
___ 2. Synovial fluid	
___ 3. Pleural fluid	
___ 4. Pericardial fluid	
___ 5. Ascites/peritoneal fluid	
___ 6. Tissue *(not sinus or skin)*	
___ 7. Cerebrospinal fluid *(CSF)*	

Definition of Date of first positive culture : **This is the date that the culture was collected or obtained from the patient and is NOT the date of the positive culture result.**

Section C: Patient Information

7. Date of Birth ____/____/_____ *NOTE: Patient must be at least 18 years of age to participate in this study*
mm/ dd/ yyyy

8. Patient had been admitted to hospital during this MSSA invasive infection
____ 1. Yes ____ 2. No

9. Gender: ___ Male ___ Female

10. Date of hospital admission: ___/___/_____
mm/dd/yyyy

11. Date of Discharge: ___/___/_____ *(if applicable)*
mm/dd/yyyy

12.Date of Death: ___/___/_____ *(if applicable)*
mm/dd/ yyyy

13. Information about the MSSA Infection ***(chart must be reviewed to collect the following information)***

A. Source

__ **Nosocomial** ***(see case definitions in data dictionary)***
__ **Community**

B. Type of MSSA Infection *(see appendix for infection definitions)*
(Check all that apply)- remember that cases may have > 1 MSSA of infection, **but at least one of the MSSA infections must be from one from the afore mentioned sterile sites and the 2nd infection must be within 7 days of the first positive culture.**

___ **1. MSSA Surgical wound infection**
___ Incisional ___ Deep

___ 2. Primary MSSA bloodstream infection
(including catheter-associated bacteremia={culture + from site of tip)

___ **Primary bloodstream(no catheter no other focus)**

___ **Catheter associated {blood culture+catheter tip positive with MSSA)**

___ **3. Secondary MSSA bloodstream infection (positive blood culture + other focus)**

___ **4. MSSA Pneumonia**

___ **5. MSSA Urinary tract infection**

___ **6. MSSA Bone and/or joint infection**

_____ Osteomyelitis ___Joint/bursa ___Vertebral disk space

___ **7. Cardiovascular system MSSA infection**

___ **arterial/venous** ___ **endocarditis**

___ **myocarditis or pericarditis** ___ **mediastinitis**

___ **8. Central nervous system MSSA infection**

___ **9. Eye, ear, nose, throat, and mouth MSSA infection**

___ **10. Gastrointestinal system MSSA infection**

___ **11.Lower respiratory tract MSSA infection (excluding pneumonia)**

___ **12.Reproductive tract MSSA infection**

___ **13.Skin and soft tissue MSSA infection**

C. Any other infection *(see appendix for infection definitions) - other than an MSSA infection*

Did the patient have <u>other non-MSSA infections</u> at the same time (on the same date) as the MSSA infection was identified or within 7 days of identification of the MRSA infection? (Check all that apply- remember that cases may have > 1 of infection)

___ **1. Surgical wound infection**

___ Incisional ___ Deep

___ 2. Primary bloodstream infection
(including catheter-associated bacteremia={culture + from site of tip)

___ Primary bloodstream(no catheter no other focus)

___ Catheter associated {blood culture+catheter positive tip)

___ 3. Secondary bloodstream infection (positive blood culture + other focus)

___ 4. Pneumonia

___ 5. Urinary tract infection

___ 6. Bone and/or joint infection

_____ Osteomyelitis ___Joint/bursa ___Vertebral disk space

___ 7. Cardiovascular system infection

___ arterial/venous ___ endocarditis

___ myocarditis or pericarditis ___ mediastinitis

___ 8. Central nervous system infection

___ 9. Eye, ear, nose, throat, and mouth infection

___10. Gastrointestinal system infection

___11. Lower respiratory tract infection (excluding pneumonia)

___12. Reproductive tract infection

___13. Skin and soft tissue infection

14. Previous residing location prior to the admission.

___Home (private residence)
___Rehabilitation Facility
___Long term care/nursing home
___Other, please specify _____

15. Service Patient on at onset of symptoms of MSSA infection (best judgement call):

___ ICU ___ Outpatient

___Non-ICU (in hospital) ___ Unknown

Section D: Patient History

16. Please indicate if the patient has had any of the following devices in the 7 days prior to the date of the first invasive positive MSSA culture (*Check all that apply*)

___Indwelling urinary catheter ___ Tracheostomy
___Mechanical ventilation ___ Peritoneal dialysis catheter
___Central venous catheter ___ Other, specify
_____

___ Nasogastric tube or feeding tube

17. In the 6 months prior to the first invasive positive MSSA culture did the patient have (check all that apply):

___Positive MRSA culture	___ infection	___ colonization
___Positive MSSA culture	___ infection	___ colonization
___Positive VRE culture	___ infection	___ colonization

18. On the same day as the first invasive positive MSSA culture was the patient known to be colonized or infected with any of the following (check all that apply):

___VRE	___ Colonized	___ Infected
___Clostridium difficile		
___ESBL organism	___ Colonized	___ Infected
___ Other multi-drug resistant organism.		
Specify organism_____	___Colonized	___ Infected

19. From the date of first invasive positive MSSA culture, had the patient been in the ICU in the previous 30 days?

___ Yes, Number of days in ICU? _____ (days)

___ No

20. From the date of the first invasive positive MSSA culture, did the patient have surgery in the previous 30 days?

_____ Yes ____ No

(if yes specify surgical procedure)

Surgical Procedure
1._____
2._____
3._____
4._____
5._____
6._____
7._____
8._____
9._____

21. From the date of first positive invasive MSSA culture, had the patient received immunosuppressive therapy in the previous 7 days?*(Therapies include chemotherapy, corticosteroids, azathioprine, cyclosporine, tacrolimus, sirolimus, cyclophosphamide, methotrexate, remicade)*.

___ Yes
___ No

22. On the day of first positive invasive MSSA culture, was the patient neutropenic (neutrophil count < 500 cells/mm^3, granulocytes <1000/mm^3) or if no WBC count done on that day use your best judgement to decide whether patient was likely to be neutropenic.

___ Yes, Total number of days of neutropenia _____ days
___ No

23. From the date of first positive invasive MSSA culture, had the patient received dialysis in the previous 7 days?

___ Yes
___ No

24. Was there an ID consult after the first positive MSSA culture was identified for this episode of infection?

___ **Yes**
___ **No**

Section E: Antibiotic Use

25. History of Antibiotic Use

Please list all systemic antibiotics given to the patient in the 4 weeks prior to the date of the first invasive positive MSSA culture (Do not include topical or inhaled antibiotics).

See Antibiotic Codes

Indicate the Antibiotic Code (one code per box) below:

Antibiotic Code (##)	Antibiotic Code (##)

26. Empiric Antibiotic therapy

Did this patient receive empiric therapy (antibiotics given between the time the culture was obtained and the first positive culture result for MSSA)

___ **Yes**
___ **No**

If Yes, Please list the empiric antibiotics given:

Antibiotic Code	Start date (mm/dd/yyyy)	Stop Date (mm/dd/yyyy)

27. Antibiotic Use <u>after</u> invasive MSSA positive culture
Please list all antibiotics and the start and stop dates given to this patient up to and including <u>28 days after the date of the first positive invasive MSSA culture was reported</u> (Do not include topical or inhaled antibiotics).

Antibiotic Code	Start date (mm/dd/yyyy)	Stop date (mm/dd/yyyy)

Section F: Comorbid conditions (Charlson Comorbidity Index)

28. At the time of admission was the patient identified with any of the following comorbidities or conditions?

Myocardial

___ Myocardial infarction **= 1 or more definite or probably event(s), hospitalization with ECG +/or enzyme changes (this includes past or present)**

___ Congestive heart failure **= patient with exertional or paroxysmal nocturnal dyspnea and who have responded symptomatically (or on physical examination) to digitalis, diuretics, or afterload reducing agents**

Vascular

___ Peripheral vascular **= patient with intermittent claudication or those who had a bypass for arterial insufficiency, those with gangrene or acute arterial insufficiency and those with an untreated thoracic or abdominal aneurysm (6cm or more)**

___ Cerebrovascular disease **= patients with a history of a CVA with minor or no residua and transient ischemic attacks**

Pulmonary ___ Pulmonary disease **= includes both mild (dyspneic with moderate activity without treatment or those who are dyspneic only with attacks), moderate (dyspneic with slight activity, with or without treatment and those who are dyspneic with moderate ability despite treatment) and severe (dyspneic at rest, despite treatment, those who require constant oxygen, those with CO_2 retention and those with a baseline PO_2 below 50 torr)**

Neurologic ___ Dementia **= patients with chronic cognitive deficit**

___ Paralysis **= patients with hemiplegia or paraplegia whether it occurred as a result of a CVA or other condition (past and present)**

Endocrine

___ Diabetes with end organ damage**= patients with retinopathy, neuropathy or nephropathy**

___ Diabetes **= patients with previous hospitalizations for ketoacidosis, hyperosmolar coma, or control and those with juvenile onset of brittle diabetics as well as other diabetes treated with insulin or oral hypoglycemics but not diet alone**

Renal

___ Renal disease (moderate or severe) = **patients on dialysis, those who had a transplant, those with uremia or with serum creatinines of > 3mg%**

Liver

___ Moderate to severe liver disease = **patients with cirrhosis, portal hypertension and a history of variceal bleeding (severe) or no bleeding (moderate)**

___ Mild liver disease **= cirrhosis without portal hypertension or chronic hepatitis**

Gastrointestinal

___ Peptic/duodenal ulcer = **patients who have required treatment for ulcer disease including those who have bled from ulcers**

Cancer/Immune

___ Tumour **= patients with solid tumours without documented metastases, but initially treated <u>in the last 5 years</u>, including breast, colon, lung, and a variety of other tumours**

___ Lymphoma **= includes patients with Hodgkins, lymphosarcoma, Waldenstrom=s macroglobulinemia, myeloma, and other lymphomas**

___ Leukemia = **patients with acute and chronic myelogenous leukemia, acute and chronic lymphocytic leukemia, and polycythemia vera**

___ AIDS **= patients with definite or probable acquired immune deficiency syndrome**

___ Metastatic cancer = **patients with metastatic solid tumours, including breast, lung, colon and other tumours**

Miscellaneous

___ Rheumatologic disease **= patients with systemic lupus erythematous, polymyositis, mixed connective tissue disease, polymyalgia rheumatica and moderate to severe rheumatoid arthritis**

IV Drug Use ___ **Was the patient know to use recreational intravenous drugs within the past year?**

Section G: Severity of the Acute MSSA Infection

29. To the best of your judgement, did the patient have any of the following as a result of this MSSA infection?

A. **Need for transfer to ICU within 48hrs before or after date of first positive invasive MRSA culture?**

___ **Yes** ___ **No**

B. **Renal insufficiency (a serum creatinine level of >176 ug/ml {>2.0mg/dl or >200mMol/L} or double the baseline or dialysis initiated)within 7 days of first positive culture.**

___ **Yes** ___ **No**

C. **Hepatic dysfunction (a serum bilirubin concentration of >3mg/dl or increased aspartate aminotransierase or alanine aminotransferase levels more than twice the baseline)within 7 days of the first positive culture.**

___ **Yes** ___ **No**

D. **Respiratory difficulty (new partial arterial 0_2 pressure of <60 mm Hg, new partial arterial CO_2 pressure of > 50mm HG, or initiation of ventilatory assistance) within 48 hours.**

___ **Yes** ___ **No**

E. **Neurological dysfunction (change in consciousness level) within 48 hours.**

___ **Yes** ___ **No**

F. **Septic shock (sepsis associated with evidence of organ hypoperfusion and a systolic blood pressure <90 or > 30 mm HG less than the baseline value or a requirement for the use of vasopressors to maintain blood pressure)within 48 hours.**

___ **Yes** ___ **No**

G. **Coagulopathy (marked reductions in blood concentrations of platelets and coagulation factors in the peripheral blood or a physician reported DIC or coagulopathy in the chart) within 48 hours.**

___ **Yes** ___ **No**

Section H: Outcomes

30. Six weeks after the date of first positive invasive MSSA culture:

____**Patient** died before or during treatment **for first invasive positive MSSA culture (e.g., patient died while on antibiotics for the infection);**

____ **Patient** died after completion of treatment **for MSSA infection but within 6 weeks of first positive invasive MRSA culture (e.g., patient died after completion of antibiotics);**

____ **Patient** remained in hospital alive **at 6 weeks after first positive invasive MSSA culture and was** no longer receiving treatment **for the MSSA infection;**

____ **Patient** remained in hospital alive **at 6 weeks after the first positive invasive MSSA culture and was** still receiving antibiotic treatment **for MSSA infection;**

____ **Patient was** discharged **from hospital** while receiving antibiotic treatment **for the MSSA infection with loss to follow-up before 6 weeks (no follow-up information available);**

____ Recovered and Discharged **from invasive MSSA infection 6 weeks after first positive invasive MSSA culture and** no longer receiving treatment**.**

____ Discharged and readmitted because of the invasive MSSA **within 6 weeks of the invasive MSSA infection culture date.**

8.1.3 MRSA/MSSA Outcomes Questionnaire - Data Dictionary

1. CNISP/CHEC site id #: **this is your CHEC sites unique hospital identifier that was assigned to you by CNISP when you began participation in the CNISP program. If you are not sure what you number is please speak to you CHEC member.**

2. Study ID: **This is a number assigned by the person filling out this questionnaire and is a unique number for each CASE questionnaire. The matched CONTROL questionnaire will have the same unique study ID entered into this spot so that the matching of case and control can be done using this number.**

3. Positive Culture: **This patient has either a positive MRSA or MSSA culture identified by routine bacteriologic procedures performed at the facilities laboratory. MRSA cultures have oxacillin minimal inhibitory concentrations (MIC) of $4mg/ml^2$, grown on oxacillin screen plates.**

4. CNISP unique identifier: **Since this project is retrospective and we are looking at MRSA cases from the years 2001 and 2002 the MRSA cases identified will have already been entered into the CNISP MRSA surveillance program. The unique identifier that was assigned to this patient should be entered here.**

5. Normally sterile site: **Normally sterile sites for this project include only the following selected isolate specimen types. If the type is not listed below this patient is not eligible to participate in this project.**

Acceptable sites are: Blood, synovial fluid, pleural fluid, pericardial fluid, ascites/peritoneal fluid, tissue (not sinus or skin) and cerebrospinal fluid (CSF).

6. Site of Isolate: **Only the afore mentioned selected specimens are acceptable. Only the FIRST isolate for this patient will be used. Therefore if the patient has more than 1 positive sterile site isolate in the 2 year of surveillance under investigation it will be only the first one that meets the criteria that will be used for this project. The month, day and year of this culture MUST be collected since this is the date that will be used for as the first day of invasive disease infection.**

7. Date of Birth: **This is the date of birth of the patient**

8. Admission to Hospital: **This is collected to ensure that all cases meet the criteria of being admitted to hospital for the study. If case was never admitted they are not eligible (i.e., Patient identified in ER and sent home or back to long term care facility).**

9. Gender: **The sex of the patient (male or female).**

10. Date of hospital admission: **The date of the patients= admission to hospital.**

11. Date of Discharge: **If patient was discharged from hospital please enter the date. If patient still in hospital or patient died please leave blank. If patient died the date of death will be collected.**

12. Date of Death: **If patient died within 6 weeks of the date of the first positive culture than the date of death should be entered. Patients will only be followed in time for 6 weeks so if death occurred after the six week period please leave this field blank.**

13. Type of Infection:

A.) SOURCE

Nosocomial**-the culture was positive for MRSA or MSSA and was performed 72 hours after date of admission with no clinical evidence of infection (fever, leukocytosis, or other signs and symptoms) present on admission.**

Community**-An infection that does not meet the definition of nosocomial. This means that patient was culture positive for MRSA or MSSA within 72 hours of admission and/or showed clinical evidence of infection on admission, with no previous hospitalization within the previous 2 weeks.**

B.) TYPE OF MRSA/MSSA INFECTION

For each of the infections listed in this section please refer to Appendix A, section 8.1.4 for the definitions for each of these infections. Please note that this section refers only to MRSA or MSSA infections and all other infections are collected in the following section. Since multiple MRSA or MSSA infections can occur at the same time please check all that apply. If a patient has an MRSA and MSSA infection list the MSSA infection under section C. If the patient has > 1 MRSA infection the first infection must be the one that meets the case definition for a positive invasive MRSA infection and the second MRSA infection must occur within 7 days after the first one was identified.

C.) ANY OTHER INFECTION

For this section the same Appendix A, section 8.1.4 definitions for infections should be used except this section collects infections that are non-MRSA/MSSA infections. Since multiple infections can occur to the same patient at the same time please check off all that apply

14. Previous residing location: **This is the place/residence type in which the patient was living in prior to this admission.**

15. Service at onset of infection: **This is the service/ward the patient was when the infection first took place (not the service where isolate was collected). This is a best judgment call. According to your professional best judgment what service of the ones listed was the patient most likely on when they acquired the MRSA or MSSA infection.**

16. Devices: **In the 7 day period prior to the date of the first invasive positive MRSA or MSSA culture did the patient have any of the listed devices for any period of time.**

17. MRSA/MSSA infection in 6 month prior period: **In the 6 month period prior to the date of the cases= first invasive positive MRSA/MSSA culture did the patient have a positive culture for MRSA or MSSA and if yes, did the patient have and infection or colonization with the organism.**

18. Other Organisms of interest: **On the date that the first positive MRSA or MSSA invasive culture was identified did the patient have any of the other listed organisms identified.**

19. Previous ICU admission: **In the 30 days prior to the date of the first positive MRSA/MSSA infection had the patient been admitted to the ICU and if yes please indicate the number of days the patient was in the ICU.**

20. Surgery: **In the 30 days prior to the date of the first positive MRSA/MSSA infection had the patient received a surgical procedure? If yes, please write right down the name of the procedure.**

21. Immunosuppressive therapy: **In the 7 days prior to the first positive MRSA/MSSA infection did the patient receive any of the listed therapies.**

22. Neutropenic: **On the day of the first positive invasive MRSA/MSSA culture, was the patient neutropenic (neutrophil count < 500 cells/mm^3) or in no WBC count done on that day use your best judgment to decide whether the patient was likely to be neutropenic. List the number of days the patient was neutropenic.**

23. Dialysis: **In the 7 days prior to the first positive MRSA/MSSA culture, had the patient received any type of dialysis (renal or peritoneal)?**

24. ID consult: **In the charts is there any indication that and infectious disease physician was consulted with respect to the patient MRSA/MSSA infection?**

25. History of Antibiotic Use: **List all systemic (not topical or inhaled) antibiotics prescribed and taken by the patient in the 4 weeks PRIOR to the date of the first positive MRSA/MSSA culture. Please refer to Appendix A, section 8.1.5 for a list of the codes assigned to each of the antibiotics. In the chart simply write the code number of the drug that was taken by the patient.**

26. Empiric Antibiotic Therapy: **In the time between when the culture was taken (suspicion of infection) and the time that the results of the culture were received (the organism was identified as either MRSA or MSSA) were any antibiotics (different than the ones listed in the history section) given specifically due to the suspected infection. If yes list the codes in the chart provided using Appendix A, section 8.1.5 for the Antibiotics, including start and stop dates.**

27. Antibiotic Use after culture received: **List the codes for the Antibiotics given once the results of the culture were received (using Appendix A, section 8.1.5) with start and stop dates.**

28. Comorbid Conditions: **The Charlson Comorbidity Index is a widely used reliable and valid scale that measures severity of comorbid conditions. Each condition was assigned a weight of either 1 or 2 depending on severity. The total of the scores is added up and the results are on a scale from 0- 30 points with the higher the number the greater the patients= severity of comorbid conditions. Upon admission date of the patient, did they have any of the listed comorbidities or conditions?**

29. Severity of the Acute MRSA/MSSA Infection: **According to your best judgment, did this MRSA/MSSA infection result in any of the following things listed.**

A) Transfer to ICU: **Did the patient need to be transferred to an ICU within 48hrs before or after date of first positive invasive MRSA/MSSA culture?**

B.) Renal insufficiency**: patient had a serum creatinine level of >176 ug/ml {>2.0mg/dl or >200mMol/L} or double the baseline or dialysis initiated, within 7 days.**

C.) Hepatic dysfunction: **patient had a serum bilirubin concentration of >3mg/dl or increased aspartate aminotransierase or alanine aminotransferase levels more than twice the baseline, within 7days.**

D.) Respiratory difficulty: **patient had a new partial arterial 0_2 pressure of <60 mm Hg, new partial arterial CO_2 pressure of > 50mm HG, or initiation of ventilatory assistance, within 48 hours before or after first positive invasive MRSA/MSSA culture.**

E.) Neurological dysfunction: **patient had a change in consciousness level, within 48 hours.**

F.) Septic shock: **patient had sepsis associated with evidence of organ hypoperfusion and a systolic blood pressure <90 or > 30 mm HG less than the baseline value or a requirement for the use of vasopressors to maintain blood pressure, within 48 hours.**

G.) Coagulopathy**: patient had a marked reduction in blood concentrations of platelets and coagulation factors in the peripheral blood or a physician reported DIC or coagulopathy in the chart, within 48 hrs.**

30. Outcomes: **Six weeks after the date of first positive invasive MRSA/MSSA culture one of the following occurred, please check off the one that describes the condition of the patient at the 6-week mark.**

___ **Patient** <u>died before or during treatment</u> **for first invasive positive MRSA culture (e.g., patient died while on antibiotics for the infection);**

___ **Patient** died after completion of treatment **for MRSA infection but within 6 weeks of first positive invasive MRSA culture (e.g., patient died after completion of antibiotics);**

___ **Patient** remained in hospital alive **at 6 weeks after first positive invasive MRSA culture and was** no longer receiving treatment **for the MRSA infection;**

___ **Patient** remained in hospital alive **at 6 weeks after the first positive invasive MRSA culture and was** still receiving antibiotic treatment **for MRSA infection;**

___ **Patient was** discharged **from hospital** while receiving antibiotic treatment **for the MRSA infection with loss to follow-up before 6 weeks (no follow-up information available);**

___ Recovered and Discharged **from invasive MRSA infection 6 weeks after first positive invasive MRSA culture and** no longer receiving treatment**.**

___ Discharged and readmitted because of the invasive MRSA **within 6 weeks of the invasive MRSA infection culture date.**

8.1.4 DEFINITIONS FOR NOSOCOMIAL INFECTIONS

Adapted from the Centers for Disease Control and Prevention and the Centers for Disease Prevention and Control, Health Canada

Definitions for surgical wound infection, bloodstream infection, pneumonia, and urinary tract infection are presented first and followed by other sites of infections listed alphabetically.

SURGICAL WOUND INFECTIONS

Surgical wound infection includes incisional surgical wound infection and deep surgical wound infection.

Incisional surgical wound infection **must meet the following criterion:**

Infection occurs at incision site within 30 days after surgery
AND
involves skin, subcutaneous tissue, or muscle located above the fascial layer
AND ANY of the following:

1. **Purulent drainage from incision or drain located above fascial layer**
2. **Organism isolated from culture of fluid or from incisional wound**
3. **Surgeon deliberately opens wound, unless wound is culture-negative**
4. **Surgeon or attending physician diagnosis of infection**

Deep surgical wound infection **musts meet the following criterion:**

Infection occurs at operative site within 30 days after surgery if no implant is left in place or within one year if implant is in place
AND
infection appears related to surgery
AND
infection involves tissues or spaces at or beneath fascial layer
AND ANY of the following:

1. **Purulent drainage from drain placed beneath fascial layer**
2. **Wound spontaneously dehisces or is deliberately opened by surgeon when patient has fever (> 38□C) and/or localized pain or tenderness, unless wound is culture negative**
3. **An abscess or other evidence of infection seen on direct examination, during surgery, or by histopathologic examination**
4. **Surgeon diagnosis of infection**

PRIMARY BLOODSTREAM INFECTION

Primary bloodstream infection includes laboratory-confirmed bloodstream infection.

Laboratory-confirmed bloodstream infection **must meet ONE of the following criteria:**

1. **Recognized pathogen isolated from blood culture**
   AND
   pathogen is not related to infection at another site.
2. **ONE of the following:**
   Fever (>38□C),
   chills, or
   hypotension

   AND ANY of the following:
   a. Common skin contaminant isolated from two blood cultures drawn on separate occasions
   AND

organism is not related to infection at another site

b. Common skin contaminant isolated from blood culture from patient with intravascular access device
AND
physician institutes appropriate antimicrobial therapy

c. Positive antigen test on blood
AND
organism is not related to infection at another site.

SECONDARY BLOODSTREAM INFECTION

Secondary bloodstream infection includes laboratory-confirmed bloodstream infection.

Laboratory-confirmed secondary bloodstream infection must include the following:
ONE of the following criteria with no other recognized cause:
fever (>38ÌC), or
hypotension (systolic BP>90mmHg) or
oliguria < 20ml/hr
AND ALL of the following:
1. Blood culture done and organisms or antigen detected in blood;
AND
2. Organism isolated from blood is compatible with a related nosocomial infection;
AND
3. Physician institutes appropriate treatment for sepsis

PNEUMONIA

Pneumonia is defined separately from other infections of the lower respiratory tract. The criteria for pneumonia involve various combinations of clinical, radiographic, and laboratory evidence of infection. In general, expectorated sputum cultures are not useful in diagnosing pneumonia but may help identify the etiologic agent and provide useful antimicrobial susceptibility data. Findings from serial chest x-ray studies may be more helpful than those from a single x-ray film

Pneumonia must meet ONE of the following criteria:

1. Rales or dullness to percussion on physical examination of chest

AND ANY of the following;
a. New onset of purulent sputum or change in character of sputum
b. Organism isolated from blood culture
c. Isolation of pathogen from specimen obtained by transtracheal aspirate, bronchial brushing, or biopsy

2. Chest radiographic examination shows new or progressive infiltrate, consolidation, cavitation, or pleural effusion
AND ANY of the following:
a. New onset of purulent sputum or change in character of sputum
b. Organism isolated from blood culture
c. Isolation of pathogen from specimen obtained by transtracheal aspirate, bronchial brushing, or biopsy
d. Isolation of virus or detection of viral antigen in respiratory secretions
e. Diagnostic single antibody titre (IgM) or fourfold increase in paired serum samples (IgG) for pathogen
f. Histopathologic evidence of pneumonia

URINARY TRACT INFECTION

Urinary tract infection includes symptomatic urinary tract infection, asymptomatic bacteriuria, and other infections of the urinary tract.

Symptomatic urinary tract infection **must meet ONE of the following with no other recognized cause:**

1. **fever (>38°C),**
   urgency,
   frequency,
   dysuria, or
   suprapubic tenderness
   AND
   a positive urine culture*[1] of $>10^8$ colonies/ml urine with no more than two species of organisms

OR

2. **TWO of the following with no other recognized cause:**
   fever (>38°C),
   urgency,
   frequency,
   dysuria, or
   suprapubic tenderness
   AND ANY of the following:
   a. Dipstick test positive for leukocyte esterase and/or nitrate
   b. Pyuria (>0 white blood cells [WBC]/ml^3 or >3 WBC/high-power field of unspun urine)
   c. Organisms seen on Gram stain of unspun urine
   d. Two urine cultures with repeated isolation of the same uropathogen†[2] with $>10^5$ colonies/ml urine in nonvoided specimens
   e. Urine culture with $>10^8$ colonies/ml urine of single uropathogen in patient being treated with appropriate antimicrobial therapy
   f. Physicians diagnosis
   g. Physician institutes appropriate antimicrobial therapy for UTI

Asymptomatic bacteriuria **must meet either of the following criteria:**

1. **An indwelling urinary catheter is present within 7 days before urine is cultured**

AND patient has NO
fever (>38°C),
urgency,
frequency,
dysuria, or

---

[1] *** For urine specimens to be of value in determining whether a nosocomial infection exists, they must be obtained aseptically using an appropriate technique, such as clean catch collection, bladder catheterization, or suprapubic aspiration**

[2] **†Gram-negative bacteria or *Staphylococcus saprophyticus***

suprapubic tenderness
AND has
urine culture of >10^5 organisms/ml urine with no more than two species of organisms.

AND

2. No indwelling urinary catheter was present within 7 days before the first of two urine cultures with >10^5 organisms/ml urine of the same organism with no more than two species of organisms,
AND patient has NO
fever (>38°C),
urgency,
frequency,
dysuria, or
suprapubic tenderness.

Other infections of the urinary tract (kidney, ureter, bladder, urethra, or tissues surrounding the retroperitoneal or perinephric spaces) must meet ONE of the following criteria:

1. Organism isolated from culture of fluid (other than urine) or tissue from affected site
2. An abscess or other evidence of infection seen on direct examination, during surgery, or by histopathologic examination
3. TWO of the following:
fever (>38□C),
localized pain, or tenderness at involved site
AND ANY of the following:
a. Purulent drainage from affected site
b. Organism isolated from blood culture
c. Radiographic evidence of infection *[3]
d. Physician=s diagnosis
e. Physician institutes appropriate antimicrobial therapy

BONE AND JOINT INFECTION

Bone and joint infection includes osteomyelitis, joint or bursa infection, and vertebral disk infection.

Osteomyelitis must meet ONE of the following criteria:

1. Organism cultured from bone
2. Evidence of osteomyelitis seen during surgery or by histopathologic examination
3. TWO of the following with no other recognized cause:
fever (>38°C),
localized swelling,
tenderness,
heat, or
drainage at suspected site of infection
AND ANY of the following:
a. Organism isolated from blood culture

---

[3] **Radiographic evidence of infection includes abnormal results of ultrasound examination, CT scan, magnetic resonance imaging, or radiolabel scan (e.g., gallium or technetium).*

b. Positive antigen test on blood
c. Radiographic evidence of infection

Joint or bursa infection must meet ONE of the following criteria:

1. Organism isolated from culture of joint fluid or synovial biopsy
2. Evidence of joint or bursa infection seen during surgery or by histopathologic examination
3. TWO of the following with no other recognized cause:
   joint pain,
   swelling,
   tenderness,
   heat,

   evidence of effusion or limitation of motion
   AND ANY of the following:
   a. Organisms and white blood cells seen on Gram stain of joint fluid
   b. Positive antigen test on blood, urine, or joint fluid
   c. Cellular profile and chemistries of joint fluid compatible with infection and not explained by underlying rheumatologic disorder
   d. Radiographic evidence of infection

Vertebral disk space infection must meet ONE of the following criteria:

1. Organism isolated from culture of involved site tissue obtained during surgery or needle aspiration
2. Evidence of infection at involved site seen during surgery or by histopathologic examination
3. Fever (>38□C) with no other recognized cause or pain at involved site
   AND
   radiographic evidence of infection
4. Fever (>38°C) with no other recognized cause
   AND
   pain at involved site
   AND
   positive antigen test on blood or urine

CARDIOVASCULAR SYSTEM INFECTION

Cardiovascular system infection includes arterial or venous infection, endocarditis, myocarditis or pericarditis, and mediastinitis. Mediastinitis is grouped with cardiovascular system infections because it is most often occurs after cardiac surgery.

Arterial venous infection must meet ONE of the following criteria:

1. Organism isolated from culture of arteries or veins removed during surgery
   AND
   blood culture not done or no organism isolated from blood culture
2. Evidence of infection at involved vascular site seen during surgery or by histopathologic examination
3. ONE of the following:
   fever (>38°C),
   pain,
   erythema, or
   heat at involved vascular site
   AND BOTH of the following:
   a. More than 15 colonies cultured from intravascular cannula tip using semiquantitative culture method
   b. Blood culture not done or no organism isolated from blood culture

4. Purulent drainage at involved vascular site
   AND
   blood culture not done or no organism isolated from blood culture

Endocarditis of natural prosthetic heart valve must meet ONE of the following criteria:

1. Organism isolated from culture of valve or vegetation
2. TWO of the following with no other recognized cause:
   fever (>38°C),
   new or changing murmur;
   embolic phenomena,
   skin manifestations (i.e., petechiae, splinter hemorrhages, painful subcutaneous nodules), congestive heart failure, or cardiac conduction abnormality
   AND
   physician institutes appropriate antimicrobial therapy if diagnosis is made antemortem
   AND ANY of the following:
   a. Organism isolated from two blood cultures
   b. Organisms seen on Gram stain of valve when culture is negative or not done
   c. Valvular vegetation seen during surgery or autopsy
   d. Positive antigen test on blood or urine
   e. Evidence of new vegetation seen on echo-cardiogram

Myocarditis or pericarditis must meet ONE of the following criteria:

1. Organism isolated from culture of pericardial tissue of fluid obtained by needle aspiration or during surgery
2. TWO of the following with no other recognized cause:
   fever (>38°C),
   chest pain,
   paradoxical pulse, or
   increased heart size
   AND ANY of the following:
   a. Abnormal electrocardiogram (ECG) consistent with myocarditis or pericarditis
   b. Positive antigen test on blood
   c. Evidence of myocarditis or pericarditis on histologic examination of heart tissue
   d. Fourfold rise in type-specific antibody with or without isolation of virus from pharynx or feces
   e. Pericardial effusion identified by echo-cardiogram, CT scan, magnetic resonance imaging, angiography, or other radiographic evidence of infection

Mediastinitis must meet ONE of the following criteria:

1. Organism isolated from culture of mediastinal tissue or fluid obtained during surgery or needle aspiration
2. Evidence of mediastinitis that is seen during surgery or by histopathologic examination
3. ONE of the following:
   fever (>38□C),
   chest pain, or
   sternal instability
   AND ANY of the following:
   a. Purulent drainage from mediastinal area
   b. Organism isolated from blood culture or culture of drainage from mediastinal area
   c. Mediastinal widening on x-ray examination

CENTRAL NERVOUS SYSTEM INFECTION

Central nervous system infection includes intracranial infection, meningitis or ventriculitis, and spinal abscess without meningitis.

Intracranial infection **(brain abscess, sub-dural or epidural infection, and encephalitis) must meet ONE of the following criteria:**

1. **Organism isolated from culture of brain tissue or dura**
2. **Abscess or evidence of intracranial infection seen during surgery or by histopathologic examination**
3. **TWO of the following with no other recognized cause:**
   headache,
   dizziness,
   fever (>38°C),
   localizing neurologic signs,
   changing level of consciousness, or confusion,
   AND
   physician institutes appropriate antimicrobial therapy if diagnosis is made antemortem
   AND ANY of the following:
   a. Organism seen on microscopic examination of brain or abscess tissue obtained by needle aspiration or by biopsy during surgery or autopsy
   b. Positive antigen test on blood or urine
   c. Radiographic evidence of infection
   d. Diagnostic single antibody titre (IgM) or fourfold increase in paired serum samples (IgG) for pathogen
   e. Positive antigen test on blood or urine
   f. Radiographic evidence of infection
   g. Diagnostic single antibody titre (IgM) or fourfold increase in paired serum samples (IgG) for pathogen

Meningitis or ventriculitis **must meet ONE of the following criteria:**

1. **Organism isolated from culture of cerebrospinal fluid (CSF)**
2. **ONE of the following with no other recognized cause:**
   fever (>38°C),
   headache,
   stiff neck,
   meningeal signs,
   cranial nerve signs, or
   irritability,
   AND
   physician institutes appropriate antimicrobial therapy if diagnosis is made antemortem
   AND ANY of the following:
   a. Increased white cells, elevated protein, and/or decreased glucose in CSF
   b. Organisms seen on Gram stain of CSF
   c. Organism isolated from blood culture
   d. Positive antigen test on CSF, blood, or urine

e. Diagnostic single antibody titre (IgM) or fourfold increase in paired serum samples (IgG) for pathogen

Spinal abscess without meningitis (an abscess of spinal epidural or subdural space, without involvement of the CSF or adjacent bone structures) must meet ONE of the following criteria:

1. Organism isolated from culture of abscess in spinal epidural or subdural space
2. Abscess in spinal epidural or subdural space seen during surgery or autopsy or by histopathologic examination
3. ONE of the following with no other recognized cause:
   fever (>38°C),
   back pain,
   focal tenderness,
   radiculitis,
   paraparesis, or
   paraplegia
   AND
   physician institutes appropriate antimicrobial therapy if diagnosis is made antemortem
   AND either of the following:
   a. Organism isolated from blood culture
   b. Radiographic evidence of spinal abscess

EYE, EAR, NOSE, THROAT, AND MOUTH INFECTION

Eye infection includes conjunctivitis and other eye infections. Ear infections include otitis externa, otitis media, otitis interna, and mastoiditis. Nose, throat, and mouth infections include oral cavity infections,upper respiratory infections, and sinusitis.

Conjunctivitis must meet either of the following criteria:

1. Pathogen isolated from culture of purulent exudate obtained from conjunctiva or contiguous tissues, such as eyelid, cornea, meibomian glands, or lacrimal glands
2. Pain or redness of conjunctivitis or around eye
   AND ANY of the following:
   a. WBCs and organisms seen on Gram stain of exudate
   b. Purulent exudate
   c. Positive antigen test on exudate or conjunctival scraping
   d. Multinucleated giant cells seen on microscopic examination of conjunctival exudate or scrapings
   e. Positive viral culture on conjunctival exudate
   f. Diagnostic single antibody titre (IgM) or fourfold increase in paired serum samples (IgG) for pathogen

Eye infections other than conjunctivitis must meet either of the following criteria:

1. Organism isolated from culture of anterior or posterior chamber or vitreous fluid
2. TWO of the following with no other recognized cause:
   eye pain,
   visual disturbance, or
   hypopyon
   AND ANY of the following:
   a. Physician=s diagnosis
   b. Positive antigen test on blood
   c. Organism isolated from blood culture

Otitis externa must meet either of the following criteria:

1. Pathogen isolated from culture of purulent drainage from ear canal
2. ONE of the following:
   fever (>38°C),
   pain,
   redness, or
   drainage from ear canal
   AND
   organism seen on Gram stain of purulent drainage

Otis media must meet either of the following criteria:

1. Organism isolated from culture of fluid from middle ear obtained by tympanocentesis or surgery
2. TWO of the following:
   fever (>38°C),
   pain in the eardrum,
   inflammation,
   retraction or decreased mobility of eardrum, or
   fluid behind eardrum

Otitis interna must meet either of the following criteria:

1. Organism isolated from culture of fluid from inner ear obtained at surgery
2. Physician=s diagnosis

Mastoiditis must meet either of the following criteria:

1. Organism isolated from culture of purulent drainage from mastoid
2. TWO of the following with no other recognized cause:
   fever (>38°C),
   pain or tenderness,
   erythema,
   headache, or
   facial paralysis
   AND either of the following:
   a. Organisms seen on Gram stain of purulent material from mastoid
   b. Positive antigen test on blood

Oral cavity infection (mouth, tongue, or gums) must meet ONE of the following criteria:

1. Organism isolated from culture of purulent material from tissues or oral cavity
2 Abscess or other evidence of oral cavity infection seen on direct examination, during surgery, or by histopathologic examination
3. ONE of the following:
   abscess,
   ulceration, or
   raised white patches on inflamed mucosa, or
   plaques on oral mucosa
   AND ANY of the following:
   a. Organisms seen on Gram stain
   b. Positive potassium hydroxide (KOH) stain
   c. Multinucleated giant cells seen on microscopic examination of mucosal scrapings
   d. Positive antigen test on oral secretions
   e. Diagnostic single antibody titre (IgM) or fourfold increase in paired serum samples (IgG) for pathogen

f. Physician's diagnosis and treatment with topical or oral antifungal therapy

Sinusitis must meet either of the following criteria:

1. Organism isolated from culture of purulent material obtained from sinus cavity
2. ONE of the following:
   fever (>38°C),
   pain or tenderness over the involved sinus,
   headache,
   purulent exudate, or
   nasal obstruction
   AND either of the following:
   a. Positive transillumination
   b. Radiographic evidence of infection

Upper respiratory and infection (pharyngitis, laryngitis, epiglottis) must meet ONE of the following criteria:

1. TWO of the following:
   fever (>38°C),
   erythema of pharynx,
   sore throat/cough/hoarseness, or
   purulent exudate in throat,
   AND ANY of the following:
   a. Organism isolated from culture of specific site
   b. Organism isolated from blood culture
   c. Positive antigen test on blood or respiratory secretions
   d. Diagnostic single antibody titre (IgM) or fourfold increase in paired serum samples (IgG) for pathogen
   e. Physician=s diagnosis

2. Abscess seen on direct examination, during surgery, or by histopathologic examination

GASTROINTESTINAL SYSTEM INFECTION

Gastrointestinal system infections include gastroenteritis, hepatitis, gastrointestinal tract infections, and intraabdominal infections not specified elsewhere.

Gastroenteritis must meet either of the following criteria:

1. Acute onset of diarrhea (liquid stools for more than 12 hours) with or without vomiting or fever (>38°C)
   AND
   no likely noninfectious cause (e.g., diagnostic tests, therapeutic regimen, acute exacerbation of a chronic condition, psychologic stress)

2. TWO of the following with no other recognized cause:
   nausea/vomiting, abdominal pain, or headache

   AND ANY of the following:
   a. Enteric pathogen isolated from stool culture or rectal swab
   b. Enteric pathogen detected by routine or electron microscopy examination
   c. Enteric pathogen detected by antigen or antibody assay on feces or blood
   d. Evidence of enteric pathogen detected by cytopathic changes in tissue culture (toxin assay)

e. Diagnostic single antibody titre (IgM) or fourfold increase in paired serum samples (IgG) for pathogen

Hepatitis must meet the following criterion:

1. TWO of the following with no other recognized cause:
   fever (>38°C),
   anorexia,
   nausea,/vomiting,
   abdominal pain,
   jaundice, or
   history of transfusion within the previous 3 months
   AND ANY of the following:
   1. Positive antigen or antibody test for hepatitis A, hepatitis B, or delta hepatitis
   2. Abnormal liver function tests (e.g., elevated alanine/aspartate aminotransferase [ALT/AST] and bilirubin)
   3. Cytomegalovirus (CMV) detected in urine or oropharyngeal secretions

Gastrointestinal (GI) tract infection (esophagus, stomach, small bowel, large bowel, and rectum), excluding gastroenteritis and appendicitis, must meet either of the following criteria:

1. Abscess or other evidence of infection seen during surgery or by histopathologic examination
2. TWO of the following with no other recognized cause and compatible with infection of the organ or tissue involved:
   fever (>38°C),
   nausea/vomiting,
   abdominal pain, or tenderness
   AND ANY of the following:
   a. Organism isolated from culture of drainage or tissue obtained during surgery or endoscopy or from surgically placed drain
   b. Organisms seen on Gram or KOH stain or multinucleated giant cells seen on microscopic examination of drainage or tissue obtained during surgery or endoscopy or from surgically placed drain
   c. Organism isolated from blood culture
   d. Radiographic evidence of infection
   e. Pathologic findings on endoscopic examination (e.g., *Candida* esophagitis or proctitis)

Intraabdominal infection (including gall-bladder, bile ducts, liver [other than viral hepatitis], spleen, pancreas, peritoneum, subphrenic or subdiaphragmatic space, or other intraabdominal tissue or area not specified elsewhere) must meet ONE of the following criteria:

1. Organism isolated from culture of purulent material from intraabdominal space obtained during surgery or needle aspiration
2. Abscess or other evidence of intraabdominal infection seen during surgery or by histopathologic examination
3. TWO of the following with no other recognized cause:
   fever (>38°C),
   nausea/vomiting,
   abdominal pain, or
   jaundice
   AND ANY of the following:
   a. Organism isolated from culture of drainage from surgically placed drain (e.g., closed suction drainage system, open drain, or T-tube drain)

b. Organisms seen on Gram stain of drainage or tissue obtained during surgery or needle aspiration
c. Organism isolated from blood culture and radiographic evidence of infection

LOWER RESPIRATORY TRACT INFECTION (EXCLUDING PNEUMONIA)

Lower respiratory tract infection (excluding pneumonia) includes infections such as bronchitis, tracheobronchitis, bronchiolitis, tracheitis, lung abscess, and empyema.

Bronchitis, tracheobronchitis, bronchiolitis, tracheitis, without evidence of pneumonia, **must meet either of the following criteria:**

1. Patient has no clinical or radiographic evidence of pneumonia
   AND has TWO of the following:
   fever (>38°C),
   cough,
   new or increased sputum production,
   rhonchi,
   wheezing,
   AND either of the following:
   a. Organism isolated from culture obtained by deep tracheal aspirate or bronchoscopy
   b. Positive antigen test on respiratory secretions

2. Patient ≤12 months of age has no clinical or radiographic evidence of pneumonia
   AND has TWO of the following with no other recognized cause:
   fever (>38°C),
   cough,
   new or increased sputum production,
   rhonchi,
   wheezing,
   respiratory distress,
   apnea, or
   bradycardia
   AND ANY of the following:
   a. Organism isolated from culture of material obtained by deep tracheal aspirate or bronchoscopy
   b. Positive antigen test on respiratory secretions
   c. Diagnostic single antibody titre (IgM) or fourfold increase in paired serum samples (IgG) for pathogen

Other infections of the lower respiratory tract **must meet ONE of the following criteria:**

1. Organisms seen on smear or isolated from culture of lung tissue or fluid, including pleural fluid
2. Lung abscess or empyema seen during surgery or by histopathologic examination
3. Abscess cavity seen on radiographic examination of lung

REPRODUCTIVE TRACT INFECTION

A group of infections that occur in obstetric and gynecology patients and in male urology patients is defined as reproductive tract infection. Such infections include endometritis, episiotomy infection, vaginal cuff infection, and other infections of the male or female reproductive tract.

Endometritis **must meet either of the following criteria:**

1. Organism isolated from culture of fluid or tissue from endometrium obtained during surgery, by needle aspiration, or by brush biopsy
2. Purulent drainage from uterus

AND TWO of the following:
fever (>38°C),
abdominal pain,
or uterine tenderness.

Episiotomy site infection must meet either of the following criteria:

1. Purulent drainage from episiotomy
2. Episiotomy abscess

Vaginal cuff infection must meet ONE of the following criteria:

1. Purulent drainage from vaginal cuff
2. Abscess at vaginal cuff
3. Pathogen isolated from culture of fluid or tissue obtained from vaginal cuff

Other infections of the male or female reproductive tract (epididymis, testes, prostate, vagina, ovaries, uterus, or other deep pelvic tissues, excluding endometritis or vaginal cuff infection) must meet ONE of the following criteria:

1. Organism isolated from culture of tissue or fluid from affected site
2. Abscess or other evidence of infection seen during surgery or by histopathologic examination
3. TWO of the following:
   fever (>38°C),
   nausea/vomiting,
   pain/tenderness,
   or dysuria
   AND either of the following:
   a. Organism isolated from blood culture
   b. Physicians diagnosis

SKIN AND SOFT TISSUE INFECTION

Skin and soft tissue infection includes skin infection (other than incisional wound infection), soft tissue infection, decubitus ulcer infection, burn infection, breast abscess or mastitis, omphalitis, infant pustulosis, and newborn circumcision infection.

Skin infection must meet either of the following criteria:

1. Purulent drainage, pustules, vesicles, or boils
2. TWO of the following at affected site: l
   localized pain or tenderness,
   swelling, redness, or heat
   AND ANY of the following:
   a. Organism isolated from culture of aspirate or drainage from affected site; if organism is normal skin flora, must be pure culture of single organism
   b. Organism isolated from blood culture
   c. Positive antigen test on infected tissue or blood
   d. Multinucleated giant cells seen on microscopic examination of affected tissue

e. Diagnostic single antibody titre (IgM) or fourfold increase in paired serum samples (IgG) for pathogen

Soft tissue infection (necrotizing fasciitis, infectious gangrene, necrotizing cellulitis, infectious myositis, lymphadenitis, or lymphangitis) must meet ONE of the following criteria:

1. Organism isolated from culture of tissue or drainage from affected site
2. Purulent drainage from affected site
3. Abscess or other evidence of infection seen during surgery or by histopathologic examination
4. TWO of the following at affected site:
   localized pain or tenderness,
   redness, swelling, or heat
   AND ANY of the following:
   a. Organism isolated from blood culture
   b. Positive antigen test on blood or urine
   c. Diagnostic single antibody titre (IgM) or fourfold increase in paired serum samples (IgG) for pathogen

Decubitus ulcer infection, including both superficial and deep infection, must meet the following criterion:

TWO of the following:
redness,
tenderness, or
swelling of wound edges
AND either of the following:

1. Organism isolated from culture of fluid obtained by needle aspiration or biopsy of tissue obtained from ulcer margin
2. Organism isolated from blood culture

Burn infection must meet ONE of the following criteria:

1. Change in burn wound appearance or character, such as rapid eschar separation, or dark brown, black, or violaceous discoloration of the eschar, or edema at wound margin,

   AND
   a.) histologic examination of burn biopsy specimen that shows invasion of organisms into adjacent viable tissue

OR

2. Change in burn wound appearance or character, such as rapid eschar separation, or dark brown, black, or violaceous discoloration of the eschar, or edema at wound margin
   AND either of the following:
   a. Organism isolated from blood culture in absence of other identifiable infection
   b. Isolation of herpes simplex virus, histologic identification of inclusions by light or electron microscopy, or visualization of viral particles by electron microscopy in biopsy specimens or lesion scrapings
3. Burn patient has TWO of the following:
   fever (>38°C) or
   hypothermia (<36°C),
   hypotension (systolic pressure <90 mm Hg.),
   oliguria (<20 ml/hr),
   hyperglycemia at previously tolerated level of dietary carbohydrate, or
   mental confusion
   AND ANY of the following:
   a. Histologic examination of burn biopsy specimen that shows invasion of organisms into adjacent viable tissue
   b. Organism isolated from blood culture

c. Isolation of herpes simplex virus, histologic identification of inclusions by light or electron microscopy, or visualization of viral particles by electron microscopy in biopsy specimens or lesion scrapings

Breast abscess or mastitis must meet ONE of the following criteria:

1. Organism isolated from culture of affected breast tissue or fluid obtained by incision and drainage or needle aspiration
2. Breast abscess or other evidence of infection seen during surgery or by histopathologic examination
3. Fever (>38°C), local inflammation of the breast, and physician's diagnosis

8.1.5 GUIDE FOR CODES FOR ANTIMICROBIAL THERAPY

Classification	Generic Name and Code
Penicillin	1. Amoxicillin 2. Amoxicillin/Clavulanate 3. Ampicillin 4. Cloxacillin 5. Nafcillin 6. Penicillin G 7. Penicillin V 8. Piperacillin 9. PiperacillinTazobactam 10.Ticarcillin/Clavulanate
Carbapenems	11. Imipenem 12. Meropenem
Aminoglycosides	13. Amikacin 14. Gentamicin 15. Tobramycin
Cephalosporins 1st generation	16. Cefadroxil 17. Cefazolin 18. Cephalexin 19. Cephalothin
Cephalosporins 2nd generation	20. Cefaclor 21. Cefonicid 22. Cefoxitin 23. Cefuroxime
Cephalosporins 3rd generation	24. Cefixime 25. Cefotaxime 26. Ceftazidime 27. Ceftizoxime 28. Cefepime 29. Ceftriaxone
Macrolides	30. Azithromycin 31. Clarithromycin 32. Erythromycin 33a. Azithromycin
Fluoroquinolones	33b. Ciprofloxacin 34. Norfloxacin 35. Levofloxacin 36. Gatifloxacin 37. Moxifloxacin
Antifungal Medications	38. Amphotericin B 39. Fluconazole 40. Itraconazole 41. Other antifungal medications
Antituberculous Medications	42. Ethambutol 43. Isoniazid 44. Pyrazinamide 45. Rifampin 46. Other antituberculous medications
Tetracyclines	47. Tetracycline 48. Doxycycline
Others	49. Clindamycin 50. Chloramphenicol 51. Metronidazole 52. Nitrofuratoin 53. Rifampin 54. Sulfamethoxazole/Trimethoprim (Septra/Bactrim) 55. Vancomycin 56. Quinupristin-dalfopristin (Synercid) 57. Linezolid (Zyroxam) 58. Teicoplainin 59. Other

8.2 Appendix B – Table of the literature review

8.2.1 Comparison of *S. aureus* bacteremia studies looking at differences in mortality between MRSA and MSSA.

Author, Country	Sample Size	Summary results Mortality rate MRSA vs. MSSA	Univariate Analysis	Multivariate Analysis	Comments
French et al,[24] Hong Kong	**141**	**MRSA 31% vs. MSSA 9%, p= Statistically significant (SS)**	Positive: **mean days in hospital prior to infection, prior antibiotic therapy, inappropriate empiric therapy, severe underlying disease (Y/N)** Negative**: age, sex, max. temperature, initial WBC count**	Positive: **prior antibiotic therapy, length of stay in hospital prior to infection and severe underlying disease**	**One hospital only, did not include surgery, devices or medical history, outcomes of infection other than death or immunosuppression. Small sample size. Not all significant variables put in MV analysis (removed inappropriate empiric therapy)**
Romero-Vivas, et al[25] Spain	**184**	**MRSA 58% vs. MSSA32%, p=SS**	Positive: **Age, median days of hospitalization prior to infection, prior antibiotic therapy, prior surgery, indwelling urinary catheter, nasogastric tube, liver disease, heart disease, meningitis, uropathy, inadequate antibiotic treatment, MRSA**	Positive: **meningitis, MRSA bacteremias, inadequate treatment**	**one hospital, larger sample, no comorbid conditions scale (each one individually listed) therefore unable to tell if having > 1 condition affects results or immunosuppression**

			Negative: **sex, tracheostomy/ventilation, central venous catheter, inappropriate empiric therapy, diabetes mellitus, neoplasia, Obstructive pulmonary disease, cerebrovascular disease, drug addiction, vascular disease, renal failure, severity of underlying condition**		
Soriano et al,[31] **Spain**	**236**	**MRSA 22% vs. MSSA 9%, p=SS**	Positive: **age, median days in hospital preinfection, prior antibiotic therapy, prior surgery, infection acquired in ICU, tracheostomy/ventilation, inappropriate empiric therapy, prognosis of underlying disease, acquired in ICU, shock, MRSA** Negative: **MRSA past history, female, HIV infection, other preexisting comorbidities, septic metastases, infection hospital acquired, prior surgery**	Positive: **age, female, prognosis of underlying disease (ultimately fatal and rapidly fatal), Source of bacteremia (intermediate and high risk source), shock, inappropriate empirical therapy, acquired in ICU**	**Large sample size, one hospital, MRSA not SS in MV analysis, pre-existing comorbidity Y/N – no standardized index used, immunosuppression. Acquired in ICU is indicator of death however being in ICU when acquiring an infection should be the indicator. MRSA was a predictor for shock but not mortality however shock was a predictor of mortality.**
Selvey et al[32],	**499**	**MRSA 18.6% vs. MSSA 13.0%, p=NS**	Positive: **sex-male, MRSA past history, median days**	**No MV analysis**	**Large sample size, one hospital, no multivariate**

Australia			**in hospital pre-infection, immunosuppression, tracheostomy/ventilation, indwelling urinary catheter** Negative: **age, prior surgery, inappropriate empiric therapy, acquired in ICU, MRSA**		**analysis**
Harbarth et al[28], **Switzerland**	**76**	**MRSA 34.2% vs. MSSA 34.2%, p=NS**	Positive: **median days of hospitalization preinfection, prior antibiotic therapy bacteremia** Negative: **age, ses, central venous catheter, indwelling urinary catheter, nasogastric tube, inappropriate empiric therapy, MRSA**	**Positive: bacteremia**	**sample size small, 13 deaths in each group, one hospital, focus of study was comparing MRSA and MSSA and designed to look at risk factors for death but risk factors for MRSA.**
Conterno et al[27], **Brazil**	**136**	**MRSA 48.9% vs. MSSA 19.6%, p=SS**	Positive: **inappropriate empiric therapy, age, hospital-acquired, lung as site of entry, septic shock, platelets > 100,000, MRSA** Negative: **sex,**	Positive**: site of entry lung, septic shock, MRSA**	**Cohort had a small sample of MSSA cases (n=46) compared to 90 MRSA cases - for determining mortality rates, one hospital**
Topeli et al[30], **Turkey**	**101**	**MRSA 58.7% vs. MSSA 30.9%, p=SS**	Positive: **septic shock, causative microorganism MRSA , days of**	Positive: **days of hospitalization (negative regression coefficient),**	**Small sample size, one hospital**

			hospitalization Negative**; age, sex indwelling urinary catheter, nasogastric tube, inappropriate empiric therapy, hospital ward type, source of acquisition, primary vs. secondary bacteremia, underlying disease, endocarditis, underlying malignancy, neutropenia, surgical wound infection, central venous catheter, mechanical ventilation, total parenteral nutrition, prior antibiotic treatment**	**underlying disease fatal, infective endocarditis, septic shock, central intravascular catheter, MRSA**	
Pujol et al[33], Spain	**34**	**25.4 vs. 21.9, p= NS** **No MV**	Positive: **Prior ICU setting, tracheostomy, parenteral nutrition, intravascular catheter** Negative: **death, MRSA**	**No MV comparison of died vs. Alive**	**Very small sample size, one hospital, no discussion on variables looking at predictors of death just comparing MRSA and MSSA risk factors, death was not statistically significant**
Hershow et al[34], USA	**25**	**5% vs. 0 p=NS** **No MV**	Positive: **did not list these** Negative: **MRSA**	**No multivariate analysis**	**Very small sample size, 12 MRSA and 13 MSSA, one hospital, only 1 death in the MRSA group and 0 in the MSSA group.**
Sorrel et al[45],	**20**	**MRSA 20% vs. MSSA 30% p=NS**	**No univariate analysis of other variables**	**No multivariate analysis**	**Very small sample size, found no difference in**

Australia					**mortality between MRSA and MSSA however only 2 MRSA and 3 MSSA patients died.**

MV = Multivariate analysis results; NS = Not statistically significant; SS = statistically significant

Appendix C - Univariate and multivariate analyses

8.2.2 MRSA vs. MSSA univariate analysis

```
                    BLOOD
MRSA        |       0       1 | Total
------------+---------------+------
   MRSA     |       4      64 |    68
            >    5.9%   94.1% > 56.2%
            |   50.0%   56.6% |
   MSSA     |       4      49 |    53
            >    7.5%   92.5% > 43.8%
            |   50.0%   43.4% |
------------+---------------+------
     Total  |       8     113 |   121
            |    6.6%   93.4% |

                     SYN
MRSA        |       0 | Total
------------+---------+------
   MRSA     |      68 |    68
            > 100.0% > 56.2%
            |   56.2% |
   MSSA     |      53 |    53
            > 100.0% > 43.8%
            |   43.8% |
------------+---------+------
     Total  |     121 |   121
            | 100.0% |


                     PLUE
MRSA        |       0       1 | Total
------------+---------------+------
   MRSA     |      65       3 |    68
            >   95.6%    4.4% > 56.2%
            |   57.5%   37.5% |
   MSSA     |      48       5 |    53
            >   90.6%    9.4% > 43.8%

            |   42.5%   62.5% |
------------+---------------+------
     Total  |     113       8 |   121
            |   93.4%    6.6% |

                          Single Table Analysis
        Fisher exact: 1-tailed P-value: 0.2306001
                      2-tailed P-value: 0.2959211

An expected value is less than 5; recommend Fisher exact results.

                    PERI
MRSA        |       0 | Total
------------+---------+------
   MRSA     |      68 |    68
            > 100.0% > 56.2%
```

```
           |  56.2% |
   MSSA    |     53 |    53
           > 100.0% > 43.8%
           |  43.8% |
-----------+--------+------
     Total |    121 |   121
           | 100.0% |
```

MRSA	ASC 0	ASC 1	Total
MRSA	67	1	68
	98.5%	1.5%	56.2%
	56.3%	50.0%	
MSSA	52	1	53
	98.1%	1.9%	43.8%
	43.7%	50.0%	
Total	119	2	121
	98.3%	1.7%	

An expected value is less than 5; recommend Fisher exact results.

MRSA	TIS 0	TIS 1	Total
MRSA	65	3	68
	95.6%	4.4%	56.2%
	55.6%	75.0%	
MSSA	52	1	53
	98.1%	1.9%	43.8%
	44.4%	25.0%	
Total	117	4	121
	96.7%	3.3%	

MRSA	CSF 0	CSF 1	Total
MRSA	67	1	68
	98.5%	1.5%	56.2%
	55.8%	100.0%	
MSSA	53	0	53
	100.0%	0.0%	43.8%
	44.2%	0.0%	
Total	120	1	121
	99.2%	0.8%	

AGE	MRSA	MRSA	Total
	MRSA	MSSA	
23.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	

26.0	0	1	1
	0.0%	100.0%	0.8%
	0.0%	1.9%	
30.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
32.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
33.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
37.0	0	1	1
	0.0%	100.0%	0.8%
	0.0%	1.9%	
39.0	0	1	1
	0.0%	100.0%	0.8%
	0.0%	1.9%	
40.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
41.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
44.0	1	1	2
	50.0%	50.0%	1.7%
	1.5%	1.9%	
45.0	2	0	2
	100.0%	0.0%	1.7%
	2.9%	0.0%	
46.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
48.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
49.0	1	2	3
	33.3%	66.7%	2.5%
	1.5%	3.8%	
50.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
51.0	0	1	1
	0.0%	100.0%	0.8%
	0.0%	1.9%	
52.0	0	2	2
	0.0%	100.0%	1.7%
	0.0%	3.8%	
54.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
55.0	3	0	3
	100.0%	0.0%	2.5%
	4.4%	0.0%	
56.0	1	1	2
	50.0%	50.0%	1.7%
	1.5%	1.9%	

57.0	1	1	2
	50.0%	50.0%	1.7%
	1.5%	1.9%	
58.0	0	3	3
	0.0%	100.0%	2.5%
	0.0%	5.7%	
61.0	2	1	3
	66.7%	33.3%	2.5%
	2.9%	1.9%	
62.0	0	1	1
	0.0%	100.0%	0.8%
	0.0%	1.9%	
64.0	1	1	2
	50.0%	50.0%	1.7%
	1.5%	1.9%	
65.0	2	3	5
	40.0%	60.0%	4.1%
	2.9%	5.7%	
66.0	2	1	3
	66.7%	33.3%	2.5%
	2.9%	1.9%	
68.0	0	1	1
	0.0%	100.0%	0.8%
	0.0%	1.9%	
69.0	1	3	4
	25.0%	75.0%	3.3%
	1.5%	5.7%	
70.0	2	0	2
	100.0%	0.0%	1.7%
	2.9%	0.0%	
71.0	2	0	2
	100.0%	0.0%	1.7%
	2.9%	0.0%	
72.0	3	0	3
	100.0%	0.0%	2.5%
	4.4%	0.0%	
73.0	4	1	5
	80.0%	20.0%	4.1%
	5.9%	1.9%	
74.0	2	3	5
	40.0%	60.0%	4.1%
	2.9%	5.7%	
75.0	5	2	7
	71.4%	28.6%	5.8%
	7.4%	3.8%	
76.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
77.0	1	2	3
	33.3%	66.7%	2.5%
	1.5%	3.8%	
78.0	2	2	4
	50.0%	50.0%	3.3%
	2.9%	3.8%	
79.0	3	2	5
	60.0%	40.0%	4.1%
	4.4%	3.8%	

80.0	1	2	3
	33.3%	66.7%	2.5%
	1.5%	3.8%	
81.0	2	2	4
	50.0%	50.0%	3.3%
	2.9%	3.8%	
82.0	2	1	3
	66.7%	33.3%	2.5%
	2.9%	1.9%	
83.0	2	1	3
	66.7%	33.3%	2.5%
	2.9%	1.9%	
84.0	0	6	6
	0.0%	100.0%	5.0%
	0.0%	11.3%	
85.0	1	1	2
	50.0%	50.0%	1.7%
	1.5%	1.9%	
86.0	2	1	3
	66.7%	33.3%	2.5%
	2.9%	1.9%	
87.0	1	1	2
	50.0%	50.0%	1.7%
	1.5%	1.9%	
88.0	2	0	2
	100.0%	0.0%	1.7%
	2.9%	0.0%	
89.0	2	1	3
	66.7%	33.3%	2.5%
	2.9%	1.9%	
92.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
Total	68	53	121
	56.2%	43.8%	

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	68	4596	67.588	266.903	16.337
MSSA	53	3660	69.057	214.208	14.636
Difference			-1.468		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	23.000	55.500	72.500	79.000	92.000	75.000
MSSA	26.000	58.000	74.000	81.000	89.000	84.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	64.220	1	64.220	0.263	0.608793	0.513156
Within	29021.301	119	243.876			
Total	29085.521	120				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.694 deg freedom = 1 p-value = 0.404718

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) =	0.214
Degrees of freedom =	1
p value =	0.643691

	SEX		
MRSA	F	M	Total
MRSA	25	43	68
	> 36.8%	63.2%	> 56.2%
	59.5%	54.4%	
MSSA	17	36	53
	> 32.1%	67.9%	> 43.8%
	40.5%	45.6%	
Total	42	79	121
	34.7%	65.3%	

Single Table Analysis

Odds ratio		1.23
Cornfield 95% confidence limits for OR	0.54 < OR <	2.84
Maximum likelihood estimate of OR (MLE)		1.23
Exact 95% confidence limits for MLE	0.54 < OR <	2.84
Exact 95% Mid-P limits for MLE	0.57 < OR <	2.66
Probability of MLE >= 1.23 if population OR = 1.0		0.36594091
RISK RATIO(RR)(Outcome:SEX=F; Exposure:MRSA=MRSA)		1.15
95% confidence limits for RR	0.69 < RR <	1.89

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.29	0.59086216
Mantel-Haenszel:	0.29	0.59240024
Yates corrected:	0.12	0.72999119

	SOURCE		
MRSA	C	N	Total
MRSA	11	57	68
	> 16.2%	83.8%	> 56.2%
	55.0%	56.4%	
MSSA	9	44	53
	> 17.0%	83.0%	> 43.8%
	45.0%	43.6%	

```
     Total |     20    101 |   121
           |  16.5%  83.5% |
```

Single Table Analysis

Odds ratio		0.94
Cornfield 95% confidence limits for OR	0.32 < OR <	2.77
Maximum likelihood estimate of OR (MLE)		0.94
Exact 95% confidence limits for MLE	0.32 < OR <	2.82
Exact 95% Mid-P limits for MLE	0.35 < OR <	2.56
Probability of MLE <= 0.94 if population OR = 1.0		0.54820231
RISK RATIO(RR)(Outcome:SOURCE=C; Exposure:MRSA=MRSA)		0.95
95% confidence limits for RR	0.43 < RR <	2.13

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.01	0.90588652
Mantel-Haenszel:	0.01	0.90627442
Yates corrected:	0.02	0.89781602

LOS	MRSA		Total
	MRSA	MSSA	
1.0	1	1	2
	50.0%	50.0%	1.7%
	1.5%	1.9%	
2.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
3.0	3	3	6
	50.0%	50.0%	5.0%
	4.4%	5.7%	
4.0	1	2	3
	33.3%	66.7%	2.5%
	1.5%	3.8%	
5.0	0	1	1
	0.0%	100.0%	0.8%
	0.0%	1.9%	
6.0	0	3	3
	0.0%	100.0%	2.5%
	0.0%	5.7%	
7.0	2	0	2
	100.0%	0.0%	1.7%
	2.9%	0.0%	
8.0	2	1	3
	66.7%	33.3%	2.5%
	2.9%	1.9%	
9.0	2	1	3
	66.7%	33.3%	2.5%
	2.9%	1.9%	
10.0	3	2	5
	60.0%	40.0%	4.1%

	4.4%	3.8%	
11.0	1	1	2
	50.0%	50.0%	1.7%
	1.5%	1.9%	
12.0	1	3	4
	25.0%	75.0%	3.3%
	1.5%	5.7%	
13.0	2	2	4
	50.0%	50.0%	3.3%
	2.9%	3.8%	
14.0	2	1	3
	66.7%	33.3%	2.5%
	2.9%	1.9%	
15.0	1	2	3
	33.3%	66.7%	2.5%
	1.5%	3.8%	
17.0	4	0	4
	100.0%	0.0%	3.3%
	5.9%	0.0%	
18.0	2	2	4
	50.0%	50.0%	3.3%
	2.9%	3.8%	
20.0	0	1	1
	0.0%	100.0%	0.8%
	0.0%	1.9%	
21.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
22.0	1	2	3
	33.3%	66.7%	2.5%
	1.5%	3.8%	
23.0	1	1	2
	50.0%	50.0%	1.7%
	1.5%	1.9%	
24.0	1	1	2
	50.0%	50.0%	1.7%
	1.5%	1.9%	
25.0	0	3	3
	0.0%	100.0%	2.5%
	0.0%	5.7%	
26.0	0	1	1
	0.0%	100.0%	0.8%
	0.0%	1.9%	
27.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
29.0	1	3	4
	25.0%	75.0%	3.3%
	1.5%	5.7%	
31.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
32.0	1	3	4
	25.0%	75.0%	3.3%
	1.5%	5.7%	
33.0	1	1	2
	50.0%	50.0%	1.7%

```
     |    1.5%    1.9% |
34.0 |       2       1 |     3
     >   66.7%   33.3% >  2.5%
     |    2.9%    1.9% |
35.0 |       1       0 |     1
     >  100.0%    0.0% >  0.8%
     |    1.5%    0.0% |
36.0 |       1       0 |     1
     >  100.0%    0.0% >  0.8%
     |    1.5%    0.0% |
37.0 |       1       0 |     1
     >  100.0%    0.0% >  0.8%
     |    1.5%    0.0% |
38.0 |       0       1 |     1
     >    0.0%  100.0% >  0.8%
     |    0.0%    1.9% |
40.0 |       0       1 |     1
     >    0.0%  100.0% >  0.8%
     |    0.0%    1.9% |
41.0 |       1       0 |     1
     >  100.0%    0.0% >  0.8%
     |    1.5%    0.0% |
42.0 |       1       0 |     1
     >  100.0%    0.0% >  0.8%
     |    1.5%    0.0% |
43.0 |       0       1 |     1
     >    0.0%  100.0% >  0.8%
     |    0.0%    1.9% |
44.0 |       1       0 |     1
     >  100.0%    0.0% >  0.8%
     |    1.5%    0.0% |
48.0 |       1       0 |     1
     >  100.0%    0.0% >  0.8%
     |    1.5%    0.0% |
49.0 |       1       1 |     2
     >   50.0%   50.0% >  1.7%
     |    1.5%    1.9% |
51.0 |       1       0 |     1
     >  100.0%    0.0% >  0.8%
     |    1.5%    0.0% |
52.0 |       1       0 |     1
     >  100.0%    0.0% >  0.8%
     |    1.5%    0.0% |
53.0 |       1       1 |     2
     >   50.0%   50.0% >  1.7%
     |    1.5%    1.9% |
54.0 |       2       0 |     2
     >  100.0%    0.0% >  1.7%
     |    2.9%    0.0% |
55.0 |       2       0 |     2
     >  100.0%    0.0% >  1.7%
     |    2.9%    0.0% |
58.0 |       1       0 |     1
     >  100.0%    0.0% >  0.8%
     |    1.5%    0.0% |
59.0 |       1       0 |     1
     >  100.0%    0.0% >  0.8%
```

```
             |    1.5%    0.0% |
        60.0 |       0       1 |     1
             >    0.0%  100.0% >  0.8%
             |    0.0%    1.9% |
        61.0 |       1       0 |     1
             >  100.0%    0.0% >  0.8%
             |    1.5%    0.0% |
        62.0 |       1       0 |     1
             >  100.0%    0.0% >  0.8%
             |    1.5%    0.0% |
        66.0 |       1       0 |     1
             >  100.0%    0.0% >  0.8%
             |    1.5%    0.0% |
        68.0 |       1       1 |     2
             >   50.0%   50.0% >  1.7%
             |    1.5%    1.9% |
        69.0 |       1       0 |     1
             >  100.0%    0.0% >  0.8%
             |    1.5%    0.0% |
        70.0 |       1       0 |     1
             >  100.0%    0.0% >  0.8%
             |    1.5%    0.0% |
        77.0 |       1       0 |     1
             >  100.0%    0.0% >  0.8%
             |    1.5%    0.0% |
        83.0 |       1       0 |     1
             >  100.0%    0.0% >  0.8%
             |    1.5%    0.0% |
        86.0 |       1       0 |     1
             >  100.0%    0.0% >  0.8%
             |    1.5%    0.0% |
       110.0 |       1       1 |     2
             >   50.0%   50.0% >  1.7%
             |    1.5%    1.9% |
       111.0 |       1       0 |     1
             >  100.0%    0.0% >  0.8%
             |    1.5%    0.0% |
       129.0 |       0       1 |     1
             >    0.0%  100.0% >  0.8%
             |    0.0%    1.9% |
       139.0 |       0       1 |     1
             >    0.0%  100.0% >  0.8%
             |    0.0%    1.9% |
       154.0 |       1       0 |     1
             >  100.0%    0.0% >  0.8%
             |    1.5%    0.0% |
       208.0 |       0       1 |     1
             >    0.0%  100.0% >  0.8%
             |    0.0%    1.9% |
-------------+----------------+------
       Total |      68      53 |   121
             |   56.2%   43.8% |


MRSA              Obs      Total       Mean   Variance    Std Dev
MRSA               68       2440     35.882    903.986     30.066
MSSA               53       1630     30.755   1444.419     38.006
```

Difference 5.128

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	1.000	12.500	30.000	54.000	154.000	17.000
MSSA	1.000	10.000	22.000	32.000	208.000	3.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	783.130	1	783.130	0.687	0.408890	0.828777
Within	135676.870	119	1140.142			
Total	136460.000	120				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 3.222 deg freedom = 1 p-value = 0.072664

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 2.893
Degrees of freedom = 1
p value = 0.088954

	MRSA		
TIMTOINF	MRSA	MSSA	Total
0.0	13	4	17
	76.5%	23.5%	14.7%
	20.3%	7.7%	
1.0	3	6	9
	33.3%	66.7%	7.8%
	4.7%	11.5%	
2.0	2	3	5
	40.0%	60.0%	4.3%
	3.1%	5.8%	
3.0	0	1	1
	0.0%	100.0%	0.9%
	0.0%	1.9%	
4.0	4	2	6
	66.7%	33.3%	5.2%
	6.3%	3.8%	
5.0	2	5	7
	28.6%	71.4%	6.0%
	3.1%	9.6%	
6.0	1	5	6
	16.7%	83.3%	5.2%
	1.6%	9.6%	
7.0	2	2	4
	50.0%	50.0%	3.4%
	3.1%	3.8%	
8.0	1	1	2
	50.0%	50.0%	1.7%

```
     |    1.6%    1.9% |
 9.0 |       2       5 |     7
     >   28.6%   71.4% >  6.0%
     |    3.1%    9.6% |
10.0 |       0       2 |     2
     >    0.0%  100.0% >  1.7%
     |    0.0%    3.8% |
11.0 |       3       0 |     3
     >  100.0%    0.0% >  2.6%
     |    4.7%    0.0% |
13.0 |       0       1 |     1
     >    0.0%  100.0% >  0.9%
     |    0.0%    1.9% |
14.0 |       1       0 |     1
     >  100.0%    0.0% >  0.9%
     |    1.6%    0.0% |
15.0 |       2       0 |     2
     >  100.0%    0.0% >  1.7%
     |    3.1%    0.0% |
16.0 |       1       1 |     2
     >   50.0%   50.0% >  1.7%
     |    1.6%    1.9% |
18.0 |       2       1 |     3
     >   66.7%   33.3% >  2.6%
     |    3.1%    1.9% |
19.0 |       1       1 |     2
     >   50.0%   50.0% >  1.7%
     |    1.6%    1.9% |
20.0 |       0       1 |     1
     >    0.0%  100.0% >  0.9%
     |    0.0%    1.9% |
21.0 |       1       0 |     1
     >  100.0%    0.0% >  0.9%
     |    1.6%    0.0% |
22.0 |       2       0 |     2
     >  100.0%    0.0% >  1.7%
     |    3.1%    0.0% |
23.0 |       0       1 |     1
     >    0.0%  100.0% >  0.9%
     |    0.0%    1.9% |
25.0 |       2       2 |     4
     >   50.0%   50.0% >  3.4%
     |    3.1%    3.8% |
26.0 |       1       0 |     1
     >  100.0%    0.0% >  0.9%
     |    1.6%    0.0% |
27.0 |       0       1 |     1
     >    0.0%  100.0% >  0.9%
     |    0.0%    1.9% |
28.0 |       1       0 |     1
     >  100.0%    0.0% >  0.9%
     |    1.6%    0.0% |
30.0 |       1       1 |     2
     >   50.0%   50.0% >  1.7%
     |    1.6%    1.9% |
31.0 |       1       1 |     2
     >   50.0%   50.0% >  1.7%
```

```
             |    1.6%    1.9% |
        32.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
        33.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
        34.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
        35.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
        36.0 |       0       1 |     1
             >    0.0%  100.0% >  0.9%
             |    0.0%    1.9% |
        37.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
        43.0 |       1       1 |     2
             >   50.0%   50.0% >  1.7%
             |    1.6%    1.9% |
        46.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
        50.0 |       2       0 |     2
             >  100.0%    0.0% >  1.7%
             |    3.1%    0.0% |
        51.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
        52.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
        54.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
        59.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
        60.0 |       0       1 |     1
             >    0.0%  100.0% >  0.9%
             |    0.0%    1.9% |
        75.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
       102.0 |       1       0 |     1
             >  100.0%    0.0% >  0.9%
             |    1.6%    0.0% |
       108.0 |       0       1 |     1
             >    0.0%  100.0% >  0.9%
             |    0.0%    1.9% |
       127.0 |       0       1 |     1
             >    0.0%  100.0% >  0.9%
             |    0.0%    1.9% |
-------------+----------------+------
       Total |      64      52 |   116
```

| 55.2% 44.8% |

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	64	1210	18.906	451.134	21.240
MSSA	52	786	15.115	581.712	24.119
Difference			3.791		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	0.000	1.500	11.000	30.500	102.000	0.000
MSSA	0.000	2.500	6.500	18.500	127.000	1.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	412.289	1	412.289	0.809	0.370276	0.899513
Within	58088.745	114	509.550			
Total	58501.034	115				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.908 deg freedom = 1 p-value = 0.340565

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.817
Degrees of freedom = 1
p value = 0.365913

	MSWI		
MRSA	0.0	1.0	Total
MRSA	64	4	68
	94.1%	5.9%	> 56.2%
	56.6%	50.0%	
MSSA	49	4	53
	92.5%	7.5%	> 43.8%
	43.4%	50.0%	
Total	113	8	121
	93.4%	6.6%	

Single Table Analysis

Odds ratio		1.31
Cornfield 95% confidence limits for OR	0.25 < OR <	6.71*
*May be inaccurate		
Maximum likelihood estimate of OR (MLE)		1.30
Exact 95% confidence limits for MLE	0.23 < OR <	7.37
Exact 95% Mid-P limits for MLE	0.28 < OR <	6.04

```
Probability of MLE >=  1.30 if population OR = 1.0                0.49564309

RISK RATIO(RR)(Outcome:MSWI=0.0; Exposure:MRSA=MRSA)                      1.02

95% confidence limits for RR                                 0.92 < RR <   1.12

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.13     0.71462516
        Mantel-Haenszel:      0.13     0.71575542
        Yates corrected:      0.00     0.99756877

        Fisher exact: 1-tailed P-value: 0.4956431
                      2-tailed P-value: 0.7285960

An expected value is less than 5; recommend Fisher exact results.

                                MPBSI
MRSA       |             0.0             1.0 | Total
-----------+-------------------------------+------
   MRSA    |              29              39 |    68
           >           42.6%           57.4% > 56.2%
           |           52.7%           59.1% |
   MSSA    |              26              27 |    53
           >           49.1%           50.9% > 43.8%
           |           47.3%           40.9% |
-----------+-------------------------------+------
     Total |              55              66 |   121
           |           45.5%           54.5% |

                           Single Table Analysis

Odds ratio                                                                0.77
Cornfield 95% confidence limits for OR                       0.35 < OR <   1.71
Maximum likelihood estimate of OR (MLE)                                   0.77
Exact 95% confidence limits for MLE                          0.35 < OR <   1.69
Exact 95% Mid-P limits for MLE                               0.37 < OR <   1.60
Probability of MLE <=  0.77 if population OR = 1.0                0.30197366

RISK RATIO(RR)(Outcome:MPBSI=0.0; Exposure:MRSA=MRSA)                     0.87
95% confidence limits for RR                                 0.59 < RR <   1.28

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.49     0.48235466

        Mantel-Haenszel:      0.49     0.48417000
        Yates corrected:      0.27     0.60409064
```

MSWITYPE	Freq	Percent	Cum.
D	6	75.0%	75.0%
I	2	25.0%	100.0%
Total	8	100.0%	

MRSA	MSWITYPE D	MSWITYPE I	Total
MRSA	4	0	4
	100.0%	0.0%	50.0%
	66.7%	0.0%	
MSSA	2	2	4
	50.0%	50.0%	50.0%
	33.3%	100.0%	
Total	6	2	8
	75.0%	25.0%	

Single Table Analysis

Odds ratio	??????
Maximum likelihood estimate of OR (MLE)	??????
Exact 95% confidence limits for MLE	0.20 < OR < ??????
Exact 95% Mid-P limits for MLE	0.31 < OR < ??????
Probability of MLE >= ?????? if population OR = 1.0	0.21428571
RISK RATIO(RR)(Outcome:MSWITYPE=D; Exposure:MRSA=MRSA)	2.00
95% confidence limits for RR	0.75 < RR < 5.33

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	2.67	0.10247043
Mantel-Haenszel:	2.33	0.12663046
Yates corrected:	0.67	0.41421618

Fisher exact: 1-tailed P-value: 0.2142857
2-tailed P-value: 0.4285714

An expected value is less than 5; recommend Fisher exact results.

MRSA	MPBSITYP C	MPBSITYP P	Total
MRSA	8	25	33
	24.2%	75.8%	55.0%
	50.0%	56.8%	
MSSA	8	19	27
	29.6%	70.4%	45.0%
	50.0%	43.2%	
Total	16	44	60
	26.7%	73.3%	

Single Table Analysis

Odds ratio		0.76
Cornfield 95% confidence limits for OR	0.21 < OR <	2.80
Maximum likelihood estimate of OR (MLE)		0.76
Exact 95% confidence limits for MLE	0.21 < OR <	2.81
Exact 95% Mid-P limits for MLE	0.23 < OR <	2.48
Probability of MLE <= 0.76 if population OR = 1.0		0.42856085
RISK RATIO(RR)(Outcome:MPBSITYP=C; Exposure:MRSA=MRSA)		0.82
95% confidence limits for RR	0.35 < RR <	1.89

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.22	0.63874621
Mantel-Haenszel:	0.22	0.64155627
Yates corrected:	0.03	0.86025883

	MSBSI		
MRSA	0.0	1.0	Total
MRSA	43	25	68
	63.2%	36.8%	56.2%
	57.3%	54.3%	
MSSA	32	21	53
	60.4%	39.6%	43.8%
	42.7%	45.7%	
Total	75	46	121
	62.0%	38.0%	

Single Table Analysis

Odds ratio		1.13
Cornfield 95% confidence limits for OR	0.50 < OR <	2.54
Maximum likelihood estimate of OR (MLE)		1.13
Exact 95% confidence limits for MLE	0.50 < OR <	2.52
Exact 95% Mid-P limits for MLE	0.53 < OR <	2.38
Probability of MLE >= 1.13 if population OR = 1.0		0.44657518
RISK RATIO(RR)(Outcome:MSBSI=0.0; Exposure:MRSA=MRSA)		1.05
95% confidence limits for RR	0.79 < RR <	1.39

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.10	0.74797339
Mantel-Haenszel:	0.10	0.74898177
Yates corrected:	0.02	0.89452515

MRSA	MPNEU 0.0	1.0	Total
MRSA	57	11	68
	83.8%	16.2%	56.2%
	57.6%	50.0%	
MSSA	42	11	53
	79.2%	20.8%	43.8%
	42.4%	50.0%	
Total	99	22	121
	81.8%	18.2%	

Single Table Analysis

Odds ratio	1.36
Cornfield 95% confidence limits for OR	0.49 < OR < 3.80
Maximum likelihood estimate of OR (MLE)	1.35
Exact 95% confidence limits for MLE	0.48 < OR < 3.81
Exact 95% Mid-P limits for MLE	0.53 < OR < 3.49

Probability of MLE >= 1.35 if population OR = 1.0 0.33920079

RISK RATIO(RR)(Outcome:MPNEU=0.0; Exposure:MRSA=MRSA)	1.06
95% confidence limits for RR	0.89 < RR < 1.26

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.42	0.51710046
Mantel-Haenszel:	0.42	0.51883717
Yates corrected:	0.17	0.68159550

MRSA	MUTI 0.0	1.0	Total
MRSA	61	7	68
	89.7%	10.3%	56.2%
	57.5%	46.7%	
MSSA	45	8	53
	84.9%	15.1%	43.8%
	42.5%	53.3%	
Total	106	15	121
	87.6%	12.4%	

Single Table Analysis

Odds ratio	1.55
Cornfield 95% confidence limits for OR	0.46 < OR < 5.25
Maximum likelihood estimate of OR (MLE)	1.54
Exact 95% confidence limits for MLE	0.45 < OR < 5.40
Exact 95% Mid-P limits for MLE	0.51 < OR < 4.78

Probability of MLE >= 1.54 if population OR = 1.0 0.30094578

RISK RATIO(RR)(Outcome:MUTI=0.0; Exposure:MRSA=MRSA) 1.06
95% confidence limits for RR 0.92 < RR < 1.21

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.63	0.42663405
Mantel-Haenszel:	0.63	0.42855143
Yates corrected:	0.27	0.60518631

MBONE

MRSA	0.0	1.0	Total
MRSA	63	5	68
>	92.6%	7.4%	> 56.2%
	55.3%	71.4%	
MSSA	51	2	53
>	96.2%	3.8%	> 43.8%
	44.7%	28.6%	
Total	114	7	121
	94.2%	5.8%	

Single Table Analysis

Odds ratio 0.49
Cornfield 95% confidence limits for OR 0.06 < OR < 3.09*
*May be inaccurate
Maximum likelihood estimate of OR (MLE) 0.50
Exact 95% confidence limits for MLE 0.05 < OR < 3.19
Exact 95% Mid-P limits for MLE 0.06 < OR < 2.63
Probability of MLE <= 0.50 if population OR = 1.0 0.33472940

RISK RATIO(RR)(Outcome:MBONE=0.0; Exposure:MRSA=MRSA) 0.96
95% confidence limits for RR 0.88 < RR < 1.05

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.70	0.40274087
Mantel-Haenszel:	0.69	0.40469166
Yates corrected:	0.20	0.65681601

Fisher exact: 1-tailed P-value: 0.3347294
2-tailed P-value: 0.4654287

An expected value is less than 5; recommend Fisher exact results.

MBONETYP

MRSA	J	O	Total
MRSA	1	4	5
	20.0%	80.0%	71.4%
	50.0%	80.0%	
MSSA	1	1	2
	50.0%	50.0%	28.6%
	50.0%	20.0%	
Total	2	5	7
	28.6%	71.4%	

Single Table Analysis

Odds ratio 0.25
Cornfield 95% confidence limits for OR 0.00 < OR < 22.79*
*May be inaccurate
Maximum likelihood estimate of OR (MLE) 0.32
Exact 95% confidence limits for MLE 0.00 < OR < 39.10
Exact 95% Mid-P limits for MLE 0.01 < OR < 19.20
Probability of MLE <= 0.32 if population OR = 1.0 0.52380952

RISK RATIO(RR)(Outcome:MBONETYP=J; Exposure:MRSA=MRSA) 0.40
95% confidence limits for RR 0.04 < RR < 3.74

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.63	0.42735531
Mantel-Haenszel:	0.54	0.46243273
Yates corrected:	0.02	0.89475684

Fisher exact: 1-tailed P-value: 0.5238095
2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

MCVS

MRSA	0.0	1.0	Total
MRSA	67	1	68
	98.5%	1.5%	56.2%
	56.3%	50.0%	
MSSA	52	1	53
	98.1%	1.9%	43.8%
	43.7%	50.0%	
Total	119	2	121
	98.3%	1.7%	

Single Table Analysis

Odds ratio 1.29

```
Cornfield 95% confidence limits for OR                    0.00 < OR <
49.33*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                             1.29
Exact 95% confidence limits for MLE                       0.02 < OR < 102.63
Exact 95% Mid-P limits for MLE                            0.03 < OR <  50.96
Probability of MLE >=  1.29 if population OR = 1.0              0.68622590

RISK RATIO(RR)(Outcome:MCVS=0.0; Exposure:MRSA=MRSA)                1.00
95% confidence limits for RR                              0.96 < RR <   1.05

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.03     0.85859962
        Mantel-Haenszel:      0.03     0.85917900
        Yates corrected:      0.29     0.58891445

        Fisher exact: 1-tailed P-value: 0.6862259
                      2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

                    MCVSTYPE
MRSA        | E         | Total
------------+-----------+------
   MRSA     |         1 |     1
           >   100.0% > 50.0%
           |    50.0% |
   MSSA     |         1 |     1
           >   100.0% > 50.0%
           |    50.0% |
------------+-----------+------
     Total  |         2 |     2
            |   100.0% |


      An expected value is < 5. Chi square not valid.
             Chi square =       0.00
     Degrees of freedom =          0
                p value = 1.00000000


                                MCNS
MRSA        |             0.0             1.0 | Total
------------+---------------------------------+------
   MRSA     |              67               1 |    68
           >           98.5%            1.5% > 56.2%
           |           56.3%           50.0% |
   MSSA     |              52               1 |    53
           >           98.1%            1.9% > 43.8%
           |           43.7%           50.0% |
------------+---------------------------------+------
     Total  |             119               2 |   121
            |           98.3%            1.7% |
```

Single Table Analysis

Odds ratio 1.29
Cornfield 95% confidence limits for OR 0.00 < OR < 49.33*
*May be inaccurate
Maximum likelihood estimate of OR (MLE) 1.29
Exact 95% confidence limits for MLE 0.02 < OR < 102.63
Exact 95% Mid-P limits for MLE 0.03 < OR < 50.96
Probability of MLE >= 1.29 if population OR = 1.0 0.68622590

RISK RATIO(RR)(Outcome:MCNS=0.0; Exposure:MRSA=MRSA) 1.00
95% confidence limits for RR 0.96 < RR < 1.05

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.03	0.85859962
Mantel-Haenszel:	0.03	0.85917900
Yates corrected:	0.29	0.58891445

Fisher exact: 1-tailed P-value: 0.6862259
2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

MRSA	MEENTM 0.0	1.0	Total
MRSA	66	2	68
>	97.1%	2.9%	> 56.2%
	55.5%	100.0%	
MSSA	53	0	53
>	100.0%	0.0%	> 43.8%
	44.5%	0.0%	
Total	119	2	121
	98.3%	1.7%	

Single Table Analysis

Odds ratio 0.00
Cornfield 95% confidence limits for OR 0.00 < OR < 5.38*
*May be inaccurate
Maximum likelihood estimate of OR (MLE) 0.00
Exact 95% confidence limits for MLE 0.00 < OR < 6.83
Exact 95% Mid-P limits for MLE 0.00 < OR < 4.45
Probability of MLE <= 0.00 if population OR = 1.0 0.31377410

RISK RATIO(RR)(Outcome:MEENTM=0.0; Exposure:MRSA=MRSA) 0.97
95% confidence limits for RR 0.93 < RR < 1.01

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	1.59	0.20803876
Mantel-Haenszel:	1.57	0.20992798
Yates corrected:	0.29	0.58891445

Fisher exact: 1-tailed P-value: 0.3137741
2-tailed P-value: 0.5035813

An expected value is less than 5; recommend Fisher exact results.

	MGI		
MRSA	0.0	1.0	Total
MRSA	68	0	68
>	100.0%	0.0%	> 56.2%
	56.7%	0.0%	
MSSA	52	1	53
>	98.1%	1.9%	> 43.8%
	43.3%	100.0%	
Total	120	1	121
	99.2%	0.8%	

Single Table Analysis

Odds ratio	??????
Maximum likelihood estimate of OR (MLE)	??????
Exact 95% confidence limits for MLE	0.03 < OR < ??????
Exact 95% Mid-P limits for MLE	0.07 < OR < ??????
Probability of MLE >= ?????? if population OR = 1.0	0.43801653
RISK RATIO(RR)(Outcome:MGI=0.0; Exposure:MRSA=MRSA)	1.02
95% confidence limits for RR	0.98 < RR < 1.06

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	1.29	0.25536524
Mantel-Haenszel:	1.28	0.25733848
Yates corrected:	0.02	0.90016725

Fisher exact: 1-tailed P-value: 0.4380165
2-tailed P-value: 0.4380165

An expected value is less than 5; recommend Fisher exact results.

	MLRT		
MRSA	0.0	1.0	Total
MRSA	65	3	68

```
          >          95.6%           4.4% > 56.2%
          |          56.0%          60.0% |
   MSSA   |             51              2 |    53
          >          96.2%           3.8% > 43.8%
          |          44.0%          40.0% |
----------+--------------------------------+------
     Total |           116              5 |   121
          |          95.9%           4.1% |
```

Single Table Analysis

Odds ratio		0.85
Cornfield 95% confidence limits for OR	0.09 < OR < 6.67*	
*May be inaccurate		
Maximum likelihood estimate of OR (MLE)		0.85
Exact 95% confidence limits for MLE	0.07 < OR <	7.72
Exact 95% Mid-P limits for MLE	0.10 < OR <	5.92
Probability of MLE <= 0.85 if population OR = 1.0		0.61695649
RISK RATIO(RR)(Outcome:MLRT=0.0; Exposure:MRSA=MRSA)		0.99
95% confidence limits for RR	0.92 < RR <	1.07

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.03	0.86108721
Mantel-Haenszel:	0.03	0.86165661
Yates corrected:	0.08	0.77540636

Fisher exact: 1-tailed P-value: 0.6169565
2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

```
                          MRPT
MRSA       |            0.0            1.0 | Total
-----------+--------------------------------+------
   MRSA    |             67              1 |    68
           >          98.5%           1.5% > 56.2%
           |          55.8%         100.0% |
   MSSA    |             53              0 |    53
           >         100.0%           0.0% > 43.8%
           |          44.2%           0.0% |
-----------+--------------------------------+------
     Total |            120              1 |   121
           |          99.2%           0.8% |
```

Single Table Analysis

Odds ratio		0.00
Cornfield 95% confidence limits for OR	0.00 < OR < 22.97*	
*May be inaccurate		
Maximum likelihood estimate of OR (MLE)		0.00

```
Exact 95% confidence limits for MLE                        0.00 < OR <  50.04
Exact 95% Mid-P limits for MLE                             0.00 < OR <  24.38
Probability of MLE <=  0.00 if population OR = 1.0                   0.56198347

RISK RATIO(RR)(Outcome:MRPT=0.0; Exposure:MRSA=MRSA)                          0.99
95% confidence limits for RR                               0.96 < RR <   1.01

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.79     0.37534068
        Mantel-Haenszel:      0.78     0.37732110
        Yates corrected:      0.02     0.90016725

        Fisher exact: 1-tailed P-value: 0.5619835
                      2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

                                 MSST
MRSA       |             0.0             1.0 | Total
-----------+-------------------------------+------
   MRSA    |              57              11 |    68
           >           83.8%           16.2% > 56.2%
           |           53.8%           73.3% |
   MSSA    |              49               4 |    53
           >           92.5%            7.5% > 43.8%
           |           46.2%           26.7% |
-----------+-------------------------------+------
     Total |             106              15 |   121
           |           87.6%           12.4% |

                          Single Table Analysis

Odds ratio                                                                    0.42
Cornfield 95% confidence limits for OR                     0.10 < OR <   1.58
Maximum likelihood estimate of OR (MLE)                                       0.43
Exact 95% confidence limits for MLE                        0.09 < OR <   1.55
Exact 95% Mid-P limits for MLE                             0.11 < OR <   1.39
Probability of MLE <=  0.43 if population OR = 1.0                   0.12402138

RISK RATIO(RR)(Outcome:MSST=0.0; Exposure:MRSA=MRSA)                          0.91
95% confidence limits for RR                               0.80 < RR <   1.03

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          2.04     0.15297596
        Mantel-Haenszel:      2.03     0.15468377
        Yates corrected:      1.33     0.24969501


                          MRSA
```

NOSAINF	MRSA	MSSA	Total
0.0	0	2	2
	0.0%	100.0%	1.7%
	0.0%	3.8%	
1.0	37	25	62
	59.7%	40.3%	51.2%
	54.4%	47.2%	
2.0	24	23	47
	51.1%	48.9%	38.8%
	35.3%	43.4%	
3.0	7	2	9
	77.8%	22.2%	7.4%
	10.3%	3.8%	
5.0	0	1	1
	0.0%	100.0%	0.8%
	0.0%	1.9%	
Total	68	53	121
	56.2%	43.8%	

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	68	106	1.559	0.459	0.678
MSSA	53	82	1.547	0.637	0.798
Difference			0.012		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	1.000	1.000	1.000	2.000	3.000	1.000
MSSA	0.000	1.000	1.000	2.000	5.000	1.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.004	1	0.004	0.008	0.930980	0.086796
Within	63.897	119	0.537			
Total	63.901	120				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 1.572 deg freedom = 1 p-value = 0.209897

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.008
Degrees of freedom = 1
p value = 0.928155

MRSA	NSWI 0.0	Total
MRSA	68	68

```
           >         100.0% > 56.2%
           |          56.2% |
   MSSA    |             53 |    53
           >         100.0% > 43.8%
           |          43.8% |
-----------+----------------+------
     Total |            121 |   121
           |         100.0% |


            Chi square =       0.00
     Degrees of freedom =          0
                p value = 1.00000000


                                NPBSI
MRSA       |            0.0            1.0 | Total
-----------+--------------------------------+------
   MRSA    |             61              7 |    68
           >          89.7%          10.3% > 56.2%
           |          54.5%          77.8% |
   MSSA    |             51              2 |    53
           >          96.2%           3.8% > 43.8%
           |          45.5%          22.2% |
-----------+--------------------------------+------
     Total |            112              9 |   121
           |          92.6%           7.4% |


                          Single Table Analysis

Odds ratio                                                          0.34
Cornfield 95% confidence limits for OR                0.05 < OR <   1.94
Maximum likelihood estimate of OR (MLE)                             0.34
Exact 95% confidence limits for MLE                   0.03 < OR <   1.92
Exact 95% Mid-P limits for MLE                        0.05 < OR <   1.63
Probability of MLE <=  0.34 if population OR = 1.0             0.15729602

RISK RATIO(RR)(Outcome:NPBSI=0.0; Exposure:MRSA=MRSA)               0.93
95% confidence limits for RR                          0.85 < RR <   1.03

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:         1.84     0.17502149
        Mantel-Haenszel:     1.82     0.17681455
        Yates corrected:     1.01     0.31389467

        Fisher exact: 1-tailed P-value: 0.1572960
                      2-tailed P-value: 0.2959520

An expected value is less than 5; recommend Fisher exact results.

                        NPBSITYP
MRSA       | C       P       | Total
```

```
-----------+-----------------+------
   MRSA    |       2       5 |     7
           >   28.6%   71.4% > 77.8%
           |   66.7%   83.3% |
   MSSA    |       1       1 |     2
           >   50.0%   50.0% > 22.2%
           |   33.3%   16.7% |
-----------+-----------------+------
     Total |       3       6 |     9
           |   33.3%   66.7% |
```

Single Table Analysis

```
Odds ratio                                                          0.40
Cornfield 95% confidence limits for OR                 0.01 < OR <
26.29*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                             0.45
Exact 95% confidence limits for MLE                    0.00 < OR <  46.97
Exact 95% Mid-P limits for MLE                         0.01 < OR <  23.14
Probability of MLE <=  0.45 if population OR = 1.0          0.58333333

RISK RATIO(RR)(Outcome:NPBSITYP=C; Exposure:MRSA=MRSA)              0.57
95% confidence limits for RR                           0.09 < RR <   3.51
```

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.32	0.57075039
Mantel-Haenszel:	0.29	0.59298010
Yates corrected:	0.08	0.77681400

Fisher exact: 1-tailed P-value: 0.5833333
2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

```
MRSA    |  Freq  Percent   Cum.
--------+-----------------------
MRSA    |    68   56.2%    56.2%
MSSA    |    53   43.8%   100.0%
--------+-----------------------
  Total |   121  100.0%
```

```
                                NSBSI
MRSA       |            0.0            1.0 | Total
-----------+--------------------------------+------
   MRSA    |             65              3 |    68
           >          95.6%           4.4% > 56.2%
           |          57.0%          42.9% |
   MSSA    |             49              4 |    53
           >          92.5%           7.5% > 43.8%
           |          43.0%          57.1% |
-----------+--------------------------------+------
```

```
     Total |           114             7 |   121
           |         94.2%          5.8% |

                        Single Table Analysis


Odds ratio                                                          1.77
Cornfield 95% confidence limits for OR                 0.31 < OR <
10.67*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                             1.76
Exact 95% confidence limits for MLE                    0.28 < OR <  12.57
Exact 95% Mid-P limits for MLE                         0.35 < OR <   9.82
Probability of MLE >=  1.76 if population OR = 1.0            0.36312160


RISK RATIO(RR)(Outcome:NSBSI=0.0; Exposure:MRSA=MRSA)               1.03
95% confidence limits for RR                           0.94 < RR <   1.13

             Ignore risk ratio if case control study

                        Chi-Squares   P-values
                        -----------   --------

       Uncorrected:         0.54     0.46358590
       Mantel-Haenszel:     0.53     0.46543912
       Yates corrected:     0.12     0.73345580

       Fisher exact: 1-tailed P-value: 0.3631216
                     2-tailed P-value: 0.6978510

An expected value is less than 5; recommend Fisher exact results.

                              NPNEU
MRSA       |            0.0             1.0 | Total
-----------+-------------------------------+------
   MRSA    |             57              11 |    68
           >          83.8%          16.2% > 56.2%
           |          57.6%          50.0% |
   MSSA    |             42              11 |    53
           >          79.2%          20.8% > 43.8%
           |          42.4%          50.0% |
-----------+-------------------------------+------
     Total |             99              22 |   121
           |          81.8%          18.2% |

                        Single Table Analysis


Odds ratio                                                          1.36
Cornfield 95% confidence limits for OR                 0.49 < OR <   3.80
Maximum likelihood estimate of OR (MLE)                             1.35
Exact 95% confidence limits for MLE                    0.48 < OR <   3.81
Exact 95% Mid-P limits for MLE                         0.53 < OR <   3.49
Probability of MLE >=  1.35 if population OR = 1.0            0.33920079

RISK RATIO(RR)(Outcome:NPNEU=0.0; Exposure:MRSA=MRSA)               1.06
95% confidence limits for RR                           0.89 < RR <   1.26
```

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.42	0.51710046
Mantel-Haenszel:	0.42	0.51883717
Yates corrected:	0.17	0.68159550

NUTI

MRSA	0.0	1.0	Total
MRSA	54	14	68
>	79.4%	20.6%	> 56.2%
	54.0%	66.7%	
MSSA	46	7	53
>	86.8%	13.2%	> 43.8%
	46.0%	33.3%	
Total	100	21	121
	82.6%	17.4%	

Single Table Analysis

Odds ratio		0.59
Cornfield 95% confidence limits for OR	0.19 < OR <	1.74
Maximum likelihood estimate of OR (MLE)		0.59
Exact 95% confidence limits for MLE	0.18 < OR <	1.72
Exact 95% Mid-P limits for MLE	0.21 < OR <	1.58
Probability of MLE <= 0.59 if population OR = 1.0		0.20654762
RISK RATIO(RR)(Outcome:NUTI=0.0; Exposure:MRSA=MRSA)		0.91
95% confidence limits for RR	0.78 < RR <	1.07

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	1.13	0.28751665
Mantel-Haenszel:	1.12	0.28951731
Yates corrected:	0.68	0.41125931

NBONE

MRSA	0.0	1.0	Total
MRSA	66	2	68
>	97.1%	2.9%	> 56.2%
	55.5%	100.0%	
MSSA	53	0	53
>	100.0%	0.0%	> 43.8%
	44.5%	0.0%	
Total	119	2	121

```
          |          98.3%           1.7% |

                          Single Table Analysis

Odds ratio                                                              0.00
Cornfield 95% confidence limits for OR                  0.00 < OR <
5.38*
                     *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 0.00
Exact 95% confidence limits for MLE                     0.00 < OR <     6.83
Exact 95% Mid-P limits for MLE                          0.00 < OR <     4.45
Probability of MLE <=  0.00 if population OR = 1.0              0.31377410

RISK RATIO(RR)(Outcome:NBONE=0.0; Exposure:MRSA=MRSA)                   0.97
95% confidence limits for RR                            0.93 < RR <     1.01

              Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          1.59     0.20803876
        Mantel-Haenszel:      1.57     0.20992798
        Yates corrected:      0.29     0.58891445

        Fisher exact: 1-tailed P-value: 0.3137741
                      2-tailed P-value: 0.5035813

An expected value is less than 5; recommend Fisher exact results.


MRSA    |  Freq  Percent   Cum.
--------+-----------------------
MRSA    |    68   56.2%    56.2%
MSSA    |    53   43.8%   100.0%
--------+-----------------------
  Total |   121  100.0%

                    NBONETYP
MRSA       | O         | Total
-----------+-----------+------
   MRSA    |         2 |     2
           >   100.0% >100.0%
           |   100.0% |
-----------+-----------+------
     Total |         2 |     2
           |   100.0% |


      An expected value is < 5. Chi square not valid.
             Chi square =       0.00
     Degrees of freedom =          0
                p value = 1.00000000


                                NCVS
MRSA       |            0.0            1.0 | Total
```

MRSA	67	1	68
	98.5%	1.5%	56.2%
	55.8%	100.0%	
MSSA	53	0	53
	100.0%	0.0%	43.8%
	44.2%	0.0%	
Total	120	1	121
	99.2%	0.8%	

Single Table Analysis

Odds ratio 0.00
Cornfield 95% confidence limits for OR 0.00 < OR < 22.97*
*May be inaccurate
Maximum likelihood estimate of OR (MLE) 0.00
Exact 95% confidence limits for MLE 0.00 < OR < 50.04
Exact 95% Mid-P limits for MLE 0.00 < OR < 24.38
Probability of MLE <= 0.00 if population OR = 1.0 0.56198347

RISK RATIO(RR)(Outcome:NCVS=0.0; Exposure:MRSA=MRSA) 0.99
95% confidence limits for RR 0.96 < RR < 1.01

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.79	0.37534068
Mantel-Haenszel:	0.78	0.37732110
Yates corrected:	0.02	0.90016725

Fisher exact: 1-tailed P-value: 0.5619835
2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

MRSA	NCVSTYPE E	Total
MRSA	1	1
	100.0%	100.0%
	100.0%	
Total	1	1
	100.0%	

An expected value is < 5. Chi square not valid.
Chi square = 0.00
Degrees of freedom = 0
p value = 1.00000000

MRSA	NCNS 0.0	Total
MRSA	68	68
	100.0% > 56.2%	
	56.2%	
MSSA	53	53
	100.0% > 43.8%	
	43.8%	
Total	121	121
	100.0%	

Chi square = 0.00
Degrees of freedom = 0
p value = 1.00000000

MRSA	NEENTM 0.0	1.0	Total
MRSA	67	1	68
	98.5%	1.5% > 56.2%	
	55.8%	100.0%	
MSSA	53	0	53
	100.0%	0.0% > 43.8%	
	44.2%	0.0%	
Total	120	1	121
	99.2%	0.8%	

Single Table Analysis

Odds ratio 0.00
Cornfield 95% confidence limits for OR 0.00 < OR < 22.97*
*May be inaccurate
Maximum likelihood estimate of OR (MLE) 0.00
Exact 95% confidence limits for MLE 0.00 < OR < 50.04
Exact 95% Mid-P limits for MLE 0.00 < OR < 24.38
Probability of MLE <= 0.00 if population OR = 1.0 0.56198347

RISK RATIO(RR)(Outcome:NEENTM=0.0; Exposure:MRSA=MRSA) 0.99
95% confidence limits for RR 0.96 < RR < 1.01

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.79	0.37534068
Mantel-Haenszel:	0.78	0.37732110
Yates corrected:	0.02	0.90016725

```
        Fisher exact: 1-tailed P-value: 0.5619835
                      2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

                                  NGI
MRSA       |            0.0            1.0 | Total
-----------+--------------------------------+------
   MRSA    |             65              3 |    68
           >          95.6%           4.4% > 56.2%
           |          56.0%          60.0% |
   MSSA    |             51              2 |    53
           >          96.2%           3.8% > 43.8%
           |          44.0%          40.0% |
-----------+--------------------------------+------
     Total |            116              5 |   121
           |          95.9%           4.1% |

                          Single Table Analysis

Odds ratio                                                          0.85
Cornfield 95% confidence limits for OR                 0.09 < OR <
6.67*
                     *May be inaccurate
Maximum likelihood estimate of OR (MLE)                             0.85
Exact 95% confidence limits for MLE                    0.07 < OR <   7.72
Exact 95% Mid-P limits for MLE                         0.10 < OR <   5.92
Probability of MLE <=  0.85 if population OR = 1.0              0.61695649

RISK RATIO(RR)(Outcome:NGI=0.0; Exposure:MRSA=MRSA)                 0.99
95% confidence limits for RR                           0.92 < RR <   1.07

               Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.03     0.86108721
        Mantel-Haenszel:      0.03     0.86165661
        Yates corrected:      0.08     0.77540636

        Fisher exact: 1-tailed P-value: 0.6169565
                      2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

                                  NLRT
MRSA       |            0.0            1.0 | Total
-----------+--------------------------------+------
   MRSA    |             66              2 |    68
           >          97.1%           2.9% > 56.2%
           |          55.5%         100.0% |
   MSSA    |             53              0 |    53
           >         100.0%           0.0% > 43.8%
           |          44.5%           0.0% |
-----------+--------------------------------+------
     Total |            119              2 |   121
```

```
          |          98.3%           1.7% |

                          Single Table Analysis

Odds ratio                                                              0.00
Cornfield 95% confidence limits for OR                  0.00 < OR <
5.38*
                     *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 0.00
Exact 95% confidence limits for MLE                     0.00 < OR <   6.83
Exact 95% Mid-P limits for MLE                          0.00 < OR <   4.45
Probability of MLE <=  0.00 if population OR = 1.0              0.31377410

RISK RATIO(RR)(Outcome:NLRT=0.0; Exposure:MRSA=MRSA)                    0.97
95% confidence limits for RR                            0.93 < RR <   1.01

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          1.59     0.20803876
        Mantel-Haenszel:      1.57     0.20992798
        Yates corrected:      0.29     0.58891445

        Fisher exact: 1-tailed P-value: 0.3137741
                      2-tailed P-value: 0.5035813

An expected value is less than 5; recommend Fisher exact results.

                          NRPT
MRSA       |             0.0 | Total
-----------+-----------------+------
   MRSA    |              68 |    68
           >         100.0% > 56.2%
           |          56.2% |
   MSSA    |              53 |    53
           >         100.0% > 43.8%
           |          43.8% |
-----------+-----------------+------
     Total |             121 |   121
           |         100.0% |



             Chi square =       0.00
     Degrees of freedom =          0
                p value = 1.00000000


                                NSST
MRSA       |             0.0             1.0 | Total
-----------+---------------------------------+------
   MRSA    |              59               9 |    68
           >          86.8%          13.2% > 56.2%
           |          55.1%          64.3% |
   MSSA    |              48               5 |    53
```

```
          >          90.6%           9.4% > 43.8%
          |          44.9%          35.7% |
----------+--------------------------------+------
    Total |           107             14   |   121
          |          88.4%          11.6% |
```

Single Table Analysis

Odds ratio		0.68
Cornfield 95% confidence limits for OR	0.18 < OR <	2.46
Maximum likelihood estimate of OR (MLE)		0.68
Exact 95% confidence limits for MLE	0.17 < OR <	2.46
Exact 95% Mid-P limits for MLE	0.20 < OR <	2.19
Probability of MLE <= 0.68 if population OR = 1.0		0.36234013

RISK RATIO(RR)(Outcome:NSST=0.0; Exposure:MRSA=MRSA)		0.96
95% confidence limits for RR	0.84 < RR <	1.09

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.42	0.51660853
Mantel-Haenszel:	0.42	0.51834642
Yates corrected:	0.13	0.71722914

```
                                  RESIDE
MRSA       | H        L        PR       R        | Total
-----------+-----------------------------------+------
   MRSA    |        8        7       51        1 |    67
           >    11.9%    10.4%    76.1%     1.5% > 56.3%
           |    88.9%    70.0%    51.5%   100.0% |
   MSSA    |        1        3       48        0 |    52
           >     1.9%     5.8%    92.3%     0.0% > 43.7%
           |    11.1%    30.0%    48.5%     0.0% |
-----------+-----------------------------------+------
     Total |        9       10       99        1 |   119
           |     7.6%     8.4%    83.2%     0.8% |
```

```
 An expected value is < 5. Chi square not valid.
        Chi square =       6.35
Degrees of freedom =          3
           p value = 0.09596231
```

```
                                          SERVICE
MRSA       |I              N              O
-----------+-----------------------------------------------
   MRSA    |             16             39             11
           >          23.5%          57.4%          16.2%
           |          51.6%          56.5%          57.9%
   MSSA    |             15             30              8
           >          28.3%          56.6%          15.1%
```

```
           |          48.4%          43.5%          42.1%
-----------+-----------------------------------------------
     Total |             31             69             19
           |          25.6%          57.0%          15.7%

                      SERVICE
MRSA       |U               | Total
-----------+----------------+------
   MRSA    |               2 |    68
           >            2.9% > 56.2%
           |          100.0% |
   MSSA    |               0 |    53
           >            0.0% > 43.8%
           |            0.0% |
-----------+----------------+------
     Total |               2 |   121
           |            1.7% |


      An expected value is < 5. Chi square not valid.
             Chi square =       1.85
     Degrees of freedom =          3
                p value = 0.60438157


                           DEVICEIU
MRSA       |             0.0             1.0 | Total
-----------+---------------------------------+------
   MRSA    |              32              36 |    68
           >           47.1%           52.9% > 56.2%
           |           53.3%           59.0% |
   MSSA    |              28              25 |    53
           >           52.8%           47.2% > 43.8%
           |           46.7%           41.0% |
-----------+---------------------------------+------
     Total |              60              61 |   121
           |           49.6%           50.4% |

                        Single Table Analysis

Odds ratio                                                          0.79
Cornfield 95% confidence limits for OR                0.36 < OR <   1.75
Maximum likelihood estimate of OR (MLE)                             0.80
Exact 95% confidence limits for MLE                   0.36 < OR <   1.73
Exact 95% Mid-P limits for MLE                        0.38 < OR <   1.64
Probability of MLE <=  0.80 if population OR = 1.0           0.32761588

RISK RATIO(RR)(Outcome:DEVICEIU=0.0; Exposure:MRSA=MRSA)            0.89
95% confidence limits for RR                          0.62 < RR <   1.27

            Ignore risk ratio if case control study

                       Chi-Squares   P-values
                       -----------   --------

        Uncorrected:          0.40     0.52871116
        Mantel-Haenszel:      0.39     0.53041931
```

Yates corrected:	0.20	0.65506508

MRSA	Freq	Percent	Cum.
MRSA	68	56.2%	56.2%
MSSA	53	43.8%	100.0%
Total	121	100.0%	

	DEVICEMV		
MRSA	0.0	1.0	Total
MRSA	56	12	68
	82.4%	17.6%	> 56.2%
	58.3%	48.0%	
MSSA	40	13	53
	75.5%	24.5%	> 43.8%
	41.7%	52.0%	
Total	96	25	121
	79.3%	20.7%	

Single Table Analysis

Odds ratio		1.52
Cornfield 95% confidence limits for OR	0.57 < OR <	4.05
Maximum likelihood estimate of OR (MLE)		1.51
Exact 95% confidence limits for MLE	0.57 < OR <	4.05
Exact 95% Mid-P limits for MLE	0.62 < OR <	3.73
Probability of MLE >= 1.51 if population OR = 1.0		0.24093255
RISK RATIO(RR)(Outcome:DEVICEMV=0.0; Exposure:MRSA=MRSA)		1.09
95% confidence limits for RR	0.90 < RR <	1.32

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.86	0.35363104
Mantel-Haenszel:	0.85	0.35562775
Yates corrected:	0.49	0.48312377

	DEVICECV		
MRSA	0.0	1.0	Total
MRSA	37	31	68
	54.4%	45.6%	> 56.2%
	56.1%	56.4%	
MSSA	29	24	53
	54.7%	45.3%	> 43.8%
	43.9%	43.6%	
Total	66	55	121

```
          |          54.5%          45.5% |
```

Single Table Analysis

Odds ratio	0.99
Cornfield 95% confidence limits for OR	0.45 < OR < 2.18
Maximum likelihood estimate of OR (MLE)	0.99
Exact 95% confidence limits for MLE	0.45 < OR < 2.16
Exact 95% Mid-P limits for MLE	0.48 < OR < 2.04
Probability of MLE <= 0.99 if population OR = 1.0	0.56005439
RISK RATIO(RR)(Outcome:DEVICECV=0.0; Exposure:MRSA=MRSA)	0.99
95% confidence limits for RR	0.72 < RR < 1.38

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.00	0.97331306
Mantel-Haenszel:	0.00	0.97342353
Yates corrected:	0.02	0.88033852

MRSA	DEVICENF 0.0	1.0	Total
MRSA	48	20	68
>	70.6%	29.4%	> 56.2%
	57.1%	54.1%	
MSSA	36	17	53
>	67.9%	32.1%	> 43.8%
	42.9%	45.9%	
Total	84	37	121
	69.4%	30.6%	

Single Table Analysis

Odds ratio	1.13
Cornfield 95% confidence limits for OR	0.48 < OR < 2.67
Maximum likelihood estimate of OR (MLE)	1.13
Exact 95% confidence limits for MLE	0.48 < OR < 2.64
Exact 95% Mid-P limits for MLE	0.51 < OR < 2.48
Probability of MLE >= 1.13 if population OR = 1.0	0.45234987
RISK RATIO(RR)(Outcome:DEVICENF=0.0; Exposure:MRSA=MRSA)	1.04
95% confidence limits for RR	0.82 < RR < 1.32

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.10	0.75236459
Mantel-Haenszel:	0.10	0.75335663
Yates corrected:	0.01	0.90711540

MRSA	DEVICETR 0.0	1.0	Total
MRSA	67	1	68
>	98.5%	1.5%	> 56.2%
	58.3%	16.7%	
MSSA	48	5	53
>	90.6%	9.4%	> 43.8%
	41.7%	83.3%	
Total	115	6	121
	95.0%	5.0%	

Single Table Analysis

Odds ratio 6.98
Cornfield 95% confidence limits for OR 0.74 < OR < 165.86*
*May be inaccurate
Maximum likelihood estimate of OR (MLE) 6.88
Exact 95% confidence limits for MLE 0.74 < OR < 334.90
Exact 95% Mid-P limits for MLE 0.92 < OR < 168.30
Probability of MLE >= 6.88 if population OR = 1.0 0.05674674

RISK RATIO(RR)(Outcome:DEVICETR=0.0; Exposure:MRSA=MRSA) 1.09
95% confidence limits for RR 0.99 < RR < 1.19

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	4.01	0.04528792 <---
Mantel-Haenszel:	3.97	0.04618697 <---
Yates corrected:	2.50	0.11411781

Fisher exact: 1-tailed P-value: 0.0567467
2-tailed P-value: 0.0852256

An expected value is less than 5; recommend Fisher exact results.

MRSA	DEVICEPD 0.0	1.0	Total
MRSA	64	4	68
>	94.1%	5.9%	> 56.2%
	54.7%	100.0%	
MSSA	53	0	53
>	100.0%	0.0%	> 43.8%
	45.3%	0.0%	
Total	117	4	121
	96.7%	3.3%	

Single Table Analysis

```
Odds ratio                                                              0.00
Cornfield 95% confidence limits for OR                  0.00 < OR <
1.98*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 0.00
Exact 95% confidence limits for MLE                     0.00 < OR <     1.92
Exact 95% Mid-P limits for MLE                          0.00 < OR <     1.40
Probability of MLE <=  0.00 if population OR = 1.0              0.09586177

RISK RATIO(RR)(Outcome:DEVICEPD=0.0; Exposure:MRSA=MRSA)                0.94
95% confidence limits for RR                            0.89 < RR <     1.00

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:         3.22     0.07255577
        Mantel-Haenszel:     3.20     0.07374702
        Yates corrected:     1.65     0.19942652

        Fisher exact: 1-tailed P-value: 0.0958618
                      2-tailed P-value: 0.1303304

An expected value is less than 5; recommend Fisher exact results.

                              DEVICEOT
MRSA       |            0.0            1.0 | Total
-----------+-------------------------------+------
   MRSA    |             59              9 |    68
           >          86.8%          13.2% > 56.2%
           |          59.0%          42.9% |
           |
   MSSA    |             41             12 |    53
           >          77.4%          22.6% > 43.8%
           |          41.0%          57.1% |
-----------+-------------------------------+------
     Total |            100             21 |   121
           |          82.6%          17.4% |

                           Single Table Analysis

Odds ratio                                                              1.92
Cornfield 95% confidence limits for OR                  0.67 < OR <     5.56

Maximum likelihood estimate of OR (MLE)                                 1.91
Exact 95% confidence limits for MLE                     0.67 < OR <     5.64
Exact 95% Mid-P limits for MLE                          0.73 < OR <     5.12
Probability of MLE >=  1.91 if population OR = 1.0              0.13292937

RISK RATIO(RR)(Outcome:DEVICEOT=0.0; Exposure:MRSA=MRSA)                1.12
95% confidence limits for RR                            0.94 < RR <     1.33

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
```

Uncorrected:	1.84	0.17526743
Mantel-Haenszel:	1.82	0.17706134
Yates corrected:	1.24	0.26546555

NODEV	MRSA	MSSA	Total
0.0	17	14	31
	54.8%	45.2%	25.6%
	25.0%	26.4%	
1.0	16	14	30
	53.3%	46.7%	24.8%
	23.5%	26.4%	
2.0	17	8	25
	68.0%	32.0%	20.7%
	25.0%	15.1%	
3.0	10	6	16
	62.5%	37.5%	13.2%
	14.7%	11.3%	
4.0	7	7	14
	50.0%	50.0%	11.6%
	10.3%	13.2%	
5.0	1	4	5
	20.0%	80.0%	4.1%
	1.5%	7.5%	
Total	68	53	121
	56.2%	43.8%	

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	68	113	1.662	1.839	1.356
MSSA	53	96	1.811	2.656	1.630
Difference			-0.150		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	0.000	0.500	2.000	3.000	5.000	0.000
MSSA	0.000	0.000	1.000	3.000	5.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.666	1	0.666	0.303	0.582816	0.550782
Within	261.334	119	2.196			
Total	262.000	120				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 1.980 deg freedom = 1 p-value = 0.159372

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.054
Degrees of freedom = 1
p value = 0.816139

	MRSAHX		
MRSA	0.0	1.0	Total
MRSA	50	18	68
	73.5%	26.5%	> 56.2%
	48.5%	100.0%	
MSSA	53	0	53
	100.0%	0.0%	> 43.8%
	51.5%	0.0%	
Total	103	18	121
	85.1%	14.9%	

Single Table Analysis

Odds ratio		0.00
Cornfield 95% confidence limits for OR	0.00 < OR <	0.28
Maximum likelihood estimate of OR (MLE)		0.00
Exact 95% confidence limits for MLE	0.00 < OR <	0.23
Exact 95% Mid-P limits for MLE	0.00 < OR <	0.18
Probability of MLE <= 0.00 if population OR = 1.0		0.00000998
RISK RATIO(RR)(Outcome:MRSAHX=0.0; Exposure:MRSA=MRSA)		0.74
95% confidence limits for RR	0.64 < RR <	0.85

Ignore risk ratio if case control study

	Chi-Squares	P-values	
Uncorrected:	16.48	0.00004914	<---
Mantel-Haenszel:	16.34	0.00005280	<---
Yates corrected:	14.46	0.00014339	<---

	MRSAHXTY			
MRSA	C	I	I/C	Total
MRSA	12	5	1	18
	66.7%	27.8%	5.6%	>100.0%
	100.0%	100.0%	100.0%	
Total	12	5	1	18
	66.7%	27.8%	5.6%	

An expected value is < 5. Chi square not valid.
Chi square = 0.00
Degrees of freedom = 0
p value = 1.00000000

MRSA	MSSAHX 0.0	1.0	Total
MRSA	66	2	68
>	97.1%	2.9%	> 56.2%
	56.9%	40.0%	
MSSA	50	3	53
>	94.3%	5.7%	> 43.8%
	43.1%	60.0%	
Total	116	5	121
	95.9%	4.1%	

Single Table Analysis

Odds ratio 1.98

Cornfield 95% confidence limits for OR 0.25 < OR < 17.98*

*May be inaccurate

Maximum likelihood estimate of OR (MLE) 1.97

Exact 95% confidence limits for MLE 0.22 < OR < 24.40

Exact 95% Mid-P limits for MLE 0.28 < OR < 17.08

Probability of MLE >= 1.97 if population OR = 1.0 0.38304351

RISK RATIO(RR)(Outcome:MSSAHX=0.0; Exposure:MRSA=MRSA) 1.03

95% confidence limits for RR 0.95 < RR < 1.11

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.56	0.45590237
Mantel-Haenszel:	0.55	0.45777011
Yates corrected:	0.08	0.77540636

Fisher exact: 1-tailed P-value: 0.3830435

2-tailed P-value: 0.6526035

An expected value is less than 5; recommend Fisher exact results.

MRSA	MSSAHXTY C	I	Total
MRSA	2	0	2
>	100.0%	0.0%	> 40.0%
	50.0%	0.0%	
MSSA	2	1	3
>	66.7%	33.3%	> 60.0%
	50.0%	100.0%	
Total	4	1	5
	80.0%	20.0%	

Single Table Analysis

Odds ratio	??????
Maximum likelihood estimate of OR (MLE)	??????
Exact 95% confidence limits for MLE	0.02 < OR < ??????
Exact 95% Mid-P limits for MLE	0.04 < OR < ??????
Probability of MLE >= ?????? if population OR = 1.0	0.60000000
RISK RATIO(RR)(Outcome:MSSAHXTY=C; Exposure:MRSA=MRSA)	1.50
95% confidence limits for RR	0.67 < RR < 3.34

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.83	0.36131043
Mantel-Haenszel:	0.67	0.41421618
Yates corrected:	0.05	0.81947698

Fisher exact: 1-tailed P-value: 0.6000000
2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

MRSA	VREHX 0.0	Total
MRSA	68	68
	100.0% > 56.2%	
	56.2%	
MSSA	53	53
	100.0% > 43.8%	
	43.8%	
Total	121	121
	100.0%	

Chi square = 0.00
Degrees of freedom = 0
p value = 1.00000000

MRSA	VRE 0.0	Total
MRSA	68	68
	100.0% > 56.2%	
	56.2%	
MSSA	53	53
	100.0% > 43.8%	
	43.8%	
Total	121	121
	100.0%	

```
          Chi square =       0.00
     Degrees of freedom =       0
                p value = 1.00000000
```

	CDIF		
MRSA	0.0	1.0	Total
MRSA	64	4	68
>	94.1%	5.9%	> 56.2%
|	54.7%	100.0%	|
MSSA	53	0	53
>	100.0%	0.0%	> 43.8%
|	45.3%	0.0%	|
Total	117	4	121
|	96.7%	3.3%	|

Single Table Analysis

```
Odds ratio                                                          0.00
Cornfield 95% confidence limits for OR                0.00 < OR <
1.98*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                             0.00
Exact 95% confidence limits for MLE                   0.00 < OR <   1.92
Exact 95% Mid-P limits for MLE                        0.00 < OR <   1.40
Probability of MLE <=  0.00 if population OR = 1.0           0.09586177

RISK RATIO(RR)(Outcome:CDIF=0.0; Exposure:MRSA=MRSA)                0.94
95% confidence limits for RR                          0.89 < RR <   1.00

              Ignore risk ratio if case control study

                        Chi-Squares   P-values
                        -----------   --------

       Uncorrected:         3.22     0.07255577
       Mantel-Haenszel:     3.20     0.07374702
       Yates corrected:     1.65     0.19942652

       Fisher exact: 1-tailed P-value: 0.0958618
                     2-tailed P-value: 0.1303304

An expected value is less than 5; recommend Fisher exact results.
```

	ESBL		
MRSA	0.0	1.0	Total
MRSA	66	2	68
>	97.1%	2.9%	> 56.2%
|	56.4%	50.0%	|
MSSA	51	2	53

```
          >          96.2%           3.8% > 43.8%
          |          43.6%          50.0% |
----------+--------------------------------+------
     Total |           117              4 |   121
          |          96.7%           3.3% |

                          Single Table Analysis

Odds ratio                                                              1.29
Cornfield 95% confidence limits for OR                  0.12 < OR <
13.62*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 1.29
Exact 95% confidence limits for MLE                     0.09 < OR <  18.38
Exact 95% Mid-P limits for MLE                          0.13 < OR <  12.76
Probability of MLE >=  1.29 if population OR = 1.0              0.59148140

RISK RATIO(RR)(Outcome:ESBL=0.0; Exposure:MRSA=MRSA)                    1.01
95% confidence limits for RR                            0.94 < RR <   1.08

              Ignore risk ratio if case control study

                        Chi-Squares   P-values
                        -----------   --------

        Uncorrected:         0.06     0.79942103
        Mantel-Haenszel:     0.06     0.80023398
        Yates corrected:     0.07     0.79615115

        Fisher exact: 1-tailed P-value: 0.5914814
                      2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

                     ESBLTYPE
MRSA       | C      I       | Total
-----------+---------------+------
   MRSA    |      0       2 |     2
          >   0.0% 100.0% > 50.0%
          |   0.0%  66.7% |
   MSSA    |      1       1 |     2
          >  50.0%  50.0% > 50.0%
          | 100.0%  33.3% |
-----------+---------------+------
     Total |      1       3 |     4
          |  25.0%  75.0% |

                          Single Table Analysis

Odds ratio                                                              0.00
Cornfield 95% confidence limits for OR                  0.00 < OR <
30.27*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 0.00
Exact 95% confidence limits for MLE                     0.00 < OR <  39.00
Exact 95% Mid-P limits for MLE                          0.00 < OR <  19.00
Probability of MLE <=  0.00 if population OR = 1.0              0.50000000
```

```
RISK RATIO(RR)(Outcome:ESBLTYPE=C; Exposure:MRSA=MRSA)                    0.00
95% confidence limits for RR                              ?????? < RR < ??????

              Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          1.33     0.24821308
        Mantel-Haenszel:      1.00     0.31731051
        Yates corrected:      0.00     1.00000000

        Fisher exact: 1-tailed P-value: 0.5000000
                      2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

                          OARO
MRSA       |             0.0 | Total
-----------+-----------------+------
   MRSA    |              68 |    68
           >          100.0% > 56.2%
           |           56.2% |
   MSSA    |              53 |    53
           >          100.0% > 43.8%
           |           43.8% |
-----------+-----------------+------
     Total |             121 |   121
           |          100.0% |



             Chi square =       0.00
     Degrees of freedom =          0
                p value = 1.00000000


                          MRSA
  NOTHORG     | MRSA    MSSA    | Total
--------------+-----------------+------
            0.0 |      61      50 |   111
                >   55.0%   45.0% > 91.7%
                |   89.7%   94.3% |
            1.0 |       6       3 |     9
                >   66.7%   33.3% >  7.4%
                |    8.8%    5.7% |
            2.0 |       1       0 |     1
                >  100.0%    0.0% >  0.8%
                |    1.5%    0.0% |
--------------+-----------------+------
        Total |      68      53 |   121
              |   56.2%   43.8% |


MRSA                Obs      Total       Mean   Variance    Std Dev
MRSA                 68          8      0.118      0.135      0.368
```

MSSA	53	3	0.057	0.054	0.233
Difference			0.061		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	0.000	0.000	0.000	0.000	2.000	0.000
MSSA	0.000	0.000	0.000	0.000	1.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.111	1	0.111	1.111	0.294021	1.053994
Within	11.889	119	0.100			
Total	12.000	120				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 11.217 deg freedom = 1 p-value = 0.000811

Bartlett's Test shows the variances in the samples to differ.
Use non-parametric results below rather than ANOVA.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.866
Degrees of freedom = 1
p value = 0.351975

	ICUADT		
MRSA	N	Y	Total
MRSA	51	17	68
	75.0%	25.0%	56.2%
	58.6%	50.0%	
MSSA	36	17	53
	67.9%	32.1%	43.8%
	41.4%	50.0%	
Total	87	34	121
	71.9%	28.1%	

Single Table Analysis

Odds ratio		1.42
Cornfield 95% confidence limits for OR	0.59 < OR <	3.41
Maximum likelihood estimate of OR (MLE)		1.41
Exact 95% confidence limits for MLE	0.59 < OR <	3.39
Exact 95% Mid-P limits for MLE	0.63 < OR <	3.17
Probability of MLE >= 1.41 if population OR = 1.0		0.25563385

RISK RATIO(RR)(Outcome:ICUADT=N; Exposure:MRSA=MRSA)		1.10
95% confidence limits for RR	0.88 < RR <	1.39

Ignore risk ratio if case control study

Chi-Squares P-values

```
                           -----------   --------

         Uncorrected:          0.74     0.39028789
         Mantel-Haenszel:      0.73     0.39225335
         Yates corrected:      0.43     0.51229342


                             MRSA
  ICUDAYS    | MRSA    MSSA    | Total
-------------+-----------------+------
         1.0 |       2       2 |     4
             >   50.0%   50.0% > 12.1%
             |   11.8%   12.5% |
         2.0 |       2       0 |     2
             >  100.0%    0.0% >  6.1%
             |   11.8%    0.0% |
         3.0 |       0       3 |     3
             >    0.0%  100.0% >  9.1%
             |    0.0%   18.8% |
         4.0 |       3       1 |     4
             >   75.0%   25.0% > 12.1%
             |   17.6%    6.3% |
         5.0 |       0       1 |     1
             >    0.0%  100.0% >  3.0%
             |    0.0%    6.3% |
         6.0 |       2       1 |     3
             >   66.7%   33.3% >  9.1%
             |   11.8%    6.3% |
         9.0 |       1       1 |     2
             >   50.0%   50.0% >  6.1%
             |    5.9%    6.3% |
        10.0 |       2       3 |     5
             >   40.0%   60.0% > 15.2%
             |   11.8%   18.8% |
        15.0 |       2       0 |     2
             >  100.0%    0.0% >  6.1%
             |   11.8%    0.0% |
        16.0 |       1       0 |     1
             >  100.0%    0.0% >  3.0%
             |    5.9%    0.0% |
        17.0 |       1       0 |     1
             >  100.0%    0.0% >  3.0%
             |    5.9%    0.0% |
        23.0 |       0       1 |     1
             >    0.0%  100.0% >  3.0%
             |    0.0%    6.3% |
        24.0 |       1       0 |     1
             >  100.0%    0.0% >  3.0%
             |    5.9%    0.0% |
        30.0 |       0       1 |     1
             >    0.0%  100.0% >  3.0%
             |    0.0%    6.3% |
        42.0 |       0       2 |     2
             >    0.0%  100.0% >  6.1%
             |    0.0%   12.5% |
-------------+-----------------+------
       Total |      17      16 |    33
```

```
             |   51.5%   48.5% |

MRSA              Obs      Total       Mean   Variance    Std Dev
MRSA               17        146      8.588     45.507      6.746
MSSA               16        202     12.625    192.917     13.889
Difference                           -4.037

MRSA          Minimum     25%ile     Median     75%ile    Maximum       Mode
MRSA            1.000      4.000      6.000     15.000     24.000      4.000
MSSA            1.000      3.000      7.500     16.500     42.000      3.000

                                ANOVA
                    (For normally distributed data only)

Variation          SS   df          MS  F statistic    p-value    t-value
Between       134.314    1     134.314        1.150   0.291907   1.072199
Within       3621.868   31     116.834
Total        3756.182   32

                Bartlett's test for homogeneity of variance
    Bartlett's chi square =   7.327  deg freedom =  1   p-value = 0.006793

        Bartlett's Test shows the variances in the samples to differ.
             Use non-parametric results below rather than ANOVA.


 Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two
groups)

Kruskal-Wallis H (equivalent to Chi square) =       0.084
                        Degrees of freedom =           1
                                  p value =    0.772248

                      SURGERY
MRSA       |      N      Y | Total
-----------+---------------+------
   MRSA    |     49     18 |    67
           >  73.1%  26.9% > 55.8%
           |  57.0%  52.9% |
   MSSA    |     37     16 |    53
           >  69.8%  30.2% > 44.2%
           |  43.0%  47.1% |
-----------+---------------+------
     Total |     86     34 |   120
           |  71.7%  28.3% |

                           Single Table Analysis

Odds ratio                                                          1.18
Cornfield 95% confidence limits for OR                0.49 < OR <   2.84
Maximum likelihood estimate of OR (MLE)                             1.18
Exact 95% confidence limits for MLE                   0.49 < OR <   2.81
Exact 95% Mid-P limits for MLE                        0.52 < OR <   2.63
Probability of MLE >=  1.18 if population OR = 1.0            0.42063931

RISK RATIO(RR)(Outcome:SURGERY=N; Exposure:MRSA=MRSA)               1.05
```

95% confidence limits for RR 0.83 < RR < 1.32

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.16	0.68830846
Mantel-Haenszel:	0.16	0.68954198
Yates corrected:	0.04	0.84368962

	IMMTHE		
MRSA	N	Y	Total
MRSA	52	16	68
	76.5%	23.5%	56.2%
	55.3%	59.3%	
MSSA	42	11	53
	79.2%	20.8%	43.8%
	44.7%	40.7%	
Total	94	27	121
	77.7%	22.3%	

Single Table Analysis

Odds ratio	0.85
Cornfield 95% confidence limits for OR	0.32 < OR < 2.22
Maximum likelihood estimate of OR (MLE)	0.85
Exact 95% confidence limits for MLE	0.32 < OR < 2.20
Exact 95% Mid-P limits for MLE	0.35 < OR < 2.04
Probability of MLE <= 0.85 if population OR = 1.0	0.44498853
RISK RATIO(RR)(Outcome:IMMTHE=N; Exposure:MRSA=MRSA)	0.96
95% confidence limits for RR	0.80 < RR < 1.17

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.13	0.71607505
Mantel-Haenszel:	0.13	0.71720010
Yates corrected:	0.02	0.88576485

	NEUTRO		
MRSA	N	Y	Total
MRSA	61	7	68
	89.7%	10.3%	57.1%
	55.5%	77.8%	
MSSA	49	2	51
	96.1%	3.9%	42.9%
	44.5%	22.2%	

```
     Total |    110      9 |   119
           |  92.4%   7.6% |
```

Single Table Analysis

Odds ratio		0.36
Cornfield 95% confidence limits for OR	0.05 < OR <	2.02
Maximum likelihood estimate of OR (MLE)		0.36
Exact 95% confidence limits for MLE	0.03 < OR <	2.00
Exact 95% Mid-P limits for MLE	0.05 < OR <	1.69
Probability of MLE <= 0.36 if population OR = 1.0		0.17186246
RISK RATIO(RR)(Outcome:NEUTRO=N; Exposure:MRSA=MRSA)		0.93
95% confidence limits for RR	0.85 < RR <	1.03

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	1.69	0.19322634
Mantel-Haenszel:	1.68	0.19510799
Yates corrected:	0.90	0.34170625

Fisher exact: 1-tailed P-value: 0.1718625
2-tailed P-value: 0.2972343

An expected value is less than 5; recommend Fisher exact results.

```
                      MRSA
  NEUTRODA    | MRSA    MSSA    | Total
--------------+-----------------+------
            1.0 |       1       0 |     1
                >  100.0%    0.0% > 20.0%
                |   25.0%    0.0% |
            3.0 |       1       0 |     1
                >  100.0%    0.0% > 20.0%
                |   25.0%    0.0% |
            5.0 |       2       0 |     2
                >  100.0%    0.0% > 40.0%
                |   50.0%    0.0% |
            6.5 |       0       1 |     1
                >    0.0%  100.0% > 20.0%
                |    0.0%  100.0% |
--------------+-----------------+------
        Total |       4       1 |     5
              |   80.0%   20.0% |
```

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	4	14	3.500	3.667	1.915
MSSA	1	7	6.500	0.000	0.000
Difference			-3.000		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	1.000	2.000	4.000	5.000	5.000	5.000
MSSA	6.500	6.500	6.500	6.500	6.500	6.500

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	7.200	1	7.200	1.964	0.255658	1.401298
Within	11.000	3	3.667			
Total	18.200	4				

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 2.105
Degrees of freedom = 1
p value = 0.146793

	DIALSIS		
MRSA	N	Y	Total
MRSA	58	10	68
	85.3%	14.7%	56.2%
	55.2%	62.5%	
MSSA	47	6	53
	88.7%	11.3%	43.8%
	44.8%	37.5%	
Total	105	16	121
	86.8%	13.2%	

Single Table Analysis

Odds ratio		0.74
Cornfield 95% confidence limits for OR	0.22 < OR <	2.46
Maximum likelihood estimate of OR (MLE)		0.74
Exact 95% confidence limits for MLE	0.21 < OR <	2.45
Exact 95% Mid-P limits for MLE	0.23 < OR <	2.20
Probability of MLE <= 0.74 if population OR = 1.0		0.39515034
RISK RATIO(RR)(Outcome:DIALSIS=N; Exposure:MRSA=MRSA)		0.96
95% confidence limits for RR	0.84 < RR <	1.10

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.30	0.58548677
Mantel-Haenszel:	0.29	0.58704062
Yates corrected:	0.08	0.78337068

	IDCONSUL		
MRSA	N	Y	Total
MRSA	28	40	68
	41.2%	58.8%	56.2%

```
          |  47.5%  64.5% |
   MSSA   |     31     22 |    53
          >  58.5%  41.5% > 43.8%
          |  52.5%  35.5% |
----------+---------------+------
    Total |     59     62 |   121
          |  48.8%  51.2% |
```

Single Table Analysis

Odds ratio		0.50
Cornfield 95% confidence limits for OR	0.22 < OR <	1.10
Maximum likelihood estimate of OR (MLE)		0.50
Exact 95% confidence limits for MLE	0.22 < OR <	1.10
Exact 95% Mid-P limits for MLE	0.24 < OR <	1.04
Probability of MLE <= 0.50 if population OR = 1.0		0.04371331
RISK RATIO(RR)(Outcome:IDCONSUL=N; Exposure:MRSA=MRSA)		0.70
95% confidence limits for RR	0.49 < RR <	1.01

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	3.57	0.05869906
Mantel-Haenszel:	3.54	0.05975288
Yates corrected:	2.91	0.08779368

NOHAB	MRSA	MSSA	Total
0.0	17	34	51
	33.3%	66.7%	42.1%
	25.0%	64.2%	
1.0	11	10	21
	52.4%	47.6%	17.4%
	16.2%	18.9%	
2.0	11	3	14
	78.6%	21.4%	11.6%
	16.2%	5.7%	
3.0	15	1	16
	93.8%	6.3%	13.2%
	22.1%	1.9%	
4.0	9	2	11
	81.8%	18.2%	9.1%
	13.2%	3.8%	
5.0	2	3	5
	40.0%	60.0%	4.1%
	2.9%	5.7%	
7.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	
8.0	1	0	1
	100.0%	0.0%	0.8%
	1.5%	0.0%	

10.0	1	0	1
	> 100.0%	0.0%	> 0.8%
	1.5%	0.0%	
Total	68	53	121
	56.2%	43.8%	

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	68	149	2.191	4.038	2.009
MSSA	53	42	0.792	2.014	1.419
Difference			1.399		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	0.000	0.500	2.000	3.000	10.000	0.000
MSSA	0.000	0.000	0.000	1.000	5.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	58.272	1	58.272	18.480	0.000035	4.298880
Within	375.232	119	3.153			
Total	433.504	120				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 6.696 deg freedom = 1 p-value = 0.009662

Bartlett's Test shows the variances in the samples to differ.
Use non-parametric results below rather than ANOVA.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 20.641
Degrees of freedom = 1
p value = 0.000006

HABUSE

MRSA	0.0	1.0	Total
MRSA	17	51	68
	25.0%	75.0%	56.2%
	33.3%	72.9%	
MSSA	34	19	53
	64.2%	35.8%	43.8%
	66.7%	27.1%	
Total	51	70	121
	42.1%	57.9%	

Single Table Analysis

Odds ratio		0.19
Cornfield 95% confidence limits for OR	0.08 < OR <	0.44
Maximum likelihood estimate of OR (MLE)		0.19

```
Exact 95% confidence limits for MLE                        0.08 < OR <   0.44
Exact 95% Mid-P limits for MLE                             0.08 < OR <   0.41
Probability of MLE <=  0.19 if population OR = 1.0                  0.00001484

RISK RATIO(RR)(Outcome:HABUSE=0.0; Exposure:MRSA=MRSA)                      0.39
95% confidence limits for RR                               0.25 < RR <   0.62

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:        18.72     0.00001511 <---
        Mantel-Haenszel:    18.57     0.00001639 <---
        Yates corrected:    17.15     0.00003450 <---


                      EMPIRIC
MRSA       |      N       Y | Total
-----------+---------------+------
   MRSA    |     15      53 |    68
           >  22.1%  77.9% > 56.2%
           |  51.7%  57.6% |
   MSSA    |     14      39 |    53
           >  26.4%  73.6% > 43.8%
           |  48.3%  42.4% |
-----------+---------------+------
     Total |     29      92 |   121
           |  24.0%  76.0% |

                           Single Table Analysis

Odds ratio                                                                  0.79
Cornfield 95% confidence limits for OR                     0.31 < OR <   1.99
Maximum likelihood estimate of OR (MLE)                                     0.79
Exact 95% confidence limits for MLE                        0.31 < OR <   1.99
Exact 95% Mid-P limits for MLE                             0.34 < OR <   1.85
Probability of MLE <=  0.79 if population OR = 1.0                  0.36470521

RISK RATIO(RR)(Outcome:EMPIRIC=N; Exposure:MRSA=MRSA)                       0.84
95% confidence limits for RR                               0.44 < RR <   1.57

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.31     0.57756963
        Mantel-Haenszel:      0.31     0.57914635
        Yates corrected:      0.12     0.73210865


                         MRSA
  NOEMPAB     | MRSA     MSSA     | Total
--------------+------------------+------
            0.0 |       15       15 |    30
                >    50.0%    50.0% > 24.8%
```

```
             |   22.1%   28.3% |
         1.0 |      16       14 |    30
             >   53.3%   46.7% > 24.8%
             |   23.5%   26.4% |
         2.0 |      19       10 |    29
             >   65.5%   34.5% > 24.0%
             |   27.9%   18.9% |
         3.0 |      14        8 |    22
             >   63.6%   36.4% > 18.2%
             |   20.6%   15.1% |
         4.0 |       4        4 |     8
             >   50.0%   50.0% >  6.6%
             |    5.9%    7.5% |
         5.0 |       0        2 |     2
             >    0.0%  100.0% >  1.7%
             |    0.0%    3.8% |
-------------+-----------------+------
       Total |      68       53 |   121
             |   56.2%   43.8% |
```

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	68	112	1.647	1.456	1.207
MSSA	53	84	1.585	2.055	1.434
Difference			0.062		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	0.000	1.000	2.000	3.000	4.000	2.000
MSSA	0.000	0.000	1.000	3.000	5.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.115	1	0.115	0.067	0.796221	0.258821
Within	204.397	119	1.718			
Total	204.512	120				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 1.743 deg freedom = 1 p-value = 0.186751

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.326
Degrees of freedom = 1
p value = 0.568016

APPEMPAB

```
MRSA       |      N      Y | Total
-----------+---------------+------
   MRSA    |     47     21 |    68
           >  69.1%  30.9% > 56.2%
```

```
          |  72.3%  37.5% |
   MSSA   |     18     35 |    53
          >  34.0%  66.0% > 43.8%
          |  27.7%  62.5% |
----------+---------------+------
    Total |     65     56 |   121
          |  53.7%  46.3% |
```

Single Table Analysis

Odds ratio	4.35
Cornfield 95% confidence limits for OR	1.88 < OR < 10.20
Maximum likelihood estimate of OR (MLE)	4.29
Exact 95% confidence limits for MLE	1.89 < OR < 10.08
Exact 95% Mid-P limits for MLE	2.01 < OR < 9.44
Probability of MLE >= 4.29 if population OR = 1.0	0.00011136

RISK RATIO(RR)(Outcome:APPEMPAB=N; Exposure:MRSA=MRSA)	2.04
95% confidence limits for RR	1.35 < RR < 3.06

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	14.81	0.00011912 <---
Mantel-Haenszel:	14.68	0.00012711 <---
Yates corrected:	13.43	0.00024813 <---

```
                      MRSA
  LOTEMDAY    | MRSA    MSSA    | Total
--------------+-----------------+------
          0.0 |      38      38 |    76
              >   50.0%   50.0% > 62.8%
              |   55.9%   71.7% |
          1.0 |      15      10 |    25
              >   60.0%   40.0% > 20.7%
              |   22.1%   18.9% |
          2.0 |      13       5 |    18
              >   72.2%   27.8% > 14.9%
              |   19.1%    9.4% |
          3.0 |       2       0 |     2
              >  100.0%    0.0% >  1.7%
              |    2.9%    0.0% |
--------------+-----------------+------
        Total |      68      53 |   121
              |   56.2%   43.8% |
```

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	68	47	0.691	0.784	0.885
MSSA	53	20	0.377	0.432	0.657
Difference			0.314		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode

MRSA	0.000	0.000	0.000	1.000	3.000	0.000
MSSA	0.000	0.000	0.000	1.000	2.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	2.933	1	2.933	4.656	0.032952	2.157816
Within	74.968	119	0.630			
Total	77.901	120				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 4.963 deg freedom = 1 p-value = 0.025889

Bartlett's Test shows the variances in the samples to differ.
Use non-parametric results below rather than ANOVA.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 3.955
Degrees of freedom = 1
p value = 0.046733

	LOTEMCAT				
MRSA	0	1	2	3+	Total
MRSA	38	15	13	2	68
	55.9%	22.1%	19.1%	2.9%	56.2%
	50.0%	60.0%	72.2%	100.0%	
MSSA	38	10	5	0	53
	71.7%	18.9%	9.4%	0.0%	43.8%
	50.0%	40.0%	27.8%	0.0%	
Total	76	25	18	2	121
	62.8%	20.7%	14.9%	1.7%	

An expected value is < 5. Chi square not valid.
Chi square = 4.77
Degrees of freedom = 3
p value = 0.18948715

MRSA

NOAABC	MRSA	MSSA	Total
0.0	17	15	32
	53.1%	46.9%	26.4%
	25.0%	28.3%	
1.0	21	13	34
	61.8%	38.2%	28.1%
	30.9%	24.5%	
2.0	11	11	22
	50.0%	50.0%	18.2%

```
             |   16.2%   20.8% |
         3.0 |       8       1 |     9
             >   88.9%   11.1% >  7.4%
             |   11.8%    1.9% |
         4.0 |       5       6 |    11
             >   45.5%   54.5% >  9.1%
             |    7.4%   11.3% |
         5.0 |       3       0 |     3
             >  100.0%    0.0% >  2.5%
             |    4.4%    0.0% |
         6.0 |       1       5 |     6
             >   16.7%   83.3% >  5.0%
             |    1.5%    9.4% |
         7.0 |       0       2 |     2
             >    0.0%  100.0% >  1.7%
             |    0.0%    3.8% |
         8.0 |       2       0 |     2
             >  100.0%    0.0% >  1.7%
             |    2.9%    0.0% |
-------------+-----------------+------
       Total |      68      53 |   121
             |   56.2%   43.8% |
```

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	68	124	1.824	3.431	1.852
MSSA	53	106	2.000	4.385	2.094
Difference			-0.176		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	0.000	0.500	1.000	3.000	8.000	1.000
MSSA	0.000	0.000	1.000	3.000	7.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.928	1	0.928	0.241	0.624341	0.490985
Within	457.882	119	3.848			
Total	458.810	120				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.880 deg freedom = 1 p-value = 0.348288

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.028
Degrees of freedom = 1
p value = 0.868175

APPAABC

MRSA	N	Y	Total

MRSA	24	44	68
	35.3%	64.7%	56.2%
	58.5%	55.0%	
MSSA	17	36	53
	32.1%	67.9%	43.8%
	41.5%	45.0%	
Total	41	80	121
	33.9%	66.1%	

Single Table Analysis

Odds ratio		1.16
Cornfield 95% confidence limits for OR	0.50 < OR <	2.68
Maximum likelihood estimate of OR (MLE)		1.15
Exact 95% confidence limits for MLE	0.51 < OR <	2.67
Exact 95% Mid-P limits for MLE	0.54 < OR <	2.51
Probability of MLE >= 1.15 if population OR = 1.0		0.43060504
RISK RATIO(RR)(Outcome:APPAABC=N; Exposure:MRSA=MRSA)		1.10
95% confidence limits for RR	0.66 < RR <	1.83

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.14	0.71054370
Mantel-Haenszel:	0.14	0.71168858
Yates corrected:	0.03	0.85906494

LOTAPDAY	MRSA	MSSA	Total
-7.0	1	0	1
	100.0%	0.0%	0.9%
	1.5%	0.0%	
-6.0	1	0	1
	100.0%	0.0%	0.9%
	1.5%	0.0%	
-2.0	1	0	1
	100.0%	0.0%	0.9%
	1.5%	0.0%	
-1.0	3	0	3
	100.0%	0.0%	2.6%
	4.5%	0.0%	
0.0	7	6	13
	53.8%	46.2%	11.1%
	10.4%	12.0%	
1.0	12	12	24
	50.0%	50.0%	20.5%
	17.9%	24.0%	
2.0	21	17	38
	55.3%	44.7%	32.5%
	31.3%	34.0%	

3.0	11	6	17
	64.7%	35.3%	14.5%
	16.4%	12.0%	
4.0	2	5	7
	28.6%	71.4%	6.0%
	3.0%	10.0%	
5.0	0	1	1
	0.0%	100.0%	0.9%
	0.0%	2.0%	
6.0	0	1	1
	0.0%	100.0%	0.9%
	0.0%	2.0%	
7.0	4	0	4
	100.0%	0.0%	3.4%
	6.0%	0.0%	
9.0	1	0	1
	100.0%	0.0%	0.9%
	1.5%	0.0%	
10.0	0	1	1
	0.0%	100.0%	0.9%
	0.0%	2.0%	
12.0	2	0	2
	100.0%	0.0%	1.7%
	3.0%	0.0%	
17.0	1	1	2
	50.0%	50.0%	1.7%
	1.5%	2.0%	
Total	67	50	117
	57.3%	42.7%	

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	67	155	2.313	12.340	3.513
MSSA	50	122	2.440	7.476	2.734
Difference			-0.127		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	-7.000	1.000	2.000	3.000	17.000	2.000
MSSA	0.000	1.000	2.000	3.000	17.000	2.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.459	1	0.459	0.045	0.832981	0.211360
Within	1180.738	115	10.267			
Total	1181.197	116				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 3.382 deg freedom = 1 p-value = 0.065923

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.119
Degrees of freedom = 1
p value = 0.730562

	LOTAPCAT								
MRSA	0	1	2	3	-1	-2	-6	-7	Total
MRSA	7	12	21	22	3	1	1	1	68
	10.3%	17.6%	30.9%	32.4%	4.4%	1.5%	1.5%	1.5%	57.1%
	53.8%	50.0%	55.3%	57.9%	100.0%	100.0%	100.0%	100.0%	
MSSA	6	12	17	16	0	0	0	0	51
	11.8%	23.5%	33.3%	31.4%	0.0%	0.0%	0.0%	0.0%	42.9%
	46.2%	50.0%	44.7%	42.1%	0.0%	0.0%	0.0%	0.0%	
Total	13	24	38	38	3	1	1	1	119
	10.9%	20.2%	31.9%	31.9%	2.5%	0.8%	0.8%	0.8%	

An expected value is < 5. Chi square not valid.
Chi square = 5.12
Degrees of freedom = 7
p value = 0.64516455

	MRSA		
LOT_AP	MRSA	MSSA	Total
0.0	2	2	4
	50.0%	50.0%	4.0%
	3.5%	4.8%	
1.0	2	0	2
	100.0%	0.0%	2.0%
	3.5%	0.0%	
2.0	5	3	8
	62.5%	37.5%	8.1%
	8.8%	7.1%	
3.0	1	1	2
	50.0%	50.0%	2.0%
	1.8%	2.4%	
4.0	8	2	10
	80.0%	20.0%	10.1%
	14.0%	4.8%	
5.0	2	3	5
	40.0%	60.0%	5.1%
	3.5%	7.1%	
6.0	3	4	7
	42.9%	57.1%	7.1%
	5.3%	9.5%	
7.0	4	3	7
	57.1%	42.9%	7.1%
	7.0%	7.1%	
8.0	4	3	7
	57.1%	42.9%	7.1%

	7.0%	7.1%	
10.0	1	2	3
	33.3%	66.7%	3.0%
	1.8%	4.8%	
12.0	1	2	3
	33.3%	66.7%	3.0%
	1.8%	4.8%	
13.0	2	1	3
	66.7%	33.3%	3.0%
	3.5%	2.4%	
14.0	4	2	6
	66.7%	33.3%	6.1%
	7.0%	4.8%	
15.0	1	1	2
	50.0%	50.0%	2.0%
	1.8%	2.4%	
16.0	1	1	2
	50.0%	50.0%	2.0%
	1.8%	2.4%	
17.0	2	1	3
	66.7%	33.3%	3.0%
	3.5%	2.4%	
20.0	1	2	3
	33.3%	66.7%	3.0%
	1.8%	4.8%	
21.0	1	1	2
	50.0%	50.0%	2.0%
	1.8%	2.4%	
22.0	2	1	3
	66.7%	33.3%	3.0%
	3.5%	2.4%	
23.0	0	2	2
	0.0%	100.0%	2.0%
	0.0%	4.8%	
26.0	2	2	4
	50.0%	50.0%	4.0%
	3.5%	4.8%	
28.0	4	1	5
	80.0%	20.0%	5.1%
	7.0%	2.4%	
31.0	1	1	2
	50.0%	50.0%	2.0%
	1.8%	2.4%	
42.0	1	0	1
	100.0%	0.0%	1.0%
	1.8%	0.0%	
45.0	2	0	2
	100.0%	0.0%	2.0%
	3.5%	0.0%	
73.0	0	1	1
	0.0%	100.0%	1.0%
	0.0%	2.4%	
Total	57	42	99
	57.6%	42.4%	

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	57	716	12.561	129.858	11.396
MSSA	42	547	13.024	158.902	12.606
Difference			-0.462		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	0.000	4.000	8.000	17.000	45.000	4.000
MSSA	0.000	5.000	9.000	20.000	73.000	6.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	5.171	1	5.171	0.036	0.849136	0.190730
Within	13787.011	97	142.134			
Total	13792.182	98				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.481 deg freedom = 1 p-value = 0.487833

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.147
Degrees of freedom = 1
p value = 0.701749

	MI		
MRSA	0.0	1.0	Total
MRSA	62	6	68
>	91.2%	8.8%	> 56.2%
	62.6%	27.3%	
MSSA	37	16	53
>	69.8%	30.2%	> 43.8%
	37.4%	72.7%	
Total	99	22	121
	81.8%	18.2%	

Single Table Analysis

Odds ratio 4.47
Cornfield 95% confidence limits for OR 1.45 < OR < 14.30*
*May be inaccurate
Maximum likelihood estimate of OR (MLE) 4.41
Exact 95% confidence limits for MLE 1.48 < OR < 15.03
Exact 95% Mid-P limits for MLE 1.62 < OR < 13.27
Probability of MLE >= 4.41 if population OR = 1.0 0.00261868

RISK RATIO(RR)(Outcome:MI=0.0; Exposure:MRSA=MRSA) 1.31
95% confidence limits for RR 1.08 < RR < 1.58

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	9.14	0.00250144 <---
Mantel-Haenszel:	9.06	0.00260691 <---
Yates corrected:	7.76	0.00534235 <---

CHCF

MRSA	0.0	1.0	Total
MRSA	55	13	68
>	80.9%	19.1%	> 56.2%
	59.1%	46.4%	
MSSA	38	15	53
>	71.7%	28.3%	> 43.8%
	40.9%	53.6%	
Total	93	28	121
	76.9%	23.1%	

Single Table Analysis

Odds ratio		1.67
Cornfield 95% confidence limits for OR	0.65 < OR <	4.29
Maximum likelihood estimate of OR (MLE)		1.66
Exact 95% confidence limits for MLE	0.65 < OR <	4.28
Exact 95% Mid-P limits for MLE	0.70 < OR <	3.97
Probability of MLE >= 1.66 if population OR = 1.0		0.16566623
RISK RATIO(RR)(Outcome:CHCF=0.0; Exposure:MRSA=MRSA)		1.13
95% confidence limits for RR	0.92 < RR <	1.38

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	1.41	0.23462720
Mantel-Haenszel:	1.40	0.23657060
Yates corrected:	0.94	0.33140594

PV

MRSA	0.0	1.0	Total
MRSA	57	11	68
>	83.8%	16.2%	> 56.2%
	55.9%	57.9%	
MSSA	45	8	53
>	84.9%	15.1%	> 43.8%
	44.1%	42.1%	
Total	102	19	121

```
          |          84.3%          15.7% |
```

Single Table Analysis

Odds ratio		0.92
Cornfield 95% confidence limits for OR	0.30 < OR <	2.77
Maximum likelihood estimate of OR (MLE)		0.92
Exact 95% confidence limits for MLE	0.30 < OR <	2.76
Exact 95% Mid-P limits for MLE	0.33 < OR <	2.51
Probability of MLE <= 0.92 if population OR = 1.0		0.53841474
RISK RATIO(RR)(Outcome:PV=0.0; Exposure:MRSA=MRSA)		0.99
95% confidence limits for RR	0.85 < RR <	1.15

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.03	0.87104916
Mantel-Haenszel:	0.03	0.87157848
Yates corrected:	0.01	0.92869457

	CD		
MRSA	0.0	1.0	Total
MRSA	56	12	68
	82.4%	17.6%	> 56.2%
	54.9%	63.2%	
MSSA	46	7	53
	86.8%	13.2%	> 43.8%
	45.1%	36.8%	
Total	102	19	121
	84.3%	15.7%	

Single Table Analysis

Odds ratio		0.71
Cornfield 95% confidence limits for OR	0.23 < OR <	2.17
Maximum likelihood estimate of OR (MLE)		0.71
Exact 95% confidence limits for MLE	0.22 < OR <	2.15
Exact 95% Mid-P limits for MLE	0.25 < OR <	1.96
Probability of MLE <= 0.71 if population OR = 1.0		0.34208275
RISK RATIO(RR)(Outcome:CD=0.0; Exposure:MRSA=MRSA)		0.95
95% confidence limits for RR	0.81 < RR <	1.10

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.44	0.50544133
Mantel-Haenszel:	0.44	0.50720559
Yates corrected:	0.17	0.67877206

	PD		
MRSA	0.0	1.0	Total
MRSA	49	19	68
	72.1%	27.9%	> 56.2%
	53.3%	65.5%	
MSSA	43	10	53
	81.1%	18.9%	> 43.8%
	46.7%	34.5%	
Total	92	29	121
	76.0%	24.0%	

Single Table Analysis

Odds ratio		0.60
Cornfield 95% confidence limits for OR	0.23 < OR <	1.56
Maximum likelihood estimate of OR (MLE)		0.60
Exact 95% confidence limits for MLE	0.22 < OR <	1.54
Exact 95% Mid-P limits for MLE	0.24 < OR <	1.43
Probability of MLE <= 0.60 if population OR = 1.0		0.17244965
RISK RATIO(RR)(Outcome:PD=0.0; Exposure:MRSA=MRSA)		0.89
95% confidence limits for RR	0.73 < RR <	1.08

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	1.35	0.24605191
Mantel-Haenszel:	1.33	0.24801301
Yates corrected:	0.89	0.34446693

	DEM		
MRSA	0.0	1.0	Total
MRSA	56	12	68
	82.4%	17.6%	> 56.2%
	52.3%	85.7%	
MSSA	51	2	53
	96.2%	3.8%	> 43.8%
	47.7%	14.3%	
Total	107	14	121
	88.4%	11.6%	

Single Table Analysis

Odds ratio		0.18
Cornfield 95% confidence limits for OR	0.03 < OR <	0.94
Maximum likelihood estimate of OR (MLE)		0.19
Exact 95% confidence limits for MLE	0.02 < OR <	0.89
Exact 95% Mid-P limits for MLE	0.03 < OR <	0.78

```
Probability of MLE <=  0.19 if population OR = 1.0                0.01561480

RISK RATIO(RR)(Outcome:DEM=0.0; Exposure:MRSA=MRSA)                         0.86
95% confidence limits for RR                                 0.76 < RR <    0.97

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

          Uncorrected:          5.60     0.01792867 <---
          Mantel-Haenszel:      5.56     0.01840905 <---
          Yates corrected:      4.33     0.03746409 <---


                                 PAR
MRSA       |             0.0             2.0 | Total
-----------+---------------------------------+------
   MRSA    |              61               7 |    68
           >           89.7%           10.3% > 56.2%
           |           54.5%           77.8% |
   MSSA    |              51               2 |    53
           >           96.2%            3.8% > 43.8%
           |           45.5%           22.2% |
-----------+---------------------------------+------
     Total |             112               9 |   121
           |           92.6%            7.4% |

                              Single Table Analysis

Odds ratio                                                                  0.34
Cornfield 95% confidence limits for OR                       0.05 < OR <    1.94
Maximum likelihood estimate of OR (MLE)                                     0.34
Exact 95% confidence limits for MLE                          0.03 < OR <    1.92
Exact 95% Mid-P limits for MLE                               0.05 < OR <    1.63
Probability of MLE <=  0.34 if population OR = 1.0                0.15729602

RISK RATIO(RR)(Outcome:PAR=0.0; Exposure:MRSA=MRSA)                         0.93
95% confidence limits for RR                                 0.85 < RR <    1.03

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

          Uncorrected:          1.84     0.17502149
          Mantel-Haenszel:      1.82     0.17681455
          Yates corrected:      1.01     0.31389467

          Fisher exact: 1-tailed P-value: 0.1572960
                        2-tailed P-value: 0.2959520

An expected value is less than 5; recommend Fisher exact results.

                               DIAEOD
MRSA       |             0.0             2.0 | Total
-----------+---------------------------------+------
```

MRSA		62	6	68
	>	91.2%	8.8%	> 56.2%
		55.9%	60.0%	
MSSA		49	4	53
	>	92.5%	7.5%	> 43.8%
		44.1%	40.0%	
Total		111	10	121
		91.7%	8.3%	

Single Table Analysis

Odds ratio		0.84
Cornfield 95% confidence limits for OR	0.18 < OR <	3.68
Maximum likelihood estimate of OR (MLE)		0.84
Exact 95% confidence limits for MLE	0.17 < OR <	3.79
Exact 95% Mid-P limits for MLE	0.20 < OR <	3.25
Probability of MLE <= 0.84 if population OR = 1.0		0.53625589
RISK RATIO(RR)(Outcome:DIAEOD=0.0; Exposure:MRSA=MRSA)		0.99
95% confidence limits for RR	0.89 < RR <	1.10

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.06	0.80027897
Mantel-Haenszel:	0.06	0.80108858
Yates corrected:	0.01	0.93643958

Fisher exact: 1-tailed P-value: 0.5362559
2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

	DIA		
MRSA	0.0	1.0	Total
MRSA	56	12	68
>	82.4%	17.6%	> 56.2%
	57.7%	50.0%	
MSSA	41	12	53
>	77.4%	22.6%	> 43.8%
	42.3%	50.0%	
Total	97	24	121
	80.2%	19.8%	

Single Table Analysis

Odds ratio		1.37
Cornfield 95% confidence limits for OR	0.51 < OR <	3.69
Maximum likelihood estimate of OR (MLE)		1.36
Exact 95% confidence limits for MLE	0.50 < OR <	3.69
Exact 95% Mid-P limits for MLE	0.55 < OR <	3.40
Probability of MLE >= 1.36 if population OR = 1.0		0.32363068

```
RISK RATIO(RR)(Outcome:DIA=0.0; Exposure:MRSA=MRSA)                    1.06
95% confidence limits for RR                          0.89 < RR <   1.28

              Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          0.47     0.49424841
        Mantel-Haenszel:      0.46     0.49603803
        Yates corrected:      0.21     0.64996359


                                RD
MRSA       |             0.0             2.0 | Total
-----------+---------------------------------+------
   MRSA    |              54              14 |    68
           >           79.4%           20.6% > 56.2%
           |           55.1%           60.9% |
   MSSA    |              44               9 |    53
           >           83.0%           17.0% > 43.8%
           |           44.9%           39.1% |
-----------+---------------------------------+------
     Total |              98              23 |   121
           |           81.0%           19.0% |

                          Single Table Analysis

Odds ratio                                                             0.79
Cornfield 95% confidence limits for OR                0.28 < OR <   2.20
Maximum likelihood estimate of OR (MLE)                                0.79
Exact 95% confidence limits for MLE                   0.27 < OR <   2.18
Exact 95% Mid-P limits for MLE                        0.30 < OR <   2.00
Probability of MLE <=  0.79 if population OR = 1.0              0.39671275

RISK RATIO(RR)(Outcome:RD=0.0; Exposure:MRSA=MRSA)                     0.96
95% confidence limits for RR                          0.81 < RR <   1.14

              Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          0.25     0.61586021
        Mantel-Haenszel:      0.25     0.61732257
        Yates corrected:      0.07     0.78852191


                                SLD
MRSA       |             0.0             3.0 | Total
-----------+---------------------------------+------
   MRSA    |              59               9 |    68
           >           86.8%           13.2% > 56.2%
           |           57.8%           47.4% |
   MSSA    |              43              10 |    53
           >           81.1%           18.9% > 43.8%
```

```
          |          42.2%          52.6% |
----------+--------------------------------+------
    Total |            102              19 |   121
          |          84.3%          15.7% |
```

Single Table Analysis

Odds ratio	1.52
Cornfield 95% confidence limits for OR	0.51 < OR < 4.57
Maximum likelihood estimate of OR (MLE)	1.52
Exact 95% confidence limits for MLE	0.51 < OR < 4.63
Exact 95% Mid-P limits for MLE	0.56 < OR < 4.19
Probability of MLE >= 1.52 if population OR = 1.0	0.27540837
RISK RATIO(RR)(Outcome:SLD=0.0; Exposure:MRSA=MRSA)	1.07
95% confidence limits for RR	0.91 < RR < 1.25

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.71	0.39815132
Mantel-Haenszel:	0.71	0.40010775
Yates corrected:	0.35	0.55310477

```
                                MLD
MRSA      |            0.0              1.0 | Total
----------+--------------------------------+------
   MRSA   |             66                2 |    68
          >          97.1%            2.9% > 56.2%
          |          55.5%          100.0% |
   MSSA   |             53                0 |    53
          >         100.0%            0.0% > 43.8%
          |          44.5%            0.0% |
----------+--------------------------------+------
    Total |            119                2 |   121
          |          98.3%            1.7% |
```

Single Table Analysis

Odds ratio	0.00
Cornfield 95% confidence limits for OR	0.00 < OR < 5.38*
*May be inaccurate	
Maximum likelihood estimate of OR (MLE)	0.00
Exact 95% confidence limits for MLE	0.00 < OR < 6.83
Exact 95% Mid-P limits for MLE	0.00 < OR < 4.45
Probability of MLE <= 0.00 if population OR = 1.0	0.31377410
RISK RATIO(RR)(Outcome:MLD=0.0; Exposure:MRSA=MRSA)	0.97
95% confidence limits for RR	0.93 < RR < 1.01

Ignore risk ratio if case control study

	Chi-Squares	P-values

```
                          -----------   --------

        Uncorrected:         1.59     0.20803876
        Mantel-Haenszel:     1.57     0.20992798
        Yates corrected:     0.29     0.58891445

        Fisher exact: 1-tailed P-value: 0.3137741

                      2-tailed P-value: 0.5035813

An expected value is less than 5; recommend Fisher exact results.

                                PEP
MRSA       |            0.0             1.0 | Total
-----------+--------------------------------+------
   MRSA    |             63               5 |    68
           >          92.6%            7.4% > 56.2%
           |          56.3%           55.6% |
   MSSA    |             49               4 |    53
           >          92.5%            7.5% > 43.8%
           |          43.8%           44.4% |
-----------+--------------------------------+------
     Total |            112               9 |   121
           |          92.6%            7.4% |

                             Single Table Analysis


Odds ratio                                                              1.03
Cornfield 95% confidence limits for OR                  0.21 < OR <
4.79*
                      *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 1.03
Exact 95% confidence limits for MLE                     0.19 < OR <   5.06
Exact 95% Mid-P limits for MLE                          0.23 < OR <   4.27
Probability of MLE >=  1.03 if population OR = 1.0              0.61573336


RISK RATIO(RR)(Outcome:PEP=0.0; Exposure:MRSA=MRSA)                     1.00
95% confidence limits for RR                            0.90 < RR <   1.11

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:         0.00     0.96777522
        Mantel-Haenszel:     0.00     0.96790858
        Yates corrected:     0.10     0.75750260

        Fisher exact: 1-tailed P-value: 0.6157334
                      2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

                                TUM
MRSA       |            0.0             2.0 | Total
```

MRSA	65	3	68
	95.6%	4.4%	> 56.2%
	58.0%	33.3%	
MSSA	47	6	53
	88.7%	11.3%	> 43.8%
	42.0%	66.7%	
Total	112	9	121
	92.6%	7.4%	

Single Table Analysis

Odds ratio 2.77
Cornfield 95% confidence limits for OR 0.57 < OR < 15.02*
*May be inaccurate
Maximum likelihood estimate of OR (MLE) 2.74
Exact 95% confidence limits for MLE 0.55 < OR < 17.81
Exact 95% Mid-P limits for MLE 0.65 < OR < 14.02
Probability of MLE >= 2.74 if population OR = 1.0 0.13865599

RISK RATIO(RR)(Outcome:TUM=0.0; Exposure:MRSA=MRSA) 1.08
95% confidence limits for RR 0.97 < RR < 1.20

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	2.07	0.15070614
Mantel-Haenszel:	2.05	0.15240408
Yates corrected:	1.18	0.27664766

Fisher exact: 1-tailed P-value: 0.1386560
2-tailed P-value: 0.1776984

An expected value is less than 5; recommend Fisher exact results.

LYM

MRSA	0.0	2.0	Total
MRSA	64	4	68
	94.1%	5.9%	> 56.2%
	56.6%	50.0%	
MSSA	49	4	53
	92.5%	7.5%	> 43.8%
	43.4%	50.0%	
Total	113	8	121
	93.4%	6.6%	

Single Table Analysis

Odds ratio 1.31
Cornfield 95% confidence limits for OR 0.25 < OR < 6.71*

```
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                              1.30
Exact 95% confidence limits for MLE                  0.23 < OR <     7.37
Exact 95% Mid-P limits for MLE                       0.28 < OR <     6.04
Probability of MLE >=  1.30 if population OR = 1.0            0.49564309

RISK RATIO(RR)(Outcome:LYM=0.0; Exposure:MRSA=MRSA)                  1.02
95% confidence limits for RR                         0.92 < RR <     1.12

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.13     0.71462516
        Mantel-Haenszel:      0.13     0.71575542
        Yates corrected:      0.00     0.99756877

        Fisher exact: 1-tailed P-value: 0.4956431
                      2-tailed P-value: 0.7285960

An expected value is less than 5; recommend Fisher exact results.

                                LEU
MRSA       |            0.0             2.0 | Total
-----------+---------------------------------+------
   MRSA    |             65               3 |    68
           >          95.6%            4.4% > 56.2%
           |          55.1%          100.0% |
   MSSA    |             53               0 |    53
           >         100.0%            0.0% > 43.8%
           |          44.9%            0.0% |
-----------+---------------------------------+------
     Total |            118               3 |   121
           |          97.5%            2.5% |

                          Single Table Analysis

Odds ratio                                                           0.00
Cornfield 95% confidence limits for OR               0.00 < OR <
2.93*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                              0.00
Exact 95% confidence limits for MLE                  0.00 < OR <     3.09
Exact 95% Mid-P limits for MLE                       0.00 < OR <     2.18
Probability of MLE <=  0.00 if population OR = 1.0            0.17402597

RISK RATIO(RR)(Outcome:LEU=0.0; Exposure:MRSA=MRSA)                  0.96
95% confidence limits for RR                         0.91 < RR <     1.01

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          2.40     0.12151519
        Mantel-Haenszel:      2.38     0.12306553
```

```
        Yates corrected:     0.92     0.33742938

        Fisher exact: 1-tailed P-value: 0.1740260
                      2-tailed P-value: 0.2553719

An expected value is less than 5; recommend Fisher exact results.

                         AIDS
MRSA       |             0.0 | Total
-----------+-----------------+------
   MRSA    |              68 |    68
           >         100.0% > 56.2%
           |          56.2% |
   MSSA    |              53 |    53
           >         100.0% > 43.8%
           |          43.8% |
-----------+-----------------+------
     Total |             121 |   121
           |         100.0% |



            Chi square =       0.00
     Degrees of freedom =          0
                p value = 1.00000000


                                 METCA
MRSA       |             0.0             6.0 | Total
-----------+---------------------------------+------
   MRSA    |              62               6 |    68
           >           91.2%            8.8% > 56.2%
           |           56.9%           50.0% |
   MSSA    |              47               6 |    53
           >           88.7%           11.3% > 43.8%
           |           43.1%           50.0% |
-----------+---------------------------------+------
     Total |             109              12 |   121
           |           90.1%            9.9% |

                              Single Table Analysis

Odds ratio                                                          1.32
Cornfield 95% confidence limits for OR                 0.34 < OR <
5.06*
                      *May be inaccurate
Maximum likelihood estimate of OR (MLE)                             1.32
Exact 95% confidence limits for MLE                    0.33 < OR <   5.27
Exact 95% Mid-P limits for MLE                         0.38 < OR <   4.57
Probability of MLE >=  1.32 if population OR = 1.0             0.43690637

RISK RATIO(RR)(Outcome:METCA=0.0; Exposure:MRSA=MRSA)               1.03
95% confidence limits for RR                           0.91 < RR <   1.16

                Ignore risk ratio if case control study

                          Chi-Squares   P-values
```

	Chi-Squares	P-values
Uncorrected:	0.21	0.64840954
Mantel-Haenszel:	0.21	0.64976786
Yates corrected:	0.02	0.88119245

MRSA	RHE 0.0	1.0	Total
MRSA	63	5	68
	92.6%	7.4%	56.2%
	55.3%	71.4%	
MSSA	51	2	53
	96.2%	3.8%	43.8%
	44.7%	28.6%	
Total	114	7	121
	94.2%	5.8%	

Single Table Analysis

Odds ratio	0.49
Cornfield 95% confidence limits for OR	0.06 < OR < 3.09*

*May be inaccurate

Maximum likelihood estimate of OR (MLE)	0.50
Exact 95% confidence limits for MLE	0.05 < OR < 3.19
Exact 95% Mid-P limits for MLE	0.06 < OR < 2.63
Probability of MLE <= 0.50 if population OR = 1.0	0.33472940

RISK RATIO(RR)(Outcome:RHE=0.0; Exposure:MRSA=MRSA)	0.96
95% confidence limits for RR	0.88 < RR < 1.05

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.70	0.40274087
Mantel-Haenszel:	0.69	0.40469166
Yates corrected:	0.20	0.65681601

Fisher exact: 1-tailed P-value: 0.3347294
2-tailed P-value: 0.4654287

An expected value is less than 5; recommend Fisher exact results.

MRSA	CCICOUNT 0.0	1.0	2.0
MRSA	4	9	10
	5.9%	13.2%	14.7%
	40.0%	69.2%	52.6%
MSSA	6	4	9
	11.3%	7.5%	17.0%
	60.0%	30.8%	47.4%

Total	10	13	19
	8.3%	10.7%	15.7%

MRSA	CCICOUNT 3.0	4.0	5.0
MRSA	16	11	6
>	23.5%	16.2%	8.8%
	55.2%	78.6%	54.5%
MSSA	13	3	5
>	24.5%	5.7%	9.4%
	44.8%	21.4%	45.5%
Total	29	14	11
	24.0%	11.6%	9.1%

MRSA	CCICOUNT 6.0	7.0	8.0
MRSA	6	2	3
>	8.8%	2.9%	4.4%
	54.5%	33.3%	60.0%
MSSA	5	4	2
>	9.4%	7.5%	3.8%
	45.5%	66.7%	40.0%
Total	11	6	5
	9.1%	5.0%	4.1%

MRSA	CCICOUNT 9.0	11.0	Total
MRSA	1	0	68
>	1.5%	0.0%	> 56.2%
	50.0%	0.0%	
MSSA	1	1	53
>	1.9%	1.9%	> 43.8%
	50.0%	100.0%	
Total	2	1	121
	1.7%	0.8%	

An expected value is < 5. Chi square not valid.
Chi square = 7.56
Degrees of freedom = 10
p value = 0.67146806

CCICOUNT	MRSA MRSA	MSSA	Total
0.0	4	6	10
	> 40.0%	60.0%	> 8.3%
	5.9%	11.3%	
1.0	9	4	13

	> 69.2%	30.8%	> 10.7%
	| 13.2%	7.5%	|
2.0	| 10	9	| 19
	> 52.6%	47.4%	> 15.7%
	| 14.7%	17.0%	|
3.0	| 16	13	| 29
	> 55.2%	44.8%	> 24.0%
	| 23.5%	24.5%	|
4.0	| 11	3	| 14
	> 78.6%	21.4%	> 11.6%
	| 16.2%	5.7%	|
5.0	| 6	5	| 11
	> 54.5%	45.5%	> 9.1%
	| 8.8%	9.4%	|
6.0	| 6	5	| 11
	> 54.5%	45.5%	> 9.1%
	| 8.8%	9.4%	|
7.0	| 2	4	| 6
	> 33.3%	66.7%	> 5.0%
	| 2.9%	7.5%	|
8.0	| 3	2	| 5
	> 60.0%	40.0%	> 4.1%
	| 4.4%	3.8%	|
9.0	| 1	1	| 2
	> 50.0%	50.0%	> 1.7%
	| 1.5%	1.9%	|
11.0	| 0	1	| 1
	> 0.0%	100.0%	> 0.8%
	| 0.0%	1.9%	|
Total	| 68	53	| 121
	| 56.2%	43.8%	|

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	68	234	3.441	4.489	2.119
MSSA	53	192	3.623	6.547	2.559
Difference			-0.181		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	0.000	2.000	3.000	5.000	9.000	3.000
MSSA	0.000	2.000	3.000	5.000	11.000	3.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.981	1	0.981	0.182	0.670411	0.426642
Within	641.218	119	5.388			
Total	642.198	120				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 2.088 deg freedom = 1 p-value = 0.148463

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.012
Degrees of freedom = 1
p value = 0.911640

	CCISCORE		
MRSA	0.0	1.0	Total
MRSA	23	45	68
	33.8%	66.2%	> 56.2%
	54.8%	57.0%	
MSSA	19	34	53
	35.8%	64.2%	> 43.8%
	45.2%	43.0%	
Total	42	79	121
	34.7%	65.3%	

Single Table Analysis

Odds ratio		0.91
Cornfield 95% confidence limits for OR	0.40 < OR <	2.10
Maximum likelihood estimate of OR (MLE)		0.92
Exact 95% confidence limits for MLE	0.40 < OR <	2.09
Exact 95% Mid-P limits for MLE	0.43 < OR <	1.96
Probability of MLE <= 0.92 if population OR = 1.0		0.48317612

RISK RATIO(RR)(Outcome:CCISCORE=0.0; Exposure:MRSA=MRSA)		0.94
95% confidence limits for RR	0.58 < RR <	1.54

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.05	0.81637323
Mantel-Haenszel:	0.05	0.81712011
Yates corrected:	0.00	0.96828259

	SICU		
MRSA	0.0	1.0	Total
MRSA	50	15	65
	76.9%	23.1%	> 56.0%
	55.6%	57.7%	
MSSA	40	11	51
	78.4%	21.6%	> 44.0%
	44.4%	42.3%	
Total	90	26	116
	77.6%	22.4%	

Single Table Analysis

Odds ratio	0.92
Cornfield 95% confidence limits for OR	0.34 < OR < 2.43
Maximum likelihood estimate of OR (MLE)	0.92
Exact 95% confidence limits for MLE	0.34 < OR < 2.41
Exact 95% Mid-P limits for MLE	0.37 < OR < 2.23
Probability of MLE <= 0.92 if population OR = 1.0	0.51433664
RISK RATIO(RR)(Outcome:SICU=0.0; Exposure:MRSA=MRSA)	0.98
95% confidence limits for RR	0.81 < RR < 1.19

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.04	0.84668308
Mantel-Haenszel:	0.04	0.84733720
Yates corrected:	0.00	0.97532029

MRSA	SRI 0.0	SRI 1.0	Total
MRSA	52	15	67
	77.6%	22.4%	55.8%
	57.1%	51.7%	
MSSA	39	14	53
	73.6%	26.4%	44.2%
	42.9%	48.3%	
Total	91	29	120
	75.8%	24.2%	

Single Table Analysis

Odds ratio	1.24
Cornfield 95% confidence limits for OR	0.49 < OR < 3.15
Maximum likelihood estimate of OR (MLE)	1.24
Exact 95% confidence limits for MLE	0.49 < OR < 3.13
Exact 95% Mid-P limits for MLE	0.53 < OR < 2.91
Probability of MLE >= 1.24 if population OR = 1.0	0.38189207
RISK RATIO(RR)(Outcome:SRI=0.0; Exposure:MRSA=MRSA)	1.05
95% confidence limits for RR	0.86 < RR < 1.30

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.26	0.60884762
Mantel-Haenszel:	0.26	0.61034400
Yates corrected:	0.09	0.76645751

	SHD		
MRSA	0.0	1.0	Total
MRSA	51	12	63
	81.0%	19.0%	55.8%
	54.3%	63.2%	
MSSA	43	7	50
	86.0%	14.0%	44.2%
	45.7%	36.8%	
Total	94	19	113
	83.2%	16.8%	

Single Table Analysis

Odds ratio		0.69
Cornfield 95% confidence limits for OR	0.22 < OR <	2.13
Maximum likelihood estimate of OR (MLE)		0.69
Exact 95% confidence limits for MLE	0.21 < OR <	2.11
Exact 95% Mid-P limits for MLE	0.24 < OR <	1.92
Probability of MLE <= 0.69 if population OR = 1.0		0.32533806
RISK RATIO(RR)(Outcome:SHD=0.0; Exposure:MRSA=MRSA)		0.94
95% confidence limits for RR	0.80 < RR <	1.11

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.51	0.47609887
Mantel-Haenszel:	0.50	0.47805709
Yates corrected:	0.21	0.64596511

	SRD		
MRSA	0.0	1.0	Total
MRSA	46	21	67
	68.7%	31.3%	57.3%
	58.2%	55.3%	
MSSA	33	17	50
	66.0%	34.0%	42.7%
	41.8%	44.7%	
Total	79	38	117
	67.5%	32.5%	

Single Table Analysis

Odds ratio		1.13
Cornfield 95% confidence limits for OR	0.48 < OR <	2.67
Maximum likelihood estimate of OR (MLE)		1.13
Exact 95% confidence limits for MLE	0.48 < OR <	2.64
Exact 95% Mid-P limits for MLE	0.51 < OR <	2.48
Probability of MLE >= 1.13 if population OR = 1.0		0.45727291

```
RISK RATIO(RR)(Outcome:SRD=0.0; Exposure:MRSA=MRSA)                    1.04
95% confidence limits for RR                          0.80 < RR <   1.34

              Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          0.09     0.76145746
        Mantel-Haenszel:      0.09     0.76244826
        Yates corrected:      0.01     0.91714432


                                ND
MRSA       |             0.0             1.0 | Total
-----------+---------------------------------+------
   MRSA    |              36              29 |    65
           >           55.4%           44.6% > 55.1%
           |           55.4%           54.7% |
   MSSA    |              29              24 |    53
           >           54.7%           45.3% > 44.9%
           |           44.6%           45.3% |
-----------+---------------------------------+------
     Total |              65              53 |   118
           |           55.1%           44.9% |

                           Single Table Analysis

Odds ratio                                                             1.03
Cornfield 95% confidence limits for OR                0.46 < OR <   2.29
Maximum likelihood estimate of OR (MLE)                                1.03
Exact 95% confidence limits for MLE                   0.46 < OR <   2.27
Exact 95% Mid-P limits for MLE                        0.49 < OR <   2.14
Probability of MLE >=  1.03 if population OR = 1.0             0.54489828

RISK RATIO(RR)(Outcome:ND=0.0; Exposure:MRSA=MRSA)                     1.01
95% confidence limits for RR                          0.73 < RR <   1.41

              Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          0.01     0.94218519
        Mantel-Haenszel:      0.01     0.94243026
        Yates corrected:      0.01     0.90962206


                                SSS
MRSA       |             0.0             1.0 | Total
-----------+---------------------------------+------
   MRSA    |              40              27 |    67
           >           59.7%           40.3% > 56.3%
           |           55.6%           57.4% |
   MSSA    |              32              20 |    52
           >           61.5%           38.5% > 43.7%
           |           44.4%           42.6% |
```

```
-----------+--------------------------------+------
     Total |             72              47 |   119
           |          60.5%           39.5% |

                          Single Table Analysis

Odds ratio                                                              0.93
Cornfield 95% confidence limits for OR                  0.41 < OR <     2.09
Maximum likelihood estimate of OR (MLE)                                 0.93
Exact 95% confidence limits for MLE                     0.41 < OR <     2.07
Exact 95% Mid-P limits for MLE                          0.44 < OR <     1.95
Probability of MLE <=  0.93 if population OR = 1.0                 0.49497711

RISK RATIO(RR)(Outcome:SSS=0.0; Exposure:MRSA=MRSA)                     0.97
95% confidence limits for RR                            0.72 < RR <     1.30

              Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          0.04     0.83887793
        Mantel-Haenszel:      0.04     0.83954711
        Yates corrected:      0.00     0.98859338


                          MRSA
  SICOUNT     | MRSA     MSSA     | Total
--------------+-----------------+------
            0.0 |      19       18 |    37
                >   51.4%   48.6% > 30.6%
                |   27.9%   34.0% |
            1.0 |      17        9 |    26
                >   65.4%   34.6% > 21.5%
                |   25.0%   17.0% |
            2.0 |      11        6 |    17
                >   64.7%   35.3% > 14.0%
                |   16.2%   11.3% |
            3.0 |       8        8 |    16
                >   50.0%   50.0% > 13.2%
                |   11.8%   15.1% |
            4.0 |       3        6 |     9
                >   33.3%   66.7% >  7.4%
                |    4.4%   11.3% |
            5.0 |       6        3 |     9
                >   66.7%   33.3% >  7.4%
                |    8.8%    5.7% |
            6.0 |       2        3 |     5
                >   40.0%   60.0% >  4.1%
                |    2.9%    5.7% |
            7.0 |       2        0 |     2
                >  100.0%    0.0% >  1.7%
                |    2.9%    0.0% |
--------------+-----------------+------
       Total |      68       53 |   121
             |   56.2%   43.8% |
```

MRSA	Obs	Total	Mean	Variance	Std Dev
MRSA	68	131	1.926	3.711	1.926
MSSA	53	102	1.925	3.610	1.900
Difference			0.002		

MRSA	Minimum	25%ile	Median	75%ile	Maximum	Mode
MRSA	0.000	0.000	1.000	3.000	7.000	0.000
MSSA	0.000	0.000	1.000	3.000	6.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.000	1	0.000	0.000	0.995592	0.005536
Within	436.330	119	3.667			
Total	436.331	120				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.011 deg freedom = 1 p-value = 0.916031

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.003
Degrees of freedom = 1
p value = 0.959508

	SCO		
MRSA	0.0	1.0	Total
MRSA	53	12	65
	81.5%	18.5%	> 56.5%
	56.4%	57.1%	
MSSA	41	9	50
	82.0%	18.0%	> 43.5%
	43.6%	42.9%	
Total	94	21	115
	81.7%	18.3%	

Single Table Analysis

Odds ratio		0.97
Cornfield 95% confidence limits for OR	0.33 < OR <	2.80
Maximum likelihood estimate of OR (MLE)		0.97
Exact 95% confidence limits for MLE	0.33 < OR <	2.79
Exact 95% Mid-P limits for MLE	0.36 < OR <	2.55
Probability of MLE <= 0.97 if population OR = 1.0		0.57380803
RISK RATIO(RR)(Outcome:SCO=0.0; Exposure:MRSA=MRSA)		0.99
95% confidence limits for RR	0.84 < RR <	1.18

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.00	0.94936240
Mantel-Haenszel:	0.00	0.94958275
Yates corrected:	0.03	0.85720134

	OUTCOME		
MRSA	1.0	2.0	Total
MRSA	54	14	68
	79.4%	20.6%	> 56.2%
	52.9%	73.7%	
MSSA	48	5	53
	90.6%	9.4%	> 43.8%
	47.1%	26.3%	
Total	102	19	121
	84.3%	15.7%	

Single Table Analysis

Odds ratio		0.40
Cornfield 95% confidence limits for OR	0.11 < OR <	1.33
Maximum likelihood estimate of OR (MLE)		0.40
Exact 95% confidence limits for MLE	0.11 < OR <	1.30
Exact 95% Mid-P limits for MLE	0.12 < OR <	1.18
Probability of MLE <= 0.40 if population OR = 1.0		0.07584075
RISK RATIO(RR)(Outcome:OUTCOME=1.0; Exposure:MRSA=MRSA)		0.88
95% confidence limits for RR	0.76 < RR <	1.02

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	2.80	0.09428671
Mantel-Haenszel:	2.78	0.09565810
Yates corrected:	2.02	0.15520259

	SICAT		
MRSA	0	1+	Total
MRSA	19	49	68
	27.9%	72.1%	> 56.2%
	51.4%	58.3%	
MSSA	18	35	53
	34.0%	66.0%	> 43.8%
	48.6%	41.7%	
Total	37	84	121
	30.6%	69.4%	

Single Table Analysis

Odds ratio		0.75
Cornfield 95% confidence limits for OR	0.32 < OR <	1.77
Maximum likelihood estimate of OR (MLE)		0.76
Exact 95% confidence limits for MLE	0.32 < OR <	1.77
Exact 95% Mid-P limits for MLE	0.34 < OR <	1.66
Probability of MLE <= 0.76 if population OR = 1.0		0.30283419
RISK RATIO(RR)(Outcome:SICAT=0; Exposure:MRSA=MRSA)		0.82
95% confidence limits for RR	0.48 < RR <	1.41

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.51	0.47571369
Mantel-Haenszel:	0.50	0.47754281
Yates corrected:	0.26	0.60699457

8.2.3 MRSA vs. MSSA Conditional logistic regression – SPSS output

Notes

Output Created		15-OCT-2012 19:47:55
Comments		
Input	Data	C:\WORK\PhD\match13.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	398
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing
Syntax		LOGISTIC REGRESSION VARIABLES mrsa /METHOD=BSTEP(COND) died habuse appempab SSS2 SHD2 ND2 cciscor2 timtoinf devices icuadt strata /CONTRAST (appempab)=Indicator /CONTRAST (SSS2)=Indicator /CONTRAST (SHD2)=Indicator /CONTRAST (ND2)=Indicator /CONTRAST (icuadt)=Indicator /PRINT=GOODFIT CORR ITER(1) CI(95) /CRITERIA=PIN(0.05) POUT(0.10) ITERATE(20) CUT(0.5).
Resources	Processor Time	00:00:00.16
	Elapsed Time	00:00:00.17

Dependent Variable Encoding

Original Value	Internal Value
1	0
2	1

Block 0: Beginning Block

Iteration History[a,b,c]

Iteration		-2 Log likelihood	Coefficients
			Constant
Step 0	1	530.948	.005
	2	530.948	.005

a. Constant is included in the model.

b. Initial -2 Log Likelihood: 530.948

c. Estimation terminated at iteration number 2 because parameter estimates changed by less than .001.

Classification Table[a,b]

			Predicted		
			mrsa		Percentage Correct
	Observed		1	2	
Step 0	Mrsa	1	0	191	.0
		2	0	192	100.0
	Overall Percentage				50.1

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.005	.102	.003	1	.959	1.005

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	died	1.872	1	.171
		habuse	32.761	1	.000
		appempab(1)	44.399	1	.000
		SSS2(1)	3.000	1	.083
		SHD2(1)	1.507	1	.220
		ND2(1)	1.813	1	.178
		cciscor2	8.527	1	.003
		timtoinf	2.281	1	.131
		devices	3.603	1	.058
		icuadt(1)	3.686	1	.055
		strata	.005	1	.945
	Overall Statistics		78.391	11	.000

Block 1: Method = Backward Stepwise (Conditional)

Iteration History[a,b,c,d]

Iteration		-2 Log likelihood	Coefficients											
			Constant	died	habuse	appempab(1)	SSS2(1)	SHD2(1)	ND2(1)	cciscor2	timtoinf	devices	icuadt(1)	strata
Step 1	1	447.601	-3.314	-.060	1.028	1.275	.309	.121	.058	.374	.006	.032	.361	-.001
	2	445.836	-3.991	-.070	1.217	1.475	.377	.171	.087	.457	.007	.036	.452	-.001
	3	445.829	-4.042	-.070	1.230	1.489	.382	.176	.090	.463	.007	.035	.460	-.001
	4	445.829	-4.042	-.070	1.230	1.489	.382	.176	.090	.463	.007	.035	.460	-.001
Step 2	1	447.618	-3.294	-.059	1.031	1.273	.304	.122	.064	.380	.005		.372	-.001
	2	445.853	-3.970	-.068	1.220	1.473	.372	.174	.093	.463	.007		.465	-.001
	3	445.845	-4.020	-.068	1.233	1.487	.378	.179	.096	.469	.007		.472	-.001
	4	445.845	-4.021	-.068	1.233	1.487	.378	.179	.096	.469	.007		.472	-.001
Step 3	1	447.670	-3.354		1.036	1.267	.284	.120	.046	.370	.005		.375	-.001
	2	445.906	-4.040		1.226	1.466	.349	.172	.073	.452	.007		.467	-.001
	3	445.898	-4.091		1.240	1.480	.354	.177	.075	.458	.007		.475	-.001
	4	445.898	-4.091		1.240	1.480	.354	.177	.075	.458	.007		.475	-.001
Step 4	1	447.700	-3.340		1.034	1.270	.309	.128		.372	.005		.370	-.001
	2	445.947	-4.018		1.222	1.470	.389	.187		.455	.007		.459	-.001
	3	445.939	-4.068		1.235	1.485	.395	.192		.461	.007		.466	-.001
	4	445.939	-4.068		1.235	1.485	.395	.193		.461	.007		.466	-.001
Step 5	1	447.870	-3.279		1.043	1.266	.329			.381	.005		.369	-.001
	2	446.162	-3.922		1.234	1.463	.415			.466	.007		.459	-.001
	3	446.154	-3.967		1.247	1.476	.421			.472	.007		.466	-.001
	4	446.154	-3.967		1.247	1.476	.421			.472	.007		.466	-.001
Step 6	1	448.218	-3.381		1.041	1.253	.334			.383	.005		.381	
	2	446.533	-4.042		1.229	1.445	.422			.468	.007		.474	
	3	446.526	-4.089		1.242	1.458	.429			.474	.007		.481	

	4	446.526	-4.089		1.242	1.458	.429			.474	.007		.481	
Step 7	1	449.481	-3.165		.979	1.235	.327			.380			.336	
	2	447.914	-3.761		1.148	1.417	.413			.463			.414	
	3	447.909	-3.800		1.158	1.429	.419			.468			.420	
	4	447.909	-3.800		1.158	1.429	.419			.468			.420	
Step 8	1	450.968	-2.983		.991	1.220				.422			.366	
	2	449.556	-3.509		1.159	1.392				.513			.445	
	3	449.552	-3.541		1.168	1.402				.519			.450	
	4	449.552	-3.541		1.168	1.402				.519			.450	

a. Method: Backward Stepwise (Conditional)

b. Constant is included in the model.

c. Initial -2 Log Likelihood: 530.948

d. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	85.119	11	.000
	Block	85.119	11	.000
	Model	85.119	11	.000
Step 2[a]	Step	-.017	1	.897
	Block	85.103	10	.000
	Model	85.103	10	.000
Step 3[a]	Step	-.053	1	.819
	Block	85.050	9	.000
	Model	85.050	9	.000
Step 4[a]	Step	-.041	1	.839

	Block	85.009	8	.000
	Model	85.009	8	.000
	Step	-.215	1	.643
Step 5[a]	Block	84.794	7	.000
	Model	84.794	7	.000
	Step	-.371	1	.542
Step 6[a]	Block	84.422	6	.000
	Model	84.422	6	.000
	Step	-1.383	1	.240
Step 7[a]	Block	83.039	5	.000
	Model	83.039	5	.000
	Step	-1.643	1	.200
Step 8[a]	Block	81.397	4	.000
	Model	81.397	4	.000

a. A negative Chi-squares value indicates that the Chi-squares value has decreased from the previous step.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	445.829[a]	.199	.266
2	445.845[a]	.199	.266
3	445.898[a]	.199	.266
4	445.939[a]	.199	.265
5	446.154[a]	.199	.265
6	446.526[a]	.198	.264
7	447.909[a]	.195	.260
8	449.552[a]	.191	.255

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	6.709	8	.568
2	5.584	8	.694
3	7.923	8	.441
4	5.327	8	.722
5	4.440	8	.815
6	9.346	8	.314
7	8.457	8	.390
8	7.723	7	.358

Contingency Table for Hosmer and Lemeshow Test

		mrsa = 1		mrsa = 2		Total
		Observed	Expected	Observed	Expected	
Step 1	1	32	32.321	6	5.679	38
	2	29	30.092	9	7.908	38
	3	27	26.671	11	11.329	38
	4	25	22.593	13	15.407	38
	5	18	19.706	20	18.294	38
	6	19	17.509	19	20.491	38
	7	19	15.414	19	22.586	38
	8	8	12.447	30	25.553	38
	9	6	8.233	32	29.767	38

	10	8	6.012	33	34.988	41
	1	32	32.329	6	5.671	38
	2	29	30.068	9	7.932	38
	3	27	26.672	11	11.328	38
	4	25	22.612	13	15.388	38
	5	18	19.689	20	18.311	38
Step 2	6	19	17.503	19	20.497	38
	7	19	15.426	19	22.574	38
	8	8	12.472	30	25.528	38
	9	7	8.223	31	29.777	38
	10	7	6.006	34	34.994	41
	1	32	32.289	6	5.711	38
	2	29	30.072	9	7.928	38
	3	27	26.716	11	11.284	38
	4	26	22.588	12	15.412	38
	5	17	19.696	21	18.304	38
Step 3	6	19	17.529	19	20.471	38
	7	19	15.372	19	22.628	38
	8	8	12.525	30	25.475	38
	9	6	8.232	32	29.768	38
	10	8	5.982	33	35.018	41
Step 4	1	32	32.275	6	5.725	38
	2	29	30.054	9	7.946	38
	3	27	26.746	11	11.254	38
	4	25	22.592	13	15.408	38
	5	18	19.655	20	18.345	38
	6	20	17.582	18	20.418	38
	7	18	15.391	20	22.609	38

	8	8	12.505	30	25.495	38
	9	7	8.206	31	29.794	38
	10	7	5.994	34	35.006	41
	1	31	32.197	7	5.803	38
	2	30	30.092	8	7.908	38
	3	27	26.759	11	11.241	38
	4	25	22.565	13	15.435	38
	5	18	19.746	20	18.254	38
Step 5	6	21	17.491	17	20.509	38
	7	16	15.470	22	22.530	38
	8	9	12.440	29	25.560	38
	9	7	8.227	31	29.773	38
	10	7	6.015	34	34.985	41
	1	35	33.727	5	6.273	40
	2	27	30.061	11	7.939	38
	3	27	26.576	11	11.424	38
	4	26	22.193	12	15.807	38
	5	18	19.543	20	18.457	38
Step 6	6	22	17.004	15	19.996	37
	7	14	16.505	27	24.495	41
	8	9	12.493	31	27.507	40
	9	5	6.515	25	23.485	30
	10	8	6.382	35	36.618	43
Step 7	1	21	22.417	5	3.583	26
	2	30	30.081	8	7.919	38
	3	34	34.386	13	12.614	47
	4	24	21.714	12	14.286	36
	5	14	14.576	13	12.424	27

	6	27	23.042	22	25.958	49
	7	15	12.071	13	15.929	28
	8	10	14.154	29	24.846	39
	9	5	9.040	31	26.960	36
	10	11	9.519	46	47.481	57
	1	12	13.833	4	2.167	16
	2	36	36.125	9	8.875	45
	3	36	36.192	13	12.808	49
	4	28	24.271	13	16.729	41
Step 8	5	22	21.929	21	21.071	43
	6	26	21.692	21	25.308	47
	7	13	16.807	32	28.193	45
	8	7	10.257	32	28.743	39
	9	11	9.894	47	48.106	58

Classification Table[a]

	Observed		Predicted		
			mrsa		Percentage Correct
			1	2	
Step 1	mrsa	1	128	63	67.0
		2	54	138	71.9
	Overall Percentage				69.5
Step 2	mrsa	1	129	62	67.5
		2	51	141	73.4
	Overall Percentage				70.5
Step 3	mrsa	1	129	62	67.5

		2	51	141	73.4
	Overall Percentage				70.5
	mrsa	1	128	63	67.0
Step 4		2	52	140	72.9
	Overall Percentage				70.0
	mrsa	1	129	62	67.5
Step 5		2	54	138	71.9
	Overall Percentage				69.7
	mrsa	1	125	66	65.4
Step 6		2	50	142	74.0
	Overall Percentage				69.7
	mrsa	1	123	68	64.4
Step 7		2	51	141	73.4
	Overall Percentage				68.9
	mrsa	1	134	57	70.2
Step 8		2	60	132	68.8
	Overall Percentage				69.5

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	died	-.070	.299	.055	1	.814	.932	.519	1.675
	habuse	1.230	.254	23.421	1	.000	3.422	2.079	5.633
	appempab(1)	1.489	.245	37.010	1	.000	4.432	2.743	7.160
	SSS2(1)	.382	.404	.897	1	.344	1.465	.664	3.232
	SHD2(1)	.176	.423	.172	1	.678	1.192	.520	2.733
	ND2(1)	.090	.384	.055	1	.814	1.095	.516	2.321
	cciscor2	.463	.245	3.555	1	.059	1.589	.982	2.570
	timtoinf	.007	.006	1.439	1	.230	1.007	.996	1.019
	devices	.035	.275	.017	1	.897	1.036	.604	1.776
	icuadt(1)	.460	.278	2.728	1	.099	1.584	.918	2.732
	strata	-.001	.002	.478	1	.489	.999	.994	1.003
	Constant	-4.042	.805	25.211	1	.000	.018		
Step 2[a]	died	-.068	.298	.052	1	.819	.934	.520	1.676
	habuse	1.233	.253	23.742	1	.000	3.433	2.090	5.638
	appempab(1)	1.487	.244	37.026	1	.000	4.425	2.741	7.145
	SSS2(1)	.378	.402	.882	1	.348	1.459	.663	3.208
	SHD2(1)	.179	.423	.179	1	.673	1.196	.522	2.738
	ND2(1)	.096	.381	.064	1	.801	1.101	.522	2.323
	cciscor2	.469	.241	3.804	1	.051	1.599	.998	2.562
	timtoinf	.007	.006	1.432	1	.231	1.007	.996	1.018
	icuadt(1)	.472	.262	3.249	1	.071	1.603	.960	2.678
	strata	-.001	.002	.476	1	.490	.999	.994	1.003
	Constant	-4.021	.788	26.056	1	.000	.018		

Step 3[a]	habuse	1.240	.252	24.246	1	.000	3.454	2.109	5.658
	appempab(1)	1.480	.242	37.320	1	.000	4.394	2.733	7.065
	SSS2(1)	.354	.389	.830	1	.362	1.425	.665	3.055
	SHD2(1)	.177	.423	.175	1	.676	1.193	.521	2.734
	ND2(1)	.075	.370	.041	1	.839	1.078	.522	2.226
	cciscor2	.458	.236	3.779	1	.052	1.582	.996	2.511
	timtoinf	.007	.006	1.489	1	.222	1.007	.996	1.018
	icuadt(1)	.475	.261	3.298	1	.069	1.607	.963	2.683
	strata	-.001	.002	.462	1	.497	.999	.994	1.003
	Constant	-4.091	.725	31.811	1	.000	.017		
Step 4[a]	habuse	1.235	.251	24.260	1	.000	3.440	2.104	5.624
	appempab(1)	1.485	.241	37.823	1	.000	4.413	2.750	7.084
	SSS2(1)	.395	.333	1.405	1	.236	1.485	.772	2.854
	SHD2(1)	.193	.416	.215	1	.643	1.212	.537	2.738
	cciscor2	.461	.236	3.826	1	.050	1.585	.999	2.515
	timtoinf	.007	.006	1.462	1	.227	1.007	.996	1.018
	icuadt(1)	.466	.258	3.269	1	.071	1.593	.962	2.639
	strata	-.001	.002	.489	1	.484	.999	.994	1.003
	Constant	-4.068	.716	32.299	1	.000	.017		
Step 5[a]	habuse	1.247	.250	24.933	1	.000	3.479	2.133	5.676
	appempab(1)	1.476	.240	37.712	1	.000	4.377	2.732	7.011
	SSS2(1)	.421	.329	1.642	1	.200	1.524	.800	2.903
	cciscor2	.472	.234	4.058	1	.044	1.603	1.013	2.537
	timtoinf	.007	.006	1.487	1	.223	1.007	.996	1.018
	icuadt(1)	.466	.258	3.270	1	.071	1.593	.962	2.639
	strata	-.001	.002	.371	1	.543	.999	.995	1.003
	Constant	-3.967	.679	34.096	1	.000	.019		
Step 6[a]	habuse	1.242	.249	24.832	1	.000	3.463	2.125	5.646

	appempab(1)	1.458	.238	37.494	1	.000	4.299	2.695	6.856
	SSS2(1)	.429	.329	1.700	1	.192	1.535	.806	2.924
	cciscor2	.474	.234	4.099	1	.043	1.606	1.015	2.542
	timtoinf	.007	.006	1.377	1	.241	1.007	.996	1.018
	icuadt(1)	.481	.256	3.527	1	.060	1.618	.979	2.673
	Constant	-4.089	.651	39.462	1	.000	.017		
Step 7[a]	habuse	1.158	.238	23.723	1	.000	3.185	1.998	5.076
	appempab(1)	1.429	.236	36.723	1	.000	4.174	2.629	6.626
	SSS2(1)	.419	.329	1.627	1	.202	1.521	.799	2.897
	cciscor2	.468	.234	4.020	1	.045	1.598	1.011	2.525
	icuadt(1)	.420	.250	2.818	1	.093	1.521	.932	2.483
	Constant	-3.800	.597	40.565	1	.000	.022		
	habuse	1.168	.237	24.248	1	.000	3.217	2.021	5.122
	appempab(1)	1.402	.234	35.948	1	.000	4.064	2.570	6.427
Step 8[a]	cciscor2	.519	.230	5.086	1	.024	1.680	1.070	2.638
	icuadt(1)	.450	.248	3.293	1	.070	1.569	.965	2.551
	Constant	-3.541	.554	40.849	1	.000	.029		

a. Variable(s) entered on step 1: died, habuse, appempab, SSS2, SHD2, ND2, cciscor2, timtoinf, devices, icuadt, strata.

Correlation Matrix

		Constant	died	habuse	appempab(1)	SSS2(1)	SHD2(1)	ND2(1)	cciscor2	timtoinf	devices	icuadt(1)	strata
Step 1	Constant	1.000	-.372	-.475	-.206	-.044	-.225	-.026	-.257	-.366	-.208	-.249	-.196
	Died	-.372	1.000	.107	-.133	-.255	-.018	-.232	-.184	.075	-.046	.060	.050
	Habuse	-.475	.107	1.000	.065	-.068	-.103	.068	.026	.284	-.092	.064	-.002
	appempab(1)	-.206	-.133	.065	1.000	.153	.094	-.056	-.023	.123	.050	.042	-.162
	SSS2(1)	-.044	-.255	-.068	.153	1.000	-.044	-.429	-.059	-.012	.089	-.180	.004
	SHD2(1)	-.225	-.018	-.103	.094	-.044	1.000	-.165	-.073	-.043	-.053	-.011	-.245
	ND2(1)	-.026	-.232	.068	-.056	-.429	-.165	1.000	.027	.018	-.118	.183	.071
	Cciscor2	-.257	-.184	.026	-.023	-.059	-.073	.027	1.000	-.028	-.199	.131	.022
	Timtoinf	-.366	.075	.284	.123	-.012	-.043	.018	-.028	1.000	.185	.134	-.068
	Devices	-.208	-.046	-.092	.050	.089	-.053	-.118	-.199	.185	1.000	-.339	-.011
	icuadt(1)	-.249	.060	.064	.042	-.180	-.011	.183	.131	.134	-.339	1.000	.104
	Strata	-.196	.050	-.002	-.162	.004	-.245	.071	.022	-.068	-.011	.104	1.000
Step 2	Constant	1.000	-.390	-.508	-.200	-.026	-.242	-.052	-.311	-.341		-.347	-.203
	Died	-.390	1.000	.104	-.131	-.252	-.020	-.240	-.197	.085		.047	.049
	Habuse	-.508	.104	1.000	.070	-.060	-.108	.057	.007	.308		.035	-.004
	appempab(1)	-.200	-.131	.070	1.000	.150	.098	-.051	-.014	.116		.063	-.161
	SSS2(1)	-.026	-.252	-.060	.150	1.000	-.039	-.423	-.042	-.029		-.160	.004
	SHD2(1)	-.242	-.020	-.108	.098	-.039	1.000	-.173	-.085	-.034		-.030	-.245
	ND2(1)	-.052	-.240	.057	-.051	-.423	-.173	1.000	.004	.041		.153	.070
	Cciscor2	-.311	-.197	.007	-.014	-.042	-.085	.004	1.000	.009		.069	.020
	Timtoinf	-.341	.085	.308	.116	-.029	-.034	.041	.009	1.000		.212	-.068
	icuadt(1)	-.347	.047	.035	.063	-.160	-.030	.153	.069	.212		1.000	.107
	Strata	-.203	.049	-.004	-.161	.004	-.245	.070	.020	-.068		.107	1.000

Step 3	Constant	1.000		-.510	-.276	-.140	-.272	-.163	-.430	-.336		-.357	-.200
	Habuse	-.510		1.000	.085	-.035	-.106	.085	.028	.302		.031	-.008
	appempab(1)	-.276		.085	1.000	.121	.096	-.085	-.041	.129		.070	-.157
	SSS2(1)	-.140		-.035	.121	1.000	-.046	-.515	-.095	-.007		-.153	.017
	SHD2(1)	-.272		-.106	.096	-.046	1.000	-.183	-.091	-.033		-.030	-.244
	ND2(1)	-.163		.085	-.085	-.515	-.183	1.000	-.047	.063		.170	.085
	Cciscor2	-.430		.028	-.041	-.095	-.091	-.047	1.000	.027		.079	.031
	Timtoinf	-.336		.302	.129	-.007	-.033	.063	.027	1.000		.210	-.072
	icuadt(1)	-.357		.031	.070	-.153	-.030	.170	.079	.210		1.000	.105
	Strata	-.200		-.008	-.157	.017	-.244	.085	.031	-.072		.105	1.000
Step 4	Constant	1.000		-.505	-.295	-.265	-.312		-.443	-.331		-.338	-.190
	Habuse	-.505		1.000	.093	.010	-.092		.032	.298		.016	-.016
	appempab(1)	-.295		.093	1.000	.090	.083		-.045	.135		.086	-.150
	SSS2(1)	-.265		.010	.090	1.000	-.167		-.140	.030		-.077	.071
	SHD2(1)	-.312		-.092	.083	-.167	1.000		-.101	-.022		.002	-.233
	Cciscor2	-.443		.032	-.045	-.140	-.101		1.000	.030		.088	.035
	Timtoinf	-.331		.298	.135	.030	-.022		.030	1.000		.203	-.077
	icuadt(1)	-.338		.016	.086	-.077	.002		.088	.203		1.000	.092
	Strata	-.190		-.016	-.150	.071	-.233		.035	-.077		.092	1.000
Step 5	Constant	1.000		-.564	-.283	-.338			-.501	-.356		-.356	-.285
	Habuse	-.564		1.000	.101	-.006			.022	.297		.017	-.038
	appempab(1)	-.283		.101	1.000	.105			-.038	.137		.087	-.133
	SSS2(1)	-.338		-.006	.105	1.000			-.160	.027		-.078	.034
	Cciscor2	-.501		.022	-.038	-.160			1.000	.028		.088	.012
	Timtoinf	-.356		.297	.137	.027			.028	1.000		.203	-.086
	icuadt(1)	-.356		.017	.087	-.078			.088	.203		1.000	.095
	Strata	-.285		-.038	-.133	.034			.012	-.086		.095	1.000
Step 6	Constant	1.000		-.599	-.339	-.343			-.520	-.397		-.345	

	Habuse	-.599		1.000	.097	-.006			.023	.295		.021	
	appempab(1)	-.339		.097	1.000	.110			-.037	.127		.102	
	SSS2(1)	-.343		-.006	.110	1.000			-.161	.030		-.080	
	Cciscor2	-.520		.023	-.037	-.161			1.000	.030		.087	
	Timtoinf	-.397		.295	.127	.030			.030	1.000		.212	
	icuadt(1)	-.345		.021	.102	-.080			.087	.212		1.000	
	Constant	1.000		-.547	-.316	-.362			-.554			-.291	
	Habuse	-.547		1.000	.061	-.017			.014			-.048	
Step 7	appempab(1)	-.316		.061	1.000	.108			-.040			.074	
	SSS2(1)	-.362		-.017	.108	1.000			-.161			-.086	
	Cciscor2	-.554		.014	-.040	-.161			1.000			.085	
	icuadt(1)	-.291		-.048	.074	-.086			.085			1.000	
	Constant	1.000		-.593	-.298				-.666			-.346	
	Habuse	-.593		1.000	.063				.010			-.050	
Step 8	appempab(1)	-.298		.063	1.000				-.023			.081	
	Cciscor2	-.666		.010	-.023				1.000			.073	
	icuadt(1)	-.346		-.050	.081				.073			1.000	

Model if Term Removed[a]

Variable		Model Log Likelihood	Change in -2 Log Likelihood	df	Sig. of the Change
Step 1	died	-222.942	.055	1	.814
	habuse	-235.329	24.829	1	.000
	appempab	-243.192	40.555	1	.000
	SSS2	-223.365	.901	1	.342
	SHD2	-223.001	.173	1	.678

	ND2	-222.942	.055	1	.814
	cciscor2	-224.701	3.573	1	.059
	timtoinf	-223.637	1.446	1	.229
	devices	-222.923	.017	1	.897
	icuadt	-224.291	2.754	1	.097
	strata	-223.154	.479	1	.489
	died	-222.949	.053	1	.819
	habuse	-235.517	25.188	1	.000
	appempab	-243.207	40.569	1	.000
	SSS2	-223.366	.887	1	.346
	SHD2	-223.012	.179	1	.672
Step 2	ND2	-222.954	.064	1	.801
	cciscor2	-224.836	3.827	1	.050
	timtoinf	-223.641	1.438	1	.231
	icuadt	-224.563	3.280	1	.070
	strata	-223.161	.478	1	.490
	habuse	-235.818	25.738	1	.000
	appempab	-243.379	40.861	1	.000
	SSS2	-223.366	.834	1	.361
	SHD2	-223.036	.175	1	.676
Step 3	ND2	-222.970	.041	1	.839
	cciscor2	-224.848	3.798	1	.051
	timtoinf	-223.696	1.494	1	.222
	icuadt	-224.615	3.332	1	.068
	strata	-223.181	.464	1	.496
Step 4	habuse	-235.839	25.739	1	.000
	appempab	-243.699	41.458	1	.000

	SSS2	-223.678	1.417	1	.234
	SHD2	-223.077	.215	1	.643
	cciscor2	-224.892	3.845	1	.050
	timtoinf	-223.703	1.468	1	.226
	icuadt	-224.620	3.302	1	.069
	strata	-223.215	.491	1	.484
	habuse	-236.328	26.501	1	.000
	appempab	-243.686	41.218	1	.000
	SSS2	-223.907	1.659	1	.198
Step 5	cciscor2	-225.117	4.080	1	.043
	timtoinf	-223.824	1.493	1	.222
	icuadt	-224.729	3.303	1	.069
	strata	-223.263	.372	1	.542
	habuse	-236.448	26.371	1	.000
	appempab	-243.696	40.866	1	.000
	SSS2	-224.122	1.718	1	.190
Step 6	cciscor2	-225.324	4.122	1	.042
	timtoinf	-223.955	1.384	1	.239
	icuadt	-225.046	3.567	1	.059
	habuse	-236.471	25.033	1	.000
	appempab	-243.835	39.762	1	.000
Step 7	SSS2	-224.776	1.644	1	.200
	cciscor2	-225.975	4.042	1	.044
	icuadt	-225.374	2.840	1	.092
	habuse	-237.585	25.619	1	.000
	appempab	-244.131	38.711	1	.000
Step 8	cciscor2	-227.340	5.128	1	.024
	icuadt	-226.438	3.325	1	.068

a. Based on conditional parameter estimates

Variables not in the Equation

			Score	df	Sig.
Step 2[a]	Variables	devices	.017	1	.897
	Overall Statistics		.017	1	.897
Step 3[b]	Variables	died	.052	1	.819
		devices	.014	1	.906
	Overall Statistics		.069	2	.966
Step 4[c]	Variables	died	.030	1	.862
		ND2(1)	.041	1	.839
		devices	.021	1	.885
	Overall Statistics		.111	3	.991
Step 5[d]	Variables	died	.020	1	.887
		SHD2(1)	.215	1	.643
		ND2(1)	.082	1	.775
		devices	.033	1	.857
	Overall Statistics		.325	4	.988
Step 6[e]	Variables	died	.012	1	.911
		SHD2(1)	.096	1	.757
		ND2(1)	.097	1	.755
		devices	.029	1	.864
		strata	.371	1	.542
	Overall Statistics		.696	5	.983
Step 7[f]	Variables	died	.052	1	.820
		SHD2(1)	.126	1	.723
		ND2(1)	.056	1	.812

		timtoinf	1.388	1	.239
		devices	.003	1	.955
		strata	.262	1	.609
	Overall Statistics		2.083	6	.912
		died	.106	1	.745
		SSS2(1)	1.637	1	.201
		SHD2(1)	.302	1	.582
	Variables	ND2(1)	.777	1	.378
Step 8[g]		timtoinf	1.314	1	.252
		devices	.003	1	.959
		strata	.314	1	.575
	Overall Statistics		3.719	7	.811

a. Variable(s) removed on step 2: devices.

b. Variable(s) removed on step 3: died.

c. Variable(s) removed on step 4: ND2.

d. Variable(s) removed on step 5: SHD2.

e. Variable(s) removed on step 6: strata.

f. Variable(s) removed on step 7: timtoinf.

g. Variable(s) removed on step 8: SSS2.

8.2.4 Died vs. lived univariate analysis

```
                          DIED
MRSA       |   1          2        | Total
-----------+----------------------+------
   MRSA    |         68        131 |   199
           >      34.2%      65.8% > 50.0%
           |      56.2%      47.3% |
   MSSA    |         53        146 |   199
           >      26.6%      73.4% > 50.0%
           |      43.8%      52.7% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |
```

Single Table Analysis

Odds ratio		1.43
Cornfield 95% confidence limits for OR	0.91 < OR <	2.26
Maximum likelihood estimate of OR (MLE)		1.43
Exact 95% confidence limits for MLE	0.91 < OR <	2.25
Exact 95% Mid-P limits for MLE	0.93 < OR <	2.20
Probability of MLE >= 1.43 if population OR = 1.0		0.06346610
RISK RATIO(RR)(Outcome:DIED=1; Exposure:MRSA=MRSA)		1.28
95% confidence limits for RR	0.95 < RR <	1.73

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	2.67	0.10214183
Mantel-Haenszel:	2.67	0.10257360
Yates corrected:	2.33	0.12711273

```
                          DIED
BLOOD      |   1          2        | Total
-----------+----------------------+------
         1 |        113        207 |   320
           >      35.3%      64.7% > 80.4%
           |      93.4%      74.7% |
         2 |          8         70 |    78
           >      10.3%      89.7% > 19.6%
           |       6.6%      25.3% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |
```

Single Table Analysis

Odds ratio		4.78
Cornfield 95% confidence limits for OR	2.11 < OR <	11.23
Maximum likelihood estimate of OR (MLE)		4.76

```
Exact 95% confidence limits for MLE                        2.18 < OR <  11.87
Exact 95% Mid-P limits for MLE                             2.29 < OR <  10.95
Probability of MLE >=  4.76 if population OR = 1.0                  0.00000372

RISK RATIO(RR)(Outcome:DIED=1; Exposure:BLOOD=1)                          3.44
95% confidence limits for RR                               1.76 < RR <   6.75

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:        18.61     0.00001606 <---
        Mantel-Haenszel:    18.56     0.00001646 <---
        Yates corrected:    17.44     0.00002962 <---


                            DIED
  AGEGRP     |   1          2        | Total
-------------+-----------------------+------
ELDERLY      |          82        122 |   204
             >      40.2%      59.8% > 51.3%
             |      67.8%      44.0% |
YOUNG ADULT  |          39        155 |   194
             >      20.1%      79.9% > 48.7%
             |      32.2%      56.0% |
-------------+-----------------------+------
       Total |         121        277 |   398
             |      30.4%      69.6% |

                          Single Table Analysis

Odds ratio                                                                2.67
Cornfield 95% confidence limits for OR                     1.66 < OR <   4.31
Maximum likelihood estimate of OR (MLE)                                   2.66
Exact 95% confidence limits for MLE                        1.67 < OR <   4.31
Exact 95% Mid-P limits for MLE                             1.71 < OR <   4.20
Probability of MLE >=  2.66 if population OR = 1.0                  0.00000932

RISK RATIO(RR)(Outcome:DIED=1; Exposure:AGEGRP=ELDERLY)                   2.00
95% confidence limits for RR                               1.44 < RR <   2.77

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:        18.97     0.00001326 <---
        Mantel-Haenszel:    18.93     0.00001359 <---
        Yates corrected:    18.04     0.00002168 <---


                            DIED
  AGE        |   1          2        | Total
-------------+-----------------------+------
         18.0 |           0          1 |     1
         20.0 |           0          1 |     1
```

22.0	0	2	2
23.0	1	1	2
24.0	0	1	1
25.0	0	1	1
26.0	1	2	3
27.0	0	1	1
28.0	0	1	1
29.0	0	1	1
30.0	1	2	3
31.0	0	1	1
32.0	1	3	4
33.0	1	2	3
34.0	0	3	3
35.0	0	2	2
36.0	0	1	1
37.0	1	3	4
38.0	0	2	2
39.0	1	5	6
40.0	1	0	1
41.0	1	7	8
42.0	0	7	7
43.0	0	4	4
44.0	2	10	12
45.0	2	3	5
46.0	1	4	5
47.0	0	4	4
48.0	1	2	3
49.0	3	5	8
50.0	1	7	8
51.0	1	7	8
52.0	2	6	8
53.0	0	5	5
54.0	1	4	5
55.0	3	6	9
56.0	2	2	4
57.0	2	7	9
58.0	3	4	7
59.0	0	2	2
60.0	0	2	2
61.0	3	3	6
62.0	1	6	7
63.0	0	9	9
64.0	2	3	5
65.0	5	4	9
66.0	3	5	8
67.0	0	3	3
68.0	1	4	5
69.0	4	1	5
70.0	2	8	10
71.0	2	4	6
72.0	3	10	13
73.0	5	5	10
74.0	5	3	8
75.0	7	9	16
76.0	1	8	9
77.0	3	4	7
78.0	4	10	14

79.0	5	10	15
80.0	3	4	7
81.0	4	6	10
82.0	3	5	8
83.0	3	8	11
84.0	6	1	7
85.0	2	1	3
86.0	3	4	7
87.0	2	0	2
88.0	2	0	2
89.0	3	0	3
90.0	0	3	3
91.0	0	1	1
92.0	1	0	1
93.0	0	1	1
Total	121	277	398

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	8256	68.231	242.379	15.569
2	277	16590	59.892	293.988	17.146
Difference			8.340		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	23.000	58.000	73.000	80.000	92.000	75.000
2	18.000	46.000	62.000	75.000	93.000	44.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	5857.115	1	5857.115	21.042	0.000006	4.587192
Within	110226.272	396	278.349			
Total	116083.387	397				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 1.513 deg freedom = 1 p-value = 0.218708

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 21.087
Degrees of freedom = 1
p value = 0.000004

	DIED		
SEX	1	2	Total
F	42	92	134
>	31.3%	68.7%	> 33.8%
|	34.7%	33.3%	|
M	79	184	263

	>	30.0%	70.0% > 66.2%
	|	65.3%	66.7% |
Total	|	121	276 | 397
	|	30.5%	69.5% |

Single Table Analysis

Odds ratio		**1.06**
Cornfield 95% confidence limits for OR	**0.66 < OR <**	**1.72**
Maximum likelihood estimate of OR (MLE)		**1.06**
Exact 95% confidence limits for MLE	**0.66 < OR <**	**1.70**
Exact 95% Mid-P limits for MLE	**0.67 < OR <**	**1.67**
Probability of MLE >= 1.06 if population OR = 1.0		**0.43778281**
RISK RATIO(RR)(Outcome:DIED=1; Exposure:SEX=F)		**1.04**
95% confidence limits for RR	**0.76 < RR <**	**1.42**

Ignore risk ratio if case control study

	Chi-Squares	**P-values**
Uncorrected:	**0.07**	**0.78934401**
Mantel-Haenszel:	**0.07**	**0.78960324**
Yates corrected:	**0.02**	**0.87928466**

		DIED		
SOURCE	|	1	2	| Total
C	|	20	66	| 86
	>	23.3%	76.7%	> 21.6%
	|	16.5%	23.8%	|
N	|	101	211	| 312
	>	32.4%	67.6%	> 78.4%
	|	83.5%	76.2%	|
Total	|	121	277	| 398
	|	30.4%	69.6%	|

Single Table Analysis

Odds ratio		0.63
Cornfield 95% confidence limits for OR	0.35 < OR <	1.14
Maximum likelihood estimate of OR (MLE)		0.63
Exact 95% confidence limits for MLE	0.34 < OR <	1.13
Exact 95% Mid-P limits for MLE	0.36 < OR <	1.09
Probability of MLE <= 0.63 if population OR = 1.0		0.06562754
RISK RATIO(RR)(Outcome:DIED=1; Exposure:SOURCE=C)		0.72
95% confidence limits for RR	0.47 < RR <	1.09

Ignore risk ratio if case control study

	Chi-Squares	P-values

Uncorrected:	2.65	0.10369625
Mantel-Haenszel:	2.64	0.10413127
Yates corrected:	2.23	0.13496447

LOS	DIED 1	DIED 2	Total
0.0	0	3	3
1.0	2	4	6
2.0	1	2	3
3.0	6	4	10
4.0	3	3	6
5.0	1	7	8
6.0	3	5	8
7.0	2	8	10
8.0	3	8	11
9.0	3	5	8
10.0	5	7	12
11.0	2	5	7
12.0	4	9	13
13.0	4	9	13
14.0	3	7	10
15.0	3	9	12
16.0	0	4	4
17.0	4	1	5
18.0	4	4	8
19.0	0	4	4
20.0	1	3	4
21.0	1	7	8
22.0	3	4	7
23.0	2	8	10
24.0	2	4	6
25.0	3	1	4
26.0	1	2	3
27.0	1	2	3
28.0	0	2	2
29.0	4	3	7
30.0	0	4	4
31.0	1	4	5
32.0	4	5	9
33.0	2	3	5
34.0	3	2	5
35.0	1	3	4
36.0	1	2	3
37.0	1	4	5
38.0	1	0	1
40.0	1	6	7
41.0	1	2	3
42.0	1	1	2
43.0	1	0	1
44.0	1	3	4
45.0	0	1	1
47.0	0	3	3
48.0	1	0	1
49.0	2	0	2

50.0	0	2	2
51.0	1	2	3
52.0	1	1	2
53.0	2	2	4
54.0	2	1	3
55.0	2	1	3
56.0	0	2	2
57.0	0	1	1
58.0	1	0	1
59.0	1	0	1
60.0	1	1	2
61.0	1	0	1
62.0	1	2	3
63.0	0	1	1
65.0	0	2	2
66.0	1	2	3
68.0	2	1	3
69.0	1	0	1
70.0	1	1	2
71.0	0	2	2
72.0	0	2	2
73.0	0	1	1
75.0	0	2	2
76.0	0	2	2
77.0	1	1	2
78.0	0	2	2
79.0	0	1	1
82.0	0	1	1
83.0	1	0	1
85.0	0	1	1
86.0	1	2	3
88.0	0	2	2
89.0	0	1	1
90.0	0	1	1
91.0	0	3	3
93.0	0	1	1
103.0	0	1	1
105.0	0	1	1
106.0	0	1	1
107.0	0	1	1
108.0	0	1	1
109.0	0	1	1
110.0	2	0	2
111.0	1	3	4
112.0	0	1	1
113.0	0	1	1
119.0	0	1	1
123.0	0	1	1
129.0	1	0	1
133.0	0	1	1
137.0	0	2	2
139.0	1	2	3
143.0	0	1	1
151.0	0	1	1
154.0	1	1	2
160.0	0	1	1
172.0	0	2	2

184.0	**0**	**1**	**1**
196.0	**0**	**1**	**1**
208.0	**1**	**0**	**1**
212.0	**0**	**1**	**1**
223.0	**0**	**1**	**1**
244.0	**0**	**1**	**1**
265.0	**0**	**1**	**1**
279.0	**0**	**1**	**1**
326.0	**0**	**1**	**1**
408.0	**0**	**1**	**1**
Total	**121**	**267**	**388**

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	4070	33.636	1137.167	33.722
2	267	12231	45.809	3110.185	55.769
Difference			-12.173		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	1.000	11.000	24.000	48.000	208.000	3.000
2	0.000	12.000	24.000	62.000	408.000	12.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	12337.677	1	12337.677	4.941	0.026800	2.222920
Within	963769.258	386	2496.812			
Total	976106.936	387				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 35.832 deg freedom = 1 p-value = 0.000000

Bartlett's Test shows the variances in the samples to differ.

Use non-parametric results below rather than ANOVA.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 1.662
Degrees of freedom = 1
p value = 0.197364

	DIED		
TIMTOINF	**1**	**2**	**Total**
0.0	**17**	**77**	**94**
1.0	**9**	**20**	**29**
2.0	**5**	**12**	**17**
3.0	**1**	**7**	**8**
4.0	**6**	**12**	**18**
5.0	**7**	**5**	**12**
6.0	**6**	**10**	**16**
7.0	**4**	**11**	**15**

8.0	2	7	9
9.0	7	6	13
10.0	2	6	8
11.0	3	8	11
12.0	0	5	5
13.0	1	7	8
14.0	1	7	8
15.0	2	3	5
16.0	2	3	5
17.0	0	3	3
18.0	3	2	5
19.0	2	3	5
20.0	1	1	2
21.0	1	2	3
22.0	2	3	5
23.0	1	0	1
24.0	0	2	2
25.0	4	1	5
26.0	1	3	4
27.0	1	1	2
28.0	1	2	3
29.0	0	1	1
30.0	2	1	3
31.0	2	1	3
32.0	1	0	1
33.0	1	0	1
34.0	1	3	4
35.0	1	0	1
36.0	1	2	3
37.0	1	2	3
39.0	0	2	2
43.0	2	0	2
44.0	0	2	2
46.0	1	1	2
47.0	0	1	1
48.0	0	2	2
49.0	0	1	1
50.0	2	1	3
51.0	1	1	2
52.0	1	1	2
54.0	1	1	2
59.0	1	2	3
60.0	1	1	2
66.0	0	1	1
68.0	0	1	1
71.0	0	1	1
72.0	0	1	1
75.0	1	0	1
76.0	0	1	1
86.0	0	1	1
90.0	0	1	1
95.0	0	1	1
97.0	0	1	1
102.0	1	0	1
104.0	0	1	1
106.0	0	1	1
108.0	1	0	1

109.0	**0**	**1**	**1**	
127.0	**1**	**0**	**1**	
Total	**116**	**267**	**383**	

DIED	Obs	Total	Mean	Variance	Std Dev
1	116	1996	17.207	508.705	22.554
2	267	3548	13.288	438.830	20.948
Difference			3.919		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	2.000	9.000	25.000	127.000	0.000
2	0.000	0.000	6.000	15.000	109.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	1241.686	1	1241.686	2.700	0.101187	1.643101
Within	175229.828	381	459.921			
Total	176471.514	382				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.890 deg freedom = 1 p-value = 0.345434

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 7.797
Degrees of freedom = 1
p value = 0.005232

MSWI	DIED 1	2	Total
1.0	8	61	69
>	11.6%	88.4%	> 17.3%
|	6.6%	22.0%	|
2.0	113	216	329
>	34.3%	65.7%	> 82.7%
|	93.4%	78.0%	|
Total	121	277	398
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio		0.25
Cornfield 95% confidence limits for OR	0.11 < OR <	0.57
Maximum likelihood estimate of OR (MLE)		0.25

```
Exact 95% confidence limits for MLE                      0.10 < OR <   0.55
Exact 95% Mid-P limits for MLE                           0.11 < OR <   0.52
Probability of MLE <=  0.25 if population OR = 1.0                0.00006510

RISK RATIO(RR)(Outcome:DIED=1; Exposure:MSWI=1.0)                          0.34
95% confidence limits for RR                             0.17 < RR <   0.66

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

          Uncorrected:        13.95     0.00018729 <---
          Mantel-Haenszel:    13.92     0.00019082 <---
          Yates corrected:    12.90     0.00032860 <---
```

MSWITYPE	DIED 1	2	Total
D	6	53	59
	10.2%	89.8%	86.8%
	75.0%	88.3%	
I	2	7	9
	22.2%	77.8%	13.2%
	25.0%	11.7%	
Total	8	60	68
	11.8%	88.2%	

Single Table Analysis

```
Odds ratio                                                                 0.40
Cornfield 95% confidence limits for OR                   0.05 < OR <
3.55*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                    0.40
Exact 95% confidence limits for MLE                      0.06 < OR <   4.84
Exact 95% Mid-P limits for MLE                           0.07 < OR <   3.39
Probability of MLE <=  0.40 if population OR = 1.0                0.28465782

RISK RATIO(RR)(Outcome:DIED=1; Exposure:MSWITYPE=D)                        0.46
95% confidence limits for RR                             0.11 < RR <   1.93

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

          Uncorrected:          1.09     0.29585587
          Mantel-Haenszel:      1.08     0.29943458
          Yates corrected:      0.24     0.62412452

          Fisher exact: 1-tailed P-value: 0.2846578
                        2-tailed P-value: 0.2846578

An expected value is less than 5; recommend Fisher exact results.
```

MPBSI	DIED 1	2	Total
1	66	115	181
>	36.5%	63.5%	> 45.5%
	54.5%	41.5%	
2	55	162	217
>	25.3%	74.7%	> 54.5%
	45.5%	58.5%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		1.69
Cornfield 95% confidence limits for OR	1.07 < OR <	2.67
Maximum likelihood estimate of OR (MLE)		1.69
Exact 95% confidence limits for MLE	1.07 < OR <	2.66
Exact 95% Mid-P limits for MLE	1.10 < OR <	2.60
Probability of MLE >= 1.69 if population OR = 1.0		0.01101640
RISK RATIO(RR)(Outcome:DIED=1; Exposure:MPBSI=1)		1.44
95% confidence limits for RR	1.07 < RR <	1.94

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	5.77	0.01634272 <---
Mantel-Haenszel:	5.75	0.01647802 <---
Yates corrected:	5.25	0.02191999 <---

MPBSITYP	DIED 1	2	Total
C	16	41	57
>	28.1%	71.9%	> 35.2%
	26.7%	40.2%	
P	44	61	105
>	41.9%	58.1%	> 64.8%
	73.3%	59.8%	
Total	60	102	162
	37.0%	63.0%	

Single Table Analysis

Odds ratio		0.54
Cornfield 95% confidence limits for OR	0.25 < OR <	1.15
Maximum likelihood estimate of OR (MLE)		0.54
Exact 95% confidence limits for MLE	0.25 < OR <	1.14
Exact 95% Mid-P limits for MLE	0.27 < OR <	1.08
Probability of MLE <= 0.54 if population OR = 1.0		0.05709873

```
RISK RATIO(RR)(Outcome:DIED=1; Exposure:MPBSITYP=C)                    0.67
95% confidence limits for RR                          0.42 < RR <   1.07

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:         3.03     0.08162647
        Mantel-Haenszel:     3.01     0.08257390
        Yates corrected:     2.47     0.11618758


                              DIED
MSBSI       |   1          2         | Total
------------+----------------------+------
          1 |         46         93 |   139
            >      33.1%      66.9% > 34.9%
            |      38.0%      33.6% |
          2 |         75        184 |   259
            >      29.0%      71.0% > 65.1%
            |      62.0%      66.4% |
------------+----------------------+------
      Total |        121        277 |   398
            |      30.4%      69.6% |

                           Single Table Analysis

Odds ratio                                                             1.21
Cornfield 95% confidence limits for OR                0.76 < OR <      1.95
Maximum likelihood estimate of OR (MLE)                                1.21
Exact 95% confidence limits for MLE                   0.76 < OR <      1.93
Exact 95% Mid-P limits for MLE                        0.78 < OR <      1.89
Probability of MLE >=  1.21 if population OR = 1.0              0.22880888

RISK RATIO(RR)(Outcome:DIED=1; Exposure:MSBSI=1)                       1.14
95% confidence limits for RR                          0.84 < RR <      1.55

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:         0.73     0.39246366
        Mantel-Haenszel:     0.73     0.39305898
        Yates corrected:     0.55     0.45877290


                              DIED
MPNEU       |   1          2         | Total
------------+----------------------+------
          1 |         22         40 |    62
            >      35.5%      64.5% > 15.6%
            |      18.2%      14.4% |
          2 |         99        237 |   336
            >      29.5%      70.5% > 84.4%
```

	81.8%	85.6%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		**1.32**
Cornfield 95% confidence limits for OR	**0.71 < OR <**	**2.43**
Maximum likelihood estimate of OR (MLE)		**1.32**
Exact 95% confidence limits for MLE	**0.71 < OR <**	**2.40**
Exact 95% Mid-P limits for MLE	**0.73 < OR <**	**2.32**
Probability of MLE >= 1.32 if population OR = 1.0		**0.21147696**
RISK RATIO(RR)(Outcome:DIED=1; Exposure:MPNEU=1)		**1.20**
95% confidence limits for RR	**0.83 < RR <**	**1.75**

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	**0.90**	**0.34375985**
Mantel-Haenszel:	**0.89**	**0.34436678**
Yates corrected:	**0.63**	**0.42573065**

	DIED		
MUTI	1	2	Total
1	15	17	32
>	46.9%	53.1%	> 8.0%
	12.4%	6.1%	
2	106	260	366
>	29.0%	71.0%	> 92.0%
	87.6%	93.9%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		2.16
Cornfield 95% confidence limits for OR	0.98 < OR <	4.79
Maximum likelihood estimate of OR (MLE)		2.16
Exact 95% confidence limits for MLE	0.97 < OR <	4.79
Exact 95% Mid-P limits for MLE	1.02 < OR <	4.52
Probability of MLE >= 2.16 if population OR = 1.0		0.03077171
RISK RATIO(RR)(Outcome:DIED=1; Exposure:MUTI=1)		1.62
95% confidence limits for RR	1.08 < RR <	2.42

Ignore risk ratio if case control study

	Chi-Squares	P-values

Uncorrected:	4.46	0.03464267 <---
Mantel-Haenszel:	4.45	0.03487084 <---
Yates corrected:	3.66	0.05585897

MBONE	DIED 1	2	Total
1.0	7	23	30
	23.3%	76.7%	7.5%
	5.8%	8.3%	
2.0	114	254	368
	31.0%	69.0%	92.5%
	94.2%	91.7%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio	0.68
Cornfield 95% confidence limits for OR	0.25 < OR < 1.74
Maximum likelihood estimate of OR (MLE)	0.68
Exact 95% confidence limits for MLE	0.24 < OR < 1.69
Exact 95% Mid-P limits for MLE	0.26 < OR < 1.59
Probability of MLE <= 0.68 if population OR = 1.0	0.25630881
RISK RATIO(RR)(Outcome:DIED=1; Exposure:MBONE=1.0)	0.75
95% confidence limits for RR	0.39 < RR < 1.47

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.77	0.38139979
Mantel-Haenszel:	0.76	0.38199861
Yates corrected:	0.45	0.50353672

MBONETYP	DIED 1	2	Total
J	2	10	12
	16.7%	83.3%	40.0%
	28.6%	43.5%	
O	5	11	16
	31.3%	68.8%	53.3%
	71.4%	47.8%	
O/J	0	1	1
	0.0%	100.0%	3.3%
	0.0%	4.3%	
V	0	1	1
	0.0%	100.0%	3.3%
	0.0%	4.3%	
Total	7	23	30

```
           |      23.3%      76.7% |


      An expected value is < 5. Chi square not valid.
             Chi square =       1.47
     Degrees of freedom =          3
                p value = 0.68981659


                            DIED
MCVS       |   1          2         | Total
-----------+----------------------+------
         1 |          2          9 |    11
           >      18.2%      81.8% >  2.8%
           |       1.7%       3.2% |
         2 |        119        268 |   387
           >      30.7%      69.3% > 97.2%
           |      98.3%      96.8% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |


                          Single Table Analysis

Odds ratio                                                              0.50
Cornfield 95% confidence limits for OR                  0.07 < OR <     2.56
Maximum likelihood estimate of OR (MLE)                                 0.50
Exact 95% confidence limits for MLE                     0.05 < OR <     2.47
Exact 95% Mid-P limits for MLE                          0.07 < OR <     2.14
Probability of MLE <=  0.50 if population OR = 1.0               0.29917274

RISK RATIO(RR)(Outcome:DIED=1; Exposure:MCVS=1)                         0.59
95% confidence limits for RR                            0.17 < RR <     2.09

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.80     0.37157145
        Mantel-Haenszel:      0.80     0.37217298
        Yates corrected:      0.31     0.57467991

        Fisher exact: 1-tailed P-value: 0.2991727
                      2-tailed P-value: 0.5156519

An expected value is less than 5; recommend Fisher exact results.

                            DIED
MCVSTYPE   |   1          2         | Total
-----------+----------------------+------
  A        |          0          3 |     3
           >       0.0%     100.0% > 27.3%
           |       0.0%      33.3% |
  E        |          2          5 |     7
           >      28.6%      71.4% > 63.6%
           |     100.0%      55.6% |
```

```
  MY       |          0          1 |     1
           >       0.0%     100.0% >  9.1%
           |       0.0%      11.1% |
-----------+----------------------+------

     Total |          2          9 |    11
           |      18.2%      81.8% |


      An expected value is < 5. Chi square not valid.
             Chi square =       1.40
     Degrees of freedom =          2
                p value = 0.49737416


                           DIED
  MCNS       |   1          2        | Total
-------------+----------------------+------
           1.0 |          2          5 |     7
               >      28.6%      71.4% >  1.8%
               |       1.7%       1.8% |
           2.0 |        119        272 |   391
               >      30.4%      69.6% > 98.2%
               |      98.3%      98.2% |
-------------+----------------------+------
       Total |        121        277 |   398
             |      30.4%      69.6% |


                          Single Table Analysis

Odds ratio                                                          0.91
Cornfield 95% confidence limits for OR                 0.12 < OR <
5.46*
                     *May be inaccurate
Maximum likelihood estimate of OR (MLE)                             0.91
Exact 95% confidence limits for MLE                    0.09 < OR <  5.68
Exact 95% Mid-P limits for MLE                         0.12 < OR <  4.71
Probability of MLE <=  0.91 if population OR = 1.0            0.63844392

RISK RATIO(RR)(Outcome:DIED=1; Exposure:MCNS=1.0)                   0.94
95% confidence limits for RR                           0.29 < RR <  3.06

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          0.01     0.91540092
        Mantel-Haenszel:      0.01     0.91550687
        Yates corrected:      0.10     0.75787580

        Fisher exact: 1-tailed P-value: 0.6384439
                      2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

                           DIED
```

MEENTM	1	2	Total
1	2	0	2
>	100.0%	0.0%	> 0.5%
	1.7%	0.0%	
2	119	277	396
>	30.1%	69.9%	> 99.5%
	98.3%	100.0%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio	??????
Maximum likelihood estimate of OR (MLE)	??????
Exact 95% confidence limits for MLE	0.43 < OR < ??????
Exact 95% Mid-P limits for MLE	0.66 < OR < ??????
Probability of MLE >= ?????? if population OR = 1.0	0.09189524
RISK RATIO(RR)(Outcome:DIED=1; Exposure:MEENTM=1)	3.33
95% confidence limits for RR	2.86 < RR < 3.87

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	4.60	0.03194146 <---
Mantel-Haenszel:	4.59	0.03215762 <---
Yates corrected:	1.89	0.16925707

Fisher exact: 1-tailed P-value: 0.0918952
2-tailed P-value: 0.0918952

An expected value is less than 5; recommend Fisher exact results.

	DIED		
MGI	1	2	Total
1	1	11	12
>	8.3%	91.7%	> 3.0%
	0.8%	4.0%	
2	120	266	386
>	31.1%	68.9%	> 97.0%
	99.2%	96.0%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio	0.20
Cornfield 95% confidence limits for OR	0.01 < OR < 1.55
Maximum likelihood estimate of OR (MLE)	0.20
Exact 95% confidence limits for MLE	0.00 < OR < 1.42
Exact 95% Mid-P limits for MLE	0.01 < OR < 1.20

Probability of MLE <= 0.20 if population OR = 1.0 0.07746113

RISK RATIO(RR)(Outcome:DIED=1; Exposure:MGI=1) 0.27
95% confidence limits for RR 0.04 < RR < 1.76

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	2.85	0.09149119
Mantel-Haenszel:	2.84	0.09189943
Yates corrected:	1.87	0.17101173

Fisher exact: 1-tailed P-value: 0.0774611
2-tailed P-value: 0.1164720

An expected value is less than 5; recommend Fisher exact results.

	DIED		
MLRT	**1**	**2**	**Total**
1	**5**	**7**	**12**
	41.7%	**58.3%**	**3.0%**
	4.1%	**2.5%**	
2	**116**	**270**	**386**
	30.1%	**69.9%**	**97.0%**
	95.9%	**97.5%**	
Total	**121**	**277**	**398**
	30.4%	**69.6%**	

Single Table Analysis

Odds ratio 1.66
Cornfield 95% confidence limits for OR 0.44 < OR < 6.04
Maximum likelihood estimate of OR (MLE) 1.66
Exact 95% confidence limits for MLE 0.41 < OR < 6.22
Exact 95% Mid-P limits for MLE 0.47 < OR < 5.48
Probability of MLE >= 1.66 if population OR = 1.0 0.28477496

RISK RATIO(RR)(Outcome:DIED=1; Exposure:MLRT=1) 1.39
95% confidence limits for RR 0.70 < RR < 2.75

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	**0.74**	**0.38901548**
Mantel-Haenszel:	**0.74**	**0.38961195**
Yates corrected:	**0.29**	**0.58728081**

Fisher exact: 1-tailed P-value: 0.2847750
2-tailed P-value: 0.5240664

An expected value is less than 5; recommend Fisher exact results.

MRPT	DIED 1	2	Total
1	1	1	2
>	50.0%	50.0%	> 0.5%
	0.8%	0.4%	
2	120	276	396
>	30.3%	69.7%	> 99.5%
	99.2%	99.6%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio	**2.30**
Cornfield 95% confidence limits for OR	**0.00 < OR < 86.30***
***May be inaccurate**	
Maximum likelihood estimate of OR (MLE)	**2.29**
Exact 95% confidence limits for MLE	**0.03 < OR < 181.18**
Exact 95% Mid-P limits for MLE	**0.06 < OR < 90.00**
Probability of MLE >= 2.29 if population OR = 1.0	**0.51614496**
RISK RATIO(RR)(Outcome:DIED=1; Exposure:MRPT=1)	**1.65**
95% confidence limits for RR	**0.41 < RR < 6.65**

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	**0.36**	**0.54581217**
Mantel-Haenszel:	**0.36**	**0.54631711**
Yates corrected:	**0.03**	**0.86776330**

Fisher exact: 1-tailed P-value: 0.5161450
2-tailed P-value: 0.5161450

An expected value is less than 5; recommend Fisher exact results.

MSST	DIED 1	2	Total
1.0	15	58	73
>	20.5%	79.5%	> 18.3%
	12.4%	20.9%	
2.0	106	219	325
>	32.6%	67.4%	> 81.7%
	87.6%	79.1%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio 0.53
Cornfield 95% confidence limits for OR 0.27 < OR < 1.03
Maximum likelihood estimate of OR (MLE) 0.54
Exact 95% confidence limits for MLE 0.27 < OR < 1.01
Exact 95% Mid-P limits for MLE 0.28 < OR < 0.97
Probability of MLE <= 0.54 if population OR = 1.0 0.02730505

RISK RATIO(RR)(Outcome:DIED=1; Exposure:MSST=1.0) 0.63
95% confidence limits for RR 0.39 < RR < 1.02

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	4.10	0.04281846 <---
Mantel-Haenszel:	4.09	0.04308033 <---
Yates corrected:	3.55	0.05947162

NOSAINF	1	2	Total
0.0	2	1	3
1.0	62	150	212
2.0	47	102	149
3.0	9	21	30
4.0	0	3	3
5.0	1	0	1
Total	121	277	398

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	188	1.554	0.533	0.730
2	277	429	1.549	0.473	0.688
Difference			0.005		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	1.000	1.000	2.000	5.000	1.000
2	0.000	1.000	1.000	2.000	4.000	1.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.002	1	0.002	0.004	0.948013	0.065244
Within	194.493	396	0.491			
Total	194.495	397				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.591 deg freedom = 1 p-value = 0.442072

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.011
Degrees of freedom = 1
p value = 0.917971

NSWI	DIED 1	2	Total
1	0	10	10
>	0.0%	100.0%	> 2.5%
|	0.0%	3.6%	|
2	121	267	388
>	31.2%	68.8%	> 97.5%
|	100.0%	96.4%	|
Total	121	277	398
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio	0.00
Cornfield 95% confidence limits for OR	0.00 < OR < 1.20
Maximum likelihood estimate of OR (MLE)	0.00
Exact 95% confidence limits for MLE	0.00 < OR < 1.00
Exact 95% Mid-P limits for MLE	0.00 < OR < 0.78
Probability of MLE <= 0.00 if population OR = 1.0	0.02535666
RISK RATIO(RR)(Outcome:DIED=1; Exposure:NSWI=1)	0.00
95% confidence limits for RR	?????? < RR < ??????

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	4.48	0.03427739 <---
Mantel-Haenszel:	4.47	0.03450396 <---
Yates corrected:	3.13	0.07695070

Fisher exact: 1-tailed P-value: 0.0253567 <---
2-tailed P-value: 0.0359141 <---

An expected value is less than 5; recommend Fisher exact results.

NSWITYPE	**DIED 2**	**Total**
D	**6**	**6**
>	**100.0%**	**> 60.0%**
|	**60.0%**	**|**
I	**4**	**4**
>	**100.0%**	**> 40.0%**
|	**40.0%**	**|**
Total	**10**	**10**
|	**100.0%**	**|**

An expected value is < 5. Chi square not valid.
Chi square = 0.00
Degrees of freedom = 0
p value = 1.00000000

NPBSI	DIED 1	2	Total
1	9	10	19
>	47.4%	52.6%	> 4.8%
	7.4%	3.6%	
2	112	267	379
>	29.6%	70.4%	> 95.2%
	92.6%	96.4%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio	2.15
Cornfield 95% confidence limits for OR	0.77 < OR < 5.95
Maximum likelihood estimate of OR (MLE)	2.14
Exact 95% confidence limits for MLE	0.75 < OR < 6.04
Exact 95% Mid-P limits for MLE	0.82 < OR < 5.53
Probability of MLE >= 2.14 if population OR = 1.0	0.08502943
RISK RATIO(RR)(Outcome:DIED=1; Exposure:NPBSI=1)	1.60
95% confidence limits for RR	0.97 < RR < 2.64

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	2.71	0.09944457
Mantel-Haenszel:	2.71	0.09987061
Yates corrected:	1.94	0.16391987

NPBSITYP	**DIED 1**	**2**	**Total**
C	**3**	**6**	**9**
>	**33.3%**	**66.7%**	**> 47.4%**
|	**33.3%**	**60.0%**	**|**
P	**6**	**4**	**10**
>	**60.0%**	**40.0%**	**> 52.6%**
|	**66.7%**	**40.0%**	**|**
Total	**9**	**10**	**19**
|	**47.4%**	**52.6%**	**|**

Single Table Analysis

Odds ratio **0.33**
Cornfield 95% confidence limits for OR **0.03 < OR < 3.11**
Maximum likelihood estimate of OR (MLE) **0.35**
Exact 95% confidence limits for MLE **0.03 < OR < 2.98**
Exact 95% Mid-P limits for MLE **0.05 < OR < 2.35**
Probability of MLE <= 0.35 if population OR = 1.0 **0.24221135**

RISK RATIO(RR)(Outcome:DIED=1; Exposure:NPBSITYP=C) **0.56**
95% confidence limits for RR **0.19 < RR < 1.59**

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	**1.35**	**0.24508396**
Mantel-Haenszel:	**1.28**	**0.25789904**
Yates corrected:	**0.49**	**0.48251264**

Fisher exact: 1-tailed P-value: 0.2422113
2-tailed P-value: 0.3698500

An expected value is less than 5; recommend Fisher exact results.

	DIED		
NSBSI	1	2	Total
1	7	6	13
>	53.8%	46.2%	> 3.3%
	5.8%	2.2%	
2	114	271	385
>	29.6%	70.4%	> 96.7%
	94.2%	97.8%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio 2.77
Cornfield 95% confidence limits for OR 0.81 < OR < 9.64*
*May be inaccurate
Maximum likelihood estimate of OR (MLE) 2.77
Exact 95% confidence limits for MLE 0.78 < OR < 10.20
Exact 95% Mid-P limits for MLE 0.88 < OR < 8.94
Probability of MLE >= 2.77 if population OR = 1.0 0.06339749

RISK RATIO(RR)(Outcome:DIED=1; Exposure:NSBSI=1) 1.82
95% confidence limits for RR 1.07 < RR < 3.08

Ignore risk ratio if case control study

	Chi-Squares	P-values

```
        Uncorrected:         3.49     0.06170761
        Mantel-Haenszel:     3.48     0.06203547
        Yates corrected:     2.44     0.11831862

        Fisher exact: 1-tailed P-value: 0.0633975
                      2-tailed P-value: 0.0716313

An expected value is less than 5; recommend Fisher exact results.

                              DIED
NPNEU      |   1          2         | Total
-----------+----------------------+------
         1 |         22         21 |    43
           >      51.2%      48.8% > 10.8%
           |      18.2%       7.6% |
         2 |         99        256 |   355
           >      27.9%      72.1% > 89.2%
           |      81.8%      92.4% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |

                           Single Table Analysis

Odds ratio                                                                 2.71
Cornfield 95% confidence limits for OR                   1.35 < OR <       5.43
Maximum likelihood estimate of OR (MLE)                                    2.70
Exact 95% confidence limits for MLE                      1.35 < OR <       5.42
Exact 95% Mid-P limits for MLE                           1.41 < OR <       5.18
Probability of MLE >=  2.70 if population OR = 1.0                  0.00208753

RISK RATIO(RR)(Outcome:DIED=1; Exposure:NPNEU=1)                           1.83
95% confidence limits for RR                             1.31 < RR <       2.57

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:         9.82     0.00172624 <---
        Mantel-Haenszel:     9.80     0.00174956 <---
        Yates corrected:     8.75     0.00309468 <---


                              DIED
NUTI       |   1          2         | Total
-----------+----------------------+------
         1 |         21         29 |    50
           >      42.0%      58.0% > 12.6%
           |      17.4%      10.5% |
         2 |        100        248 |   348
           >      28.7%      71.3% > 87.4%
           |      82.6%      89.5% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |
```

Single Table Analysis

Odds ratio		1.80
Cornfield 95% confidence limits for OR	0.93 < OR <	3.46
Maximum likelihood estimate of OR (MLE)		1.79
Exact 95% confidence limits for MLE	0.92 < OR <	3.43
Exact 95% Mid-P limits for MLE	0.97 < OR <	3.30
Probability of MLE >= 1.79 if population OR = 1.0		0.04304373
RISK RATIO(RR)(Outcome:DIED=1; Exposure:NUTI=1)		1.46
95% confidence limits for RR	1.01 < RR <	2.11

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	3.64	0.05656640
Mantel-Haenszel:	3.63	0.05687769
Yates corrected:	3.04	0.08146439

NBONE	DIED 1	2	Total
1.0	2	7	9
	22.2%	77.8%	2.3%
	1.7%	2.5%	
2.0	119	270	389
	30.6%	69.4%	97.7%
	98.3%	97.5%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		**0.65**
Cornfield 95% confidence limits for OR	**0.09 < OR <**	**3.51**
Maximum likelihood estimate of OR (MLE)		**0.65**
Exact 95% confidence limits for MLE	**0.06 < OR <**	**3.48**
Exact 95% Mid-P limits for MLE	**0.09 < OR <**	**2.96**
Probability of MLE <= 0.65 if population OR = 1.0		**0.45069033**
RISK RATIO(RR)(Outcome:DIED=1; Exposure:NBONE=1.0)		**0.73**
95% confidence limits for RR	**0.21 < RR <**	**2.49**

Ignore risk ratio if case control study

	Chi-Squares	**P-values**
Uncorrected:	**0.29**	**0.58946555**
Mantel-Haenszel:	**0.29**	**0.58993354**
Yates corrected:	**0.03**	**0.86255913**

```
        Fisher exact: 1-tailed P-value: 0.4506903
                      2-tailed P-value: 0.7285971

An expected value is less than 5; recommend Fisher exact results.


                              DIED
NBONETYP   |   1          2         | Total
-----------+----------------------+------
  J        |          0          3 |     3
           >       0.0%     100.0% > 37.5%
           |       0.0%      50.0% |
  O        |          2          3 |     5
           >      40.0%      60.0% > 62.5%
           |     100.0%      50.0% |
-----------+----------------------+------
     Total |          2          6 |     8
           |      25.0%      75.0% |

                           Single Table Analysis

Odds ratio                                                              0.00
Cornfield 95% confidence limits for OR                  0.00 < OR <
10.07*
                     *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 0.00
Exact 95% confidence limits for MLE                     0.00 < OR <   9.17
Exact 95% Mid-P limits for MLE                          0.00 < OR <   5.84
Probability of MLE <=  0.00 if population OR = 1.0              0.35714286

RISK RATIO(RR)(Outcome:DIED=1; Exposure:NBONETYP=J)                     0.00
95% confidence limits for RR                          ?????? < RR < ??????

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          1.60     0.20590321
        Mantel-Haenszel:      1.40     0.23672357
        Yates corrected:      0.18     0.67328998

        Fisher exact: 1-tailed P-value: 0.3571429
                      2-tailed P-value: 0.4642857

An expected value is less than 5; recommend Fisher exact results.

                              DIED
NCVS       |   1          2         | Total
-----------+----------------------+------
         1 |          1          1 |     2
           >      50.0%      50.0% >  0.5%
           |       0.8%       0.4% |
         2 |         120        276 |   396
           >      30.3%      69.7% > 99.5%
           |      99.2%      99.6% |
-----------+----------------------+------
```

```
     Total |        121        277 |   398
           |      30.4%      69.6% |

                          Single Table Analysis

Odds ratio                                                              2.30
Cornfield 95% confidence limits for OR                  0.00 < OR <
86.30*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 2.29
Exact 95% confidence limits for MLE                     0.03 < OR < 181.18
Exact 95% Mid-P limits for MLE                          0.06 < OR <  90.00
Probability of MLE >=  2.29 if population OR = 1.0             0.51614496

RISK RATIO(RR)(Outcome:DIED=1; Exposure:NCVS=1)                         1.65
95% confidence limits for RR                            0.41 < RR <   6.65

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          0.36     0.54581217
        Mantel-Haenszel:      0.36     0.54631711
        Yates corrected:      0.03     0.86776330

        Fisher exact: 1-tailed P-value: 0.5161450
                      2-tailed P-value: 0.5161450

An expected value is less than 5; recommend Fisher exact results.

                            DIED
NCVSTYPE   |   1          2         | Total
-----------+-----------------------+------
         E |          1          1 |     2
           >      50.0%       50.0% >100.0%
           |     100.0%      100.0% |
-----------+-----------------------+------
     Total |          1          1 |     2
           |      50.0%       50.0% |


      An expected value is < 5. Chi square not valid.
             Chi square =       0.00
     Degrees of freedom =          0
                p value = 1.00000000


                            DIED
NCNS       |   1          2         | Total
-----------+-----------------------+------
         1 |          0          2 |     2
           >       0.0%      100.0% >  0.5%
           |       0.0%        0.7% |
         2 |        121        275 |   396
           >      30.6%       69.4% > 99.5%
           |     100.0%       99.3% |
```

```
-----------+-----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |

                          Single Table Analysis

Odds ratio                                                              0.00
Cornfield 95% confidence limits for OR                  0.00 < OR <
9.52*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 0.00
Exact 95% confidence limits for MLE                     0.00 < OR <  12.21
Exact 95% Mid-P limits for MLE                          0.00 < OR <   7.96
Probability of MLE <=  0.00 if population OR = 1.0              0.48385504

RISK RATIO(RR)(Outcome:DIED=1; Exposure:NCNS=1)                         0.00
95% confidence limits for RR                          ?????? < RR < ??????

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.88     0.34873397
        Mantel-Haenszel:      0.88     0.34934020
        Yates corrected:      0.03     0.86776330

        Fisher exact: 1-tailed P-value: 0.4838550
                      2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

                            DIED
NEENTM     |   1          2        | Total
-----------+-----------------------+------
         1 |          1          1 |     2
           >      50.0%       50.0% >  0.5%
           |       0.8%        0.4% |
         2 |        120        276 |   396
           >      30.3%       69.7% > 99.5%
           |      99.2%       99.6% |
-----------+-----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |

                          Single Table Analysis

Odds ratio                                                              2.30
Cornfield 95% confidence limits for OR                  0.00 < OR <
86.30*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 2.29
Exact 95% confidence limits for MLE                     0.03 < OR < 181.18
Exact 95% Mid-P limits for MLE                          0.06 < OR <  90.00
Probability of MLE >=  2.29 if population OR = 1.0              0.51614496

RISK RATIO(RR)(Outcome:DIED=1; Exposure:NEENTM=1)                       1.65
```

```
95% confidence limits for RR                              0.41 < RR <   6.65

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          0.36     0.54581217
        Mantel-Haenszel:      0.36     0.54631711
        Yates corrected:      0.03     0.86776330

        Fisher exact: 1-tailed P-value: 0.5161450
                      2-tailed P-value: 0.5161450

An expected value is less than 5; recommend Fisher exact results.

                             DIED
NGI         |   1          2        | Total
------------+----------------------+------
          1 |          5         10 |    15
            >      33.3%      66.7% >  3.8%
            |       4.1%       3.6% |
          2 |        116        267 |   383
            >      30.3%      69.7% > 96.2%
            |      95.9%      96.4% |
------------+----------------------+------
      Total |        121        277 |   398
            |      30.4%      69.6% |

                             Single Table Analysis

Odds ratio                                                              1.15
Cornfield 95% confidence limits for OR                  0.33 < OR <   3.80
Maximum likelihood estimate of OR (MLE)                                 1.15
Exact 95% confidence limits for MLE                     0.30 < OR <   3.79
Exact 95% Mid-P limits for MLE                          0.35 < OR <   3.42
Probability of MLE >=  1.15 if population OR = 1.0              0.49941371

RISK RATIO(RR)(Outcome:DIED=1; Exposure:NGI=1)                          1.10
95% confidence limits for RR                            0.53 < RR <   2.29

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          0.06     0.80135413
        Mantel-Haenszel:      0.06     0.80159862
        Yates corrected:      0.00     0.97247489

        Fisher exact: 1-tailed P-value: 0.4994137
                      2-tailed P-value: 0.7801079

An expected value is less than 5; recommend Fisher exact results.

                             DIED
NLRT        |   1          2        | Total
```

```
-----------+-----------------------+------
         1 |           2           4 |     6
           >       33.3%       66.7% >  1.5%
           |        1.7%        1.4% |
         2 |         119         273 |   392
           >       30.4%       69.6% > 98.5%
           |       98.3%       98.6% |
-----------+-----------------------+------
     Total |         121         277 |   398
           |       30.4%       69.6% |
```

Single Table Analysis

Odds ratio		1.15
Cornfield 95% confidence limits for OR	0.14 < OR <	7.48*
*May be inaccurate		
Maximum likelihood estimate of OR (MLE)		1.15
Exact 95% confidence limits for MLE	0.10 < OR <	8.13
Exact 95% Mid-P limits for MLE	0.15 < OR <	6.55
Probability of MLE >= 1.15 if population OR = 1.0		0.58988027
RISK RATIO(RR)(Outcome:DIED=1; Exposure:NLRT=1)		1.10
95% confidence limits for RR	0.35 < RR <	3.44

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.02	0.87501994
Mantel-Haenszel:	0.02	0.87517576
Yates corrected:	0.08	0.77192757

Fisher exact: 1-tailed P-value: 0.5898803
2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

```
                          DIED
NRPT       |   1           2        | Total
-----------+-----------------------+------
         1 |           0           1 |     1
           >       0.0%      100.0% >  0.3%
           |       0.0%        0.4% |
         2 |         121         276 |   397
           >      30.5%       69.5% > 99.7%
           |     100.0%       99.6% |
-----------+-----------------------+------
     Total |         121         277 |   398
           |       30.4%       69.6% |
```

Single Table Analysis

Odds ratio		0.00
Cornfield 95% confidence limits for OR	0.00 < OR <	40.63*

```
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                  0.00
Exact 95% confidence limits for MLE                        0.00 < OR <  89.28
Exact 95% Mid-P limits for MLE                             0.00 < OR <  43.50
Probability of MLE <=  0.00 if population OR = 1.0                  0.69597990

RISK RATIO(RR)(Outcome:DIED=1; Exposure:NRPT=1)                          0.00
95% confidence limits for RR                          ?????? < RR < ??????

               Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.44     0.50812644
        Mantel-Haenszel:      0.44     0.50865981
        Yates corrected:      0.18     0.66967967

        Fisher exact: 1-tailed P-value: 0.6959799
                      2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

                            DIED
  NSST       |   1          2         | Total
-------------+----------------------+------
           1.0 |         14         23 |    37
               >      37.8%      62.2% >  9.3%
               |      11.6%       8.3% |
           2.0 |        107        254 |   361
               >      29.6%      70.4% > 90.7%
               |      88.4%      91.7% |
-------------+----------------------+------
       Total |        121        277 |   398
             |      30.4%      69.6% |

                           Single Table Analysis

Odds ratio                                                               1.44
Cornfield 95% confidence limits for OR                     0.67 < OR <   3.09
Maximum likelihood estimate of OR (MLE)                                  1.44
Exact 95% confidence limits for MLE                        0.66 < OR <   3.06
Exact 95% Mid-P limits for MLE                             0.70 < OR <   2.91
Probability of MLE >=  1.44 if population OR = 1.0                  0.19753431

RISK RATIO(RR)(Outcome:DIED=1; Exposure:NSST=1.0)                        1.28
95% confidence limits for RR                               0.82 < RR <   1.99

               Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          1.07     0.30186181
        Mantel-Haenszel:      1.06     0.30246993
        Yates corrected:      0.71     0.39821316
```

NOINF	DIED 1	2	Total
0.0	59	182	241
	24.5%	75.5%	60.6%
	48.8%	65.7%	
1.0	44	70	114
	38.6%	61.4%	28.6%
	36.4%	25.3%	
2.0	14	22	36
	38.9%	61.1%	9.0%
	11.6%	7.9%	
3.0	4	2	6
	66.7%	33.3%	1.5%
	3.3%	0.7%	
5.0	0	1	1
	0.0%	100.0%	0.3%
	0.0%	0.4%	
Total	121	277	398
	30.4%	69.6%	

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	84	0.694	0.647	0.805
2	277	125	0.451	0.524	0.724
Difference			0.243		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	0.000	1.000	1.000	3.000	0.000
2	0.000	0.000	0.000	1.000	5.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	4.971	1	4.971	8.856	0.003101	2.975841
Within	222.278	396	0.561			
Total	227.249	397				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 1.918 deg freedom = 1 p-value = 0.166124

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 10.294
Degrees of freedom = 1
p value = 0.001335

RESIDE	DIED 1	2	Total

1.0	10	19	29
	34.5%	65.5%	7.4%
	8.4%	6.9%	
2.0	108	252	360
	30.0%	70.0%	91.6%
	90.8%	92.0%	
3.0	1	3	4
	25.0%	75.0%	1.0%
	0.8%	1.1%	
Total	119	274	393
	30.3%	69.7%	

An expected value is < 5. Chi square not valid.
Chi square = 0.31
Degrees of freedom = 2
p value = 0.85691767

SERVICE	DIED 1	2	Total
I	31	50	81
	38.3%	61.7%	20.4%
	25.6%	18.1%	
N	69	167	236
	29.2%	70.8%	59.3%
	57.0%	60.3%	
O	19	56	75
	25.3%	74.7%	18.8%
	15.7%	20.2%	
U	2	4	6
	33.3%	66.7%	1.5%
	1.7%	1.4%	
Total	121	277	398
	30.4%	69.6%	

An expected value is < 5. Chi square not valid.
Chi square = 3.46
Degrees of freedom = 3
p value = 0.32636894

DEVICEIU	DIED 1	2	Total
1.0	61	110	171
	35.7%	64.3%	43.0%
	50.4%	39.7%	
2.0	60	167	227
	26.4%	73.6%	57.0%
	49.6%	60.3%	

```
       Total |        121        277 |   398
             |      30.4%      69.6% |

                          Single Table Analysis

Odds ratio                                                              1.54
Cornfield 95% confidence limits for OR                  0.98 < OR <     2.44
Maximum likelihood estimate of OR (MLE)                                 1.54
Exact 95% confidence limits for MLE                     0.98 < OR <     2.43
Exact 95% Mid-P limits for MLE                          1.00 < OR <     2.38
Probability of MLE >=  1.54 if population OR = 1.0              0.03070230

RISK RATIO(RR)(Outcome:DIED=1; Exposure:DEVICEIU=1.0)                   1.35
95% confidence limits for RR                            1.00 < RR <     1.81

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:         3.94     0.04726211 <---
        Mantel-Haenszel:     3.93     0.04754085 <---
        Yates corrected:     3.51     0.06094720


                              DIED
DEVICEMV   |   1          2        | Total
-----------+----------------------+------
         1 |         25         44 |    69
           >      36.2%      63.8% > 17.3%
           |      20.7%      15.9% |
         2 |         96        233 |   329
           >      29.2%      70.8% > 82.7%
           |      79.3%      84.1% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |

                          Single Table Analysis

Odds ratio                                                              1.38
Cornfield 95% confidence limits for OR                  0.77 < OR <     2.47
Maximum likelihood estimate of OR (MLE)                                 1.38
Exact 95% confidence limits for MLE                     0.76 < OR <     2.45
Exact 95% Mid-P limits for MLE                          0.79 < OR <     2.37
Probability of MLE >=  1.38 if population OR = 1.0              0.15530565

RISK RATIO(RR)(Outcome:DIED=1; Exposure:DEVICEMV=1)                     1.24
95% confidence limits for RR                            0.87 < RR <     1.77

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:         1.34     0.24689750
        Mantel-Haenszel:     1.34     0.24749207
```

Yates corrected: 1.03 0.31058662

DEVICECV	DIED 1	DIED 2	Total
1.0	55	101	156
	> 35.3%	64.7%	> 39.2%
	45.5%	36.5%	
2.0	66	176	242
	> 27.3%	72.7%	> 60.8%
	54.5%	63.5%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		1.45
Cornfield 95% confidence limits for OR	0.92 < OR <	2.30
Maximum likelihood estimate of OR (MLE)		1.45
Exact 95% confidence limits for MLE	0.92 < OR <	2.29
Exact 95% Mid-P limits for MLE	0.94 < OR <	2.24
Probability of MLE >= 1.45 if population OR = 1.0		0.05762298
RISK RATIO(RR)(Outcome:DIED=1; Exposure:DEVICECV=1.0)		1.29
95% confidence limits for RR	0.96 < RR <	1.74

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	2.86	0.09095685
Mantel-Haenszel:	2.85	0.09136385
Yates corrected:	2.49	0.11439006

DEVICENF	DIED 1	DIED 2	Total
1.0	37	59	96
	> 38.5%	61.5%	> 24.1%
	30.6%	21.3%	
2.0	84	218	302
	> 27.8%	72.2%	> 75.9%
	69.4%	78.7%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		1.63
Cornfield 95% confidence limits for OR	0.97 < OR <	2.72
Maximum likelihood estimate of OR (MLE)		1.63
Exact 95% confidence limits for MLE	0.97 < OR <	2.70

```
Exact 95% Mid-P limits for MLE                          1.00 < OR <   2.63
Probability of MLE >=  1.63 if population OR = 1.0              0.03248791

RISK RATIO(RR)(Outcome:DIED=1; Exposure:DEVICENF=1.0)                1.39
95% confidence limits for RR                            1.02 < RR <   1.89

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:         3.96     0.04655198 <---
        Mantel-Haenszel:     3.95     0.04682809 <---
        Yates corrected:     3.47     0.06246273


                              DIED
DEVICETR    |   1          2        | Total
------------+----------------------+------
          1 |          6         14 |    20
            >      30.0%      70.0% >  5.0%
            |       5.0%       5.1% |
          2 |        115        263 |   378
            >      30.4%      69.6% > 95.0%
            |      95.0%      94.9% |
------------+----------------------+------
      Total |        121        277 |   398
            |      30.4%      69.6% |


                           Single Table Analysis

Odds ratio                                                           0.98
Cornfield 95% confidence limits for OR                  0.32 < OR <   2.84
Maximum likelihood estimate of OR (MLE)                              0.98
Exact 95% confidence limits for MLE                     0.30 < OR <   2.80
Exact 95% Mid-P limits for MLE                          0.34 < OR <   2.57
Probability of MLE <=  0.98 if population OR = 1.0              0.59370128

RISK RATIO(RR)(Outcome:DIED=1; Exposure:DEVICETR=1)                  0.99
95% confidence limits for RR                            0.50 < RR <   1.96

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:         0.00     0.96800945
        Mantel-Haenszel:     0.00     0.96804964
        Yates corrected:     0.04     0.83421582


                              DIED
DEVICEPD    |   1          2        | Total
------------+----------------------+------
          1 |          4          7 |    11
            >      36.4%      63.6% >  2.8%
            |       3.3%       2.5% |
```

```
         2 |        117        270 |   387
           >      30.2%      69.8% > 97.2%
           |      96.7%      97.5% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |
```

Single Table Analysis

```
Odds ratio                                                          1.32
Cornfield 95% confidence limits for OR                 0.31 < OR <   5.19
Maximum likelihood estimate of OR (MLE)                             1.32
Exact 95% confidence limits for MLE                    0.28 < OR <   5.30
Exact 95% Mid-P limits for MLE                         0.33 < OR <   4.64
Probability of MLE >=  1.32 if population OR = 1.0          0.44238064

RISK RATIO(RR)(Outcome:DIED=1; Exposure:DEVICEPD=1)                 1.20
95% confidence limits for RR                           0.54 < RR <   2.67
```

Ignore risk ratio if case control study

```
                        Chi-Squares   P-values
                        -----------   --------

        Uncorrected:          0.19     0.66290143
        Mantel-Haenszel:      0.19     0.66329907
        Yates corrected:      0.01     0.91752671

        Fisher exact: 1-tailed P-value: 0.4423806
                      2-tailed P-value: 0.7415534
```

An expected value is less than 5; recommend Fisher exact results.

```
                            DIED
DEVICEOT   |   1          2         | Total
-----------+----------------------+------
         1 |         21         50 |    71
           >      29.6%      70.4% > 17.8%
           |      17.4%      18.1% |
         2 |        100        227 |   327
           >      30.6%      69.4% > 82.2%
           |      82.6%      81.9% |

-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |
```

Single Table Analysis

```
Odds ratio                                                          0.95
Cornfield 95% confidence limits for OR                 0.52 < OR <   1.74
Maximum likelihood estimate of OR (MLE)                             0.95
Exact 95% confidence limits for MLE                    0.52 < OR <   1.72
Exact 95% Mid-P limits for MLE                         0.54 < OR <   1.66
Probability of MLE <=  0.95 if population OR = 1.0          0.49512049

RISK RATIO(RR)(Outcome:DIED=1; Exposure:DEVICEOT=1)                 0.97
```

95% confidence limits for RR **0.65 < RR < 1.43**

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.03	0.86765858
Mantel-Haenszel:	0.03	0.86782341
Yates corrected:	0.00	0.98060088

NODEV	DIED 1	2	Total
0.0	31	106	137
>	22.6%	77.4%	> 34.4%
|	25.6%	38.3%	|
1.0	30	67	97
>	30.9%	69.1%	> 24.4%
|	24.8%	24.2%	|
2.0	25	36	61
>	41.0%	59.0%	> 15.3%
|	20.7%	13.0%	|
3.0	16	34	50
>	32.0%	68.0%	> 12.6%
|	13.2%	12.3%	|
4.0	14	27	41
>	34.1%	65.9%	> 10.3%
|	11.6%	9.7%	|
5.0	5	6	11
>	45.5%	54.5%	> 2.8%
|	4.1%	2.2%	|
6.0	0	1	1
>	0.0%	100.0%	> 0.3%
|	0.0%	0.4%	|
Total	121	277	398
|	30.4%	69.6%	|

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	209	1.727	2.183	1.478
2	277	385	1.390	2.174	1.474
Difference			0.337		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	0.000	1.000	3.000	5.000	0.000
2	0.000	0.000	1.000	2.000	6.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	9.586	1	9.586	4.404	0.036484	2.098616
Within	861.892	396	2.176			
Total	871.477	397				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.001 deg freedom = 1 p-value = 0.976791

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 5.586
Degrees of freedom = 1
p value = 0.018106

	DIED		
MRSAHX	1	2	Total
1.0	18	45	63
>	28.6%	71.4%	> 15.8%
|	14.9%	16.2%	|
2.0	103	232	335
>	30.7%	69.3%	> 84.2%
|	85.1%	83.8%	|
Total	121	277	398
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio		**0.90**
Cornfield 95% confidence limits for OR	**0.47 < OR <**	**1.70**
Maximum likelihood estimate of OR (MLE)		**0.90**
Exact 95% confidence limits for MLE	**0.47 < OR <**	**1.68**
Exact 95% Mid-P limits for MLE	**0.49 < OR <**	**1.62**
Probability of MLE <= 0.90 if population OR = 1.0		**0.42785949**
RISK RATIO(RR)(Outcome:DIED=1; Exposure:MRSAHX=1.0)		**0.93**
95% confidence limits for RR	**0.61 < RR <**	**1.42**

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	**0.12**	**0.73062548**
Mantel-Haenszel:	**0.12**	**0.73095096**
Yates corrected:	**0.04**	**0.84537360**

	DIED		
MRSAHXTY	1	2	Total
C	12	24	36
>	33.3%	66.7%	> 58.1%

	66.7%	54.5%	
I	5	13	18
	27.8%	72.2%	29.0%
	27.8%	29.5%	
I/C	1	7	8
	12.5%	87.5%	12.9%
	5.6%	15.9%	
Total	18	44	62
	29.0%	71.0%	

Chi square = 1.40
Degrees of freedom = 2
p value = 0.49702789

	DIED		
MSSAHX	1	2	Total
1	5	27	32
	15.6%	84.4%	8.0%
	4.1%	9.7%	
2	116	250	366
	31.7%	68.3%	92.0%
	95.9%	90.3%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio	0.40
Cornfield 95% confidence limits for OR	0.13 < OR < 1.14
Maximum likelihood estimate of OR (MLE)	0.40
Exact 95% confidence limits for MLE	0.12 < OR < 1.09
Exact 95% Mid-P limits for MLE	0.13 < OR < 1.01
Probability of MLE <= 0.40 if population OR = 1.0	0.03992087

RISK RATIO(RR)(Outcome:DIED=1; Exposure:MSSAHX=1)	0.49
95% confidence limits for RR	0.22 < RR < 1.12

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	3.59	0.05809018
Mantel-Haenszel:	3.58	0.05840648
Yates corrected:	2.87	0.09014366

	DIED		
MSSAHXTY	**1**	**2**	**Total**
C	**4**	**10**	**14**

```
           >      28.6%      71.4% > 45.2%
           |      80.0%      38.5% |
  I        |          1         15 |    16
           >       6.3%      93.8% > 51.6%
           |      20.0%      57.7% |
  I/C      |          0          1 |     1
           >       0.0%     100.0% >  3.2%
           |       0.0%       3.8% |
-----------+----------------------+------
     Total |          5         26 |    31
           |      16.1%      83.9% |


      An expected value is < 5. Chi square not valid.
             Chi square =       2.95
     Degrees of freedom =          2
                p value = 0.22891233


                           DIED
VREHX      |   1          2         | Total
-----------+----------------------+------
         1 |          0          3 |     3
           >       0.0%     100.0% >  0.8%
           |       0.0%       1.1% |
         2 |        121        274 |   395
           >      30.6%      69.4% > 99.2%
           |     100.0%      98.9% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |


                          Single Table Analysis

Odds ratio                                                              0.00
Cornfield 95% confidence limits for OR                  0.00 < OR <
5.22*
                     *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 0.00
Exact 95% confidence limits for MLE                     0.00 < OR <   5.55
Exact 95% Mid-P limits for MLE                          0.00 < OR <   3.93
Probability of MLE <=  0.00 if population OR = 1.0              0.33601045

RISK RATIO(RR)(Outcome:DIED=1; Exposure:VREHX=1)                        0.00
95% confidence limits for RR                         ?????? < RR < ??????

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          1.32     0.25051628
        Mantel-Haenszel:      1.32     0.25111235
        Yates corrected:      0.27     0.60365549

        Fisher exact: 1-tailed P-value: 0.3360104
                      2-tailed P-value: 0.5564662
```

An expected value is less than 5; recommend Fisher exact results.

VREHXTYP	DIED 2	Total
C	3	3
	100.0%	>100.0%
	100.0%	
Total	3	3
	100.0%	

An expected value is < 5. Chi square not valid.
Chi square = 0.00
Degrees of freedom = 0
p value = 1.00000000

VRE	DIED 1	2	Total
1	0	2	2
	0.0%	100.0%	> 0.5%
	0.0%	0.7%	
2	121	275	396
	30.6%	69.4%	> 99.5%
	100.0%	99.3%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio 0.00
Cornfield 95% confidence limits for OR 0.00 < OR < 9.52*
*May be inaccurate
Maximum likelihood estimate of OR (MLE) 0.00
Exact 95% confidence limits for MLE 0.00 < OR < 12.21
Exact 95% Mid-P limits for MLE 0.00 < OR < 7.96
Probability of MLE <= 0.00 if population OR = 1.0 0.48385504

RISK RATIO(RR)(Outcome:DIED=1; Exposure:VRE=1) 0.00
95% confidence limits for RR ?????? < RR < ??????

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.88	0.34873397
Mantel-Haenszel:	0.88	0.34934020
Yates corrected:	0.03	0.86776330

Fisher exact: 1-tailed P-value: 0.4838550

2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

VRETYPE	DIED 2	Total
C	3	3
	100.0%	100.0%
	100.0%	
Total	3	3
	100.0%	

An expected value is < 5. Chi square not valid.
Chi square = 0.00
Degrees of freedom = 0
p value = 1.00000000

CDIF	DIED 1	2	Total
1.0	4	11	15
	26.7%	73.3%	3.8%
	3.3%	4.0%	
2.0	117	266	383
	30.5%	69.5%	96.2%
	96.7%	96.0%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		0.83
Cornfield 95% confidence limits for OR	0.21 < OR <	2.91
Maximum likelihood estimate of OR (MLE)		0.83
Exact 95% confidence limits for MLE	0.19 < OR <	2.87
Exact 95% Mid-P limits for MLE	0.22 < OR <	2.57
Probability of MLE <= 0.83 if population OR = 1.0		0.50058629
RISK RATIO(RR)(Outcome:DIED=1; Exposure:CDIF=1.0)		0.87
95% confidence limits for RR	0.37 < RR <	2.05

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.10	0.74851058
Mantel-Haenszel:	0.10	0.74881605
Yates corrected:	0.00	0.97247489

Fisher exact: 1-tailed P-value: 0.5005863

2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

ESBL	DIED 1	2	Total
1	4	0	4
>	100.0%	0.0%	> 1.0%
|	3.3%	0.0%	|
2	117	277	394
>	29.7%	70.3%	> 99.0%
|	96.7%	100.0%	|
Total	121	277	398
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio	??????
Maximum likelihood estimate of OR (MLE)	??????
Exact 95% confidence limits for MLE	1.53 < OR < ??????
Exact 95% Mid-P limits for MLE	2.09 < OR < ??????
Probability of MLE >= ?????? if population OR = 1.0	0.00824954
RISK RATIO(RR)(Outcome:DIED=1; Exposure:ESBL=1)	3.37
95% confidence limits for RR	2.89 < RR < 3.92

Ignore risk ratio if case control study

	Chi-Squares	P-values	
Uncorrected:	9.25	0.00235497	<---
Mantel-Haenszel:	9.23	0.00238505	<---
Yates corrected:	6.23	0.01259078	<---

Fisher exact: 1-tailed P-value: 0.0082495 <---
2-tailed P-value: 0.0082495 <---

An expected value is less than 5; recommend Fisher exact results.

ESBLTYPE	**DIED 1**	**Total**
C	**1**	**1**
>	**100.0%**	**> 25.0%**
|	**25.0%**	**|**
I	**3**	**3**
>	**100.0%**	**> 75.0%**
|	**75.0%**	**|**
Total	**4**	**4**
|	**100.0%**	**|**

An expected value is < 5. Chi square not valid.

Chi square = 0.00
Degrees of freedom = 0
p value = 1.00000000

OARO	DIED 1	2	Total
2	121	277	398
	30.4%	69.6%	100.0%
	100.0%	100.0%	
Total	121	277	398
	30.4%	69.6%	

Chi square = 0.00
Degrees of freedom = 0
p value = 1.00000000

NOTHORG	DIED 1	2	Total
0.0	111	263	374
1.0	9	14	23
2.0	1	0	1
Total	121	277	398

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	11	0.091	0.100	0.316
2	277	14	0.051	0.048	0.219
Difference			0.040		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	0.000	0.000	0.000	2.000	0.000
2	0.000	0.000	0.000	0.000	1.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.137	1	0.137	2.149	0.143495	1.465805
Within	25.292	396	0.064			
Total	25.430	397				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 24.040 deg freedom = 1 p-value = 0.000001

Bartlett's Test shows the variances in the samples to differ.
Use non-parametric results below rather than ANOVA.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 1.568
Degrees of freedom = 1
p value = 0.210559

ICUADT	DIED 1	2	Total
N	87	192	279
>	31.2%	68.8%	> 70.3%
	71.9%	69.6%	
Y	34	84	118
>	28.8%	71.2%	> 29.7%
	28.1%	30.4%	
Total	121	276	397
	30.5%	69.5%	

Single Table Analysis

Odds ratio		**1.12**
Cornfield 95% confidence limits for OR	**0.68 < OR <**	**1.85**
Maximum likelihood estimate of OR (MLE)		**1.12**
Exact 95% confidence limits for MLE	**0.68 < OR <**	**1.86**
Exact 95% Mid-P limits for MLE	**0.70 < OR <**	**1.81**
Probability of MLE >= 1.12 if population OR = 1.0		**0.36554235**
RISK RATIO(RR)(Outcome:DIED=1; Exposure:ICUADT=N)		**1.08**
95% confidence limits for RR	**0.78 < RR <**	**1.51**

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.22	0.63928056
Mantel-Haenszel:	0.22	0.63970289
Yates corrected:	0.12	0.72676986

ICUDAYS	DIED 1	2	Total
1.0	4	8	12
2.0	2	9	11
3.0	3	13	16
4.0	4	8	12
5.0	1	6	7
6.0	3	3	6
7.0	0	6	6
8.0	0	2	2
9.0	2	0	2
10.0	5	1	6
12.0	0	1	1
14.0	0	3	3

15.0	2	0	2
16.0	1	1	2
17.0	1	0	1
19.0	0	1	1
20.0	0	1	1
21.0	0	1	1
23.0	1	0	1
24.0	1	1	2
25.0	0	1	1
26.0	0	2	2
29.0	0	1	1
30.0	1	2	3
31.0	0	1	1
37.0	0	1	1
42.0	2	0	2
44.0	0	1	1
56.0	0	1	1
58.0	0	1	1
63.0	0	1	1
Total	33	77	110

DIED	Obs	Total	Mean	Variance	Std Dev
1	33	348	10.545	117.381	10.834
2	77	822	10.675	189.643	13.771
Difference			-0.130		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	1.000	3.000	6.000	15.000	42.000	10.000
2	1.000	3.000	5.000	14.000	63.000	3.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.390	1	0.390	0.002	0.961706	0.048124
Within	18169.065	108	168.232			
Total	18169.455	109				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 2.385 deg freedom = 1 p-value = 0.122523

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.702
Degrees of freedom = 1
p value = 0.402018

	DIED	
SURGERY	1	2	Total

```
-----------+-----------------------+------
         C |          34         120 |   154
           >       22.1%       77.9% > 38.9%
           |       28.3%       43.5% |
         N |          86         156 |   242
           >       35.5%       64.5% > 61.1%
           |       71.7%       56.5% |
-----------+-----------------------+------
     Total |         120         276 |   396
           |       30.3%       69.7% |
```

Single Table Analysis

Odds ratio		0.51
Cornfield 95% confidence limits for OR	0.31 < OR <	0.84
Maximum likelihood estimate of OR (MLE)		0.51
Exact 95% confidence limits for MLE	0.31 < OR <	0.83
Exact 95% Mid-P limits for MLE	0.32 < OR <	0.81
Probability of MLE <= 0.51 if population OR = 1.0		0.00290228
RISK RATIO(RR)(Outcome:DIED=1; Exposure:SURGERY=C)		0.62
95% confidence limits for RR	0.44 < RR <	0.87

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	8.07	0.00449532 <---
Mantel-Haenszel:	8.05	0.00454618 <---
Yates corrected:	7.45	0.00635296 <---

```
                          DIED
IMMTHE     |   1          2         | Total
-----------+-----------------------+------
         N |          94         233 |   327
           >       28.7%       71.3% > 83.8%
           |       77.7%       86.6% |
         Y |          27          36 |    63
           >       42.9%       57.1% > 16.2%
           |       22.3%       13.4% |
-----------+-----------------------+------
     Total |         121         269 |   390
           |       31.0%       69.0% |
```

Single Table Analysis

Odds ratio		0.54
Cornfield 95% confidence limits for OR	0.30 < OR <	0.98
Maximum likelihood estimate of OR (MLE)		0.54
Exact 95% confidence limits for MLE	0.30 < OR <	0.98
Exact 95% Mid-P limits for MLE	0.31 < OR <	0.94
Probability of MLE <= 0.54 if population OR = 1.0		0.02089489
RISK RATIO(RR)(Outcome:DIED=1; Exposure:IMMTHE=N)		0.67
95% confidence limits for RR	0.48 < RR <	0.94

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	4.92	0.02662356 <---
Mantel-Haenszel:	4.90	0.02681853 <---
Yates corrected:	4.28	0.03861384 <---

NEUTRO	DIED 1	2	Total
N	110	265	375
>	29.3%	70.7%	> 96.2%
	92.4%	97.8%	
Y	9	6	15
>	60.0%	40.0%	> 3.8%
	7.6%	2.2%	
Total	119	271	390
	30.5%	69.5%	

Single Table Analysis

Odds ratio		0.28
Cornfield 95% confidence limits for OR	0.08 < OR <	0.88
Maximum likelihood estimate of OR (MLE)		0.28
Exact 95% confidence limits for MLE	0.08 < OR <	0.90
Exact 95% Mid-P limits for MLE	0.09 < OR <	0.81
Probability of MLE <= 0.28 if population OR = 1.0		0.01531104
RISK RATIO(RR)(Outcome:DIED=1; Exposure:NEUTRO=N)		0.49
95% confidence limits for RR	0.31 < RR <	0.76

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	6.40	0.01142871 <---
Mantel-Haenszel:	6.38	0.01153482 <---
Yates corrected:	5.03	0.02487182 <---

Fisher exact: 1-tailed P-value: 0.0153110 <---
2-tailed P-value: 0.0190748 <---

An expected value is less than 5; recommend Fisher exact results.

NEUTRODA	**DIED 1**	**2**	**Total**
1.0	**1**	**1**	**2**
3.0	**1**	**1**	**2**
4.0	**0**	**1**	**1**
5.0	**2**	**1**	**3**

6.5	1	0	1	
7.0	0	1	1	
Total	5	5	10	

DIED	Obs	Total	Mean	Variance	Std Dev
1	5	21	4.100	4.550	2.133
2	5	20	4.000	5.000	2.236
Difference			0.100		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	1.000	3.000	5.000	5.000	6.500	5.000
2	1.000	3.000	4.000	5.000	7.000	1.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.025	1	0.025	0.005	0.944094	0.072357
Within	38.200	8	4.775			
Total	38.225	9				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.008 deg freedom = 1 p-value = 0.929161

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.011
Degrees of freedom = 1
p value = 0.915266

	DIED		
DIALSIS	1	2	Total
N	105	243	348
>	30.2%	69.8%	> 87.9%
|	86.8%	88.4%	|
Y	16	32	48
>	33.3%	66.7%	> 12.1%
|	13.2%	11.6%	|
Total	121	275	396
|	30.6%	69.4%	|

Single Table Analysis

Odds ratio		0.86
Cornfield 95% confidence limits for OR	0.43 < OR <	1.74
Maximum likelihood estimate of OR (MLE)		0.86
Exact 95% confidence limits for MLE	0.44 < OR <	1.76
Exact 95% Mid-P limits for MLE	0.46 < OR <	1.68

Probability of MLE <= 0.86 if population OR = 1.0 0.38460094

RISK RATIO(RR)(Outcome:DIED=1; Exposure:DIALSIS=N) 0.91
95% confidence limits for RR 0.59 < RR < 1.39

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	**0.20**	**0.65583650**
Mantel-Haenszel:	**0.20**	**0.65624334**
Yates corrected:	**0.08**	**0.78059556**

IDCONSUL	DIED 1	2	Total
1.0	62	167	229
>	27.1%	72.9%	> 58.6%
|	51.2%	61.9%	|
2.0	59	103	162
>	36.4%	63.6%	> 41.4%
|	48.8%	38.1%	|
Total	121	270	391
|	30.9%	69.1%	|

Single Table Analysis

Odds ratio 0.65
Cornfield 95% confidence limits for OR 0.41 < OR < 1.03
Maximum likelihood estimate of OR (MLE) 0.65

Exact 95% confidence limits for MLE 0.41 < OR < 1.02
Exact 95% Mid-P limits for MLE 0.42 < OR < 1.00
Probability of MLE <= 0.65 if population OR = 1.0 0.03186984

RISK RATIO(RR)(Outcome:DIED=1; Exposure:IDCONSUL=1.0) 0.74
95% confidence limits for RR 0.55 < RR < 1.00

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	3.88	0.04892879 <---
Mantel-Haenszel:	3.87	0.04921874 <---
Yates corrected:	3.45	0.06314485

HABC1	**DIED 1**	**2**	**Total**
1.0	**1**	**1**	**2**
2.0	**0**	**1**	**1**

3.0	2	5	7
4.0	4	6	10
6.0	0	2	2
8.0	0	1	1
9.0	3	5	8
11.0	0	1	1
12.0	2	1	3
14.0	0	2	2
15.0	0	1	1
17.0	7	38	45
18.0	0	5	5
19.0	0	2	2
23.0	3	2	5
25.0	3	0	3
26.0	1	2	3
27.0	0	1	1
29.0	4	11	15
30.0	1	0	1
31.0	0	1	1
32.0	0	5	5
33.0	11	29	40
34.0	0	1	1
35.0	9	9	18
39.0	4	3	7
49.0	3	6	9
51.0	2	12	14
54.0	2	3	5
55.0	6	17	23
57.0	1	0	1
59.0	1	1	2
Total	70	174	244

HABC2	DIED 1	2	Total
1.0	2	1	3
2.0	0	1	1
3.0	0	1	1
4.0	0	1	1
6.0	0	1	1
8.0	0	1	1
9.0	4	3	7
11.0	1	2	3
12.0	1	0	1
14.0	1	4	5
15.0	0	3	3
17.0	2	6	8
18.0	1	2	3
23.0	1	4	5
25.0	3	3	6
26.0	0	2	2
27.0	0	2	2
28.0	1	0	1
29.0	2	4	6

30.0	1	1	2
31.0	1	1	2
32.0	0	1	1
33.0	10	18	28
34.0	0	1	1
35.0	3	8	11
36.0	0	1	1
39.0	0	3	3
48.0	0	1	1
49.0	4	7	11
51.0	7	15	22
54.0	0	4	4
55.0	3	8	11
59.0	1	0	1
Total	49	110	159

HABC3	DIED 1	2	Total
3.0	1	3	4
4.0	3	0	3
6.0	1	3	4
9.0	0	1	1
11.0	0	1	1
14.0	1	3	4
15.0	1	1	2
17.0	2	9	11
18.0	0	1	1
23.0	0	2	2
24.0	0	1	1
25.0	1	1	2
26.0	3	2	5
29.0	3	2	5
31.0	1	1	2
32.0	0	1	1
33.0	3	7	10
35.0	3	2	5
38.0	0	1	1
39.0	0	2	2
49.0	3	1	4
51.0	7	10	17
53.0	0	1	1
54.0	0	1	1
55.0	2	4	6
59.0	0	1	1
Total	35	62	97

HABC4	DIED 1	2	Total
3.0	1	0	1

9.0	0	3	3
11.0	1	1	2
12.0	1	0	1
14.0	1	1	2
17.0	0	2	2
18.0	0	2	2
23.0	0	1	1
24.0	1	0	1
25.0	1	0	1
26.0	0	2	2
27.0	0	1	1
31.0	0	1	1
32.0	0	1	1
33.0	1	7	8
35.0	2	0	2
36.0	0	1	1
39.0	0	1	1
43.0	1	0	1
49.0	2	0	2
51.0	3	5	8
54.0	0	3	3
55.0	4	5	9
Total	19	37	56

HABC5	DIED 1	2	Total
3.0	1	0	1
17.0	0	1	1
25.0	2	0	2
26.0	0	2	2
29.0	0	1	1
32.0	0	2	2
33.0	3	3	6
45.0	1	0	1
49.0	0	1	1
51.0	1	3	4
55.0	0	2	2
57.0	0	2	2
Total	8	17	25

HABC6	DIED 1	2	Total
3.0	0	1	1
9.0	1	0	1
14.0	0	2	2
15.0	0	1	1
17.0	0	1	1
29.0	0	1	1
35.0	1	0	1
38.0	0	1	1

```
          44.0 |          1          0 |     1
          51.0 |          0          1 |     1
---------------+----------------------+------
         Total |          3          8 |    11


                           DIED
  HABC7        |   1          2        | Total
---------------+----------------------+------
           7.0 |          0          1 |     1
          11.0 |          0          1 |     1
          14.0 |          1          1 |     2
          39.0 |          1          1 |     2
          49.0 |          1          0 |     1
          51.0 |          0          1 |     1
          54.0 |          0          1 |     1
---------------+----------------------+------
         Total |          3          6 |     9

                           DIED
  HABC8        |   1          2        | Total
---------------+----------------------+------
           3.0 |          0          1 |     1
          17.0 |          0          1 |     1
          30.0 |          1          0 |     1
          55.0 |          0          1 |     1
          59.0 |          1          0 |     1
---------------+----------------------+------
         Total |          2          3 |     5


                           DIED
  HABC9        |   1          2        | Total
---------------+----------------------+------
          10.0 |          0          1 |     1
          33.0 |          1          0 |     1
          39.0 |          0          1 |     1
---------------+----------------------+------
         Total |          1          2 |     3

                       DIED
  HABC10       |   1        | Total
---------------+------------+------
          55.0 |          1 |     1
---------------+------------+------
         Total |          1 |     1
                           DIED

  NOHAB        |   1          2        | Total
---------------+----------------------+------
           0.0 |         51         103 |   154
           1.0 |         21          64 |    85
           2.0 |         14          48 |    62
           3.0 |         16          25 |    41
           4.0 |         11          20 |    31
           5.0 |          5           9 |    14
           6.0 |          0           2 |     2
```

7.0	1	3	4
8.0	1	1	2
9.0	0	2	2
10.0	1	0	1
Total	121	277	398

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	191	1.579	3.613	1.901
2	277	419	1.513	3.033	1.742
Difference			0.066		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	0.000	1.000	3.000	10.000	0.000
2	0.000	0.000	1.000	2.000	9.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.365	1	0.365	0.114	0.735933	0.337481
Within	1270.710	396	3.209			
Total	1271.075	397				

Bartlett's test for homogeneity of variance

Bartlett's chi square = 1.301 deg freedom = 1 p-value = 0.254002

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.007
Degrees of freedom = 1
p value = 0.932177

HABUSE	DIED 1	DIED 2	Total
1.0	70	174	244
>	28.7%	71.3%	> 61.3%
|	57.9%	62.8%	|
2.0	51	103	154
>	33.1%	66.9%	> 38.7%
|	42.1%	37.2%	|
Total	121	277	398
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio		0.81
Cornfield 95% confidence limits for OR	0.51 < OR <	1.29
Maximum likelihood estimate of OR (MLE)		0.81

Exact 95% confidence limits for MLE **0.51 < OR < 1.29**
Exact 95% Mid-P limits for MLE **0.53 < OR < 1.26**
Probability of MLE <= 0.81 if population OR = 1.0 **0.20482070**

RISK RATIO(RR)(Outcome:DIED=1; Exposure:HABUSE=1.0) **0.87**
95% confidence limits for RR **0.64 < RR < 1.17**

Ignore risk ratio if case control study

	Chi-Squares	**P-values**
Uncorrected:	**0.88**	**0.34957149**
Mantel-Haenszel:	**0.87**	**0.35017758**
Yates corrected:	**0.68**	**0.41019385**

	DIED		
EMPIRIC	1	2	Total
N	29	48	77
>	37.7%	62.3%	> 19.3%
	24.0%	17.3%	
Y	92	229	321
>	28.7%	71.3%	> 80.7%
	76.0%	82.7%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio 1.50
Cornfield 95% confidence limits for OR 0.86 < OR < 2.62
Maximum likelihood estimate of OR (MLE) 1.50
Exact 95% confidence limits for MLE 0.86 < OR < 2.60
Exact 95% Mid-P limits for MLE 0.89 < OR < 2.53
Probability of MLE >= 1.50 if population OR = 1.0 0.08147332

RISK RATIO(RR)(Outcome:DIED=1; Exposure:EMPIRIC=N) 1.31
95% confidence limits for RR 0.94 < RR < 1.84

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	2.38	0.12302465
Mantel-Haenszel:	2.37	0.12349631
Yates corrected:	1.97	0.16023855

	DIED		
EABC1	**1**	**2**	**Total**
3.0	**3**	**11**	**14**
4.0	**9**	**20**	**29**

6.0	1	0	1
9.0	7	4	11
11.0	0	2	2
12.0	0	1	1
14.0	2	2	4
15.0	0	1	1
17.0	8	46	54
18.0	1	3	4
23.0	2	4	6
25.0	4	6	10
26.0	4	1	5
29.0	7	9	16
30.0	1	0	1
33.0	8	19	27
35.0	7	10	17
39.0	1	1	2
49.0	2	9	11
51.0	3	5	8
54.0	0	4	4
55.0	21	68	89
59.0	0	2	2
Total	91	228	319

EABC2	DIED 1	2	Total
1.0	1	1	2
3.0	2	1	3
4.0	3	5	8
6.0	1	0	1
8.0	1	0	1
9.0	3	0	3
12.0	1	1	2
14.0	1	13	14
15.0	2	1	3
17.0	5	6	11
18.0	0	1	1
23.0	3	3	6
25.0	1	1	2
26.0	0	7	7
27.0	0	1	1
29.0	1	7	8
30.0	0	1	1
33.0	9	10	19
35.0	3	7	10
39.0	0	2	2
45.0	0	2	2
49.0	2	6	8
51.0	12	15	27
53.0	0	3	3
54.0	2	1	3
55.0	8	16	24
59.0	0	2	2
Total	61	113	174

	DIED	
EABC3	1	2	Total
3.0	5	3	8
4.0	2	2	4
6.0	0	1	1
8.0	1	0	1
9.0	1	0	1
14.0	2	5	7
17.0	1	5	6
23.0	0	1	1
26.0	2	0	2
29.0	4	0	4
30.0	0	1	1
31.0	0	1	1
32.0	0	1	1
33.0	5	5	10
35.0	1	0	1
49.0	1	2	3
51.0	4	11	15
55.0	3	13	16
Total	32	51	83

	DIED	
EABC4	1	2	Total
4.0	0	1	1
11.0	0	1	1
14.0	1	1	2
17.0	0	2	2
25.0	1	0	1
26.0	1	1	2
29.0	1	1	2
33.0	2	2	4
39.0	0	4	4
49.0	0	3	3
51.0	0	1	1
53.0	1	1	2
55.0	3	5	8
Total	10	23	33

	DIED	
EABC5	1	2	Total
4.0	0	2	2
9.0	0	1	1
14.0	0	1	1
19.0	0	1	1
39.0	0	1	1
51.0	1	3	4
55.0	1	1	2

Total	2	10	12

EABC6	DIED 2	Total
33.0	1	1
Total	1	1

NOEMPAB	DIED 1	2	Total
0.0	30	49	79
1.0	30	115	145
2.0	29	62	91
3.0	22	28	50
4.0	8	13	21
5.0	2	9	11
6.0	0	1	1
Total	121	277	398

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	196	1.620	1.704	1.305
2	277	426	1.538	1.554	1.247
Difference			0.082		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	1.000	2.000	3.000	5.000	0.000
2	0.000	1.000	1.000	2.000	6.000	1.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.565	1	0.565	0.353	0.552522	0.594494
Within	633.364	396	1.599			
Total	633.930	397				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.360 deg freedom = 1 p-value = 0.548303

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.519
Degrees of freedom = 1
p value = 0.471155

LOTEMDAY	DIED 1	2	Total
0.0	76	175	251
1.0	25	74	99
2.0	18	22	40
3.0	2	3	5
4.0	0	3	3
Total	121	277	398

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	67	0.554	0.649	0.806
2	277	139	0.502	0.606	0.778
Difference			0.052		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	0.000	0.000	1.000	3.000	0.000
2	0.000	0.000	0.000	1.000	4.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.227	1	0.227	0.367	0.545200	0.605490
Within	245.150	396	0.619			
Total	245.377	397				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.199 deg freedom = 1 p-value = 0.655172

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.212
Degrees of freedom = 1
p value = 0.644874

APPEMPAB	DIED 1	2	Total
1.0	56	171	227
	24.7%	75.3%	> 57.0%
	46.3%	61.7%	
2.0	65	106	171
	38.0%	62.0%	> 43.0%
	53.7%	38.3%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		0.53
Cornfield 95% confidence limits for OR	0.34 < OR <	0.85
Maximum likelihood estimate of OR (MLE)		0.53
Exact 95% confidence limits for MLE	0.34 < OR <	0.84
Exact 95% Mid-P limits for MLE	0.35 < OR <	0.82
Probability of MLE <= 0.53 if population OR = 1.0		0.00299950
RISK RATIO(RR)(Outcome:DIED=1; Exposure:APPEMPAB=1.0)		0.65
95% confidence limits for RR	0.48 < RR <	0.87

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	8.21	0.00417711 <---
Mantel-Haenszel:	8.18	0.00422485 <---
Yates corrected:	7.59	0.00587995 <---

	DIED		
LOTEMCAT	**1**	**2**	**Total**
0	**76**	**175**	**251**
	30.3%	**69.7%**	**63.1%**
	62.8%	**63.2%**	
1	**25**	**74**	**99**
	25.3%	**74.7%**	**24.9%**
	20.7%	**26.7%**	
2	**18**	**22**	**40**
	45.0%	**55.0%**	**10.1%**
	14.9%	**7.9%**	
3+	**2**	**6**	**8**
	25.0%	**75.0%**	**2.0%**
	1.7%	**2.2%**	
Total	**121**	**277**	**398**
	30.4%	**69.6%**	

Chi square = 5.38
Degrees of freedom = 3
p value = 0.14590955

	DIED		
AABC1	**1**	**2**	**Total**
3.0	**0**	**1**	**1**
4.0	**16**	**47**	**63**
6.0	**0**	**3**	**3**
9.0	**3**	**4**	**7**
11.0	**2**	**3**	**5**
12.0	**0**	**2**	**2**
14.0	**0**	**2**	**2**
15.0	**0**	**1**	**1**
17.0	**5**	**25**	**30**

18.0	0	5	5
19.0	0	1	1
23.0	1	1	2
25.0	1	3	4
26.0	1	0	1
28.0	0	1	1
29.0	0	3	3
30.0	1	0	1
31.0	1	0	1
32.0	1	1	2
33.0	6	23	29
35.0	2	7	9
36.0	0	1	1
39.0	0	8	8
48.0	0	2	2
49.0	1	7	8
51.0	3	2	5
53.0	1	3	4
54.0	2	5	7
55.0	40	77	117
57.0	2	1	3
59.0	0	2	2
Total	89	241	330

AABC2	DIED 1	2	Total
3.0	0	2	2
4.0	4	8	12
8.0	0	1	1
9.0	4	1	5
10.0	1	0	1
11.0	0	1	1
12.0	0	1	1
14.0	1	2	3
15.0	2	3	5
17.0	3	11	14
18.0	0	2	2
24.0	0	1	1
25.0	3	1	4
26.0	3	5	8
29.0	4	2	6
31.0	0	1	1
32.0	0	1	1
33.0	6	18	24
35.0	2	6	8
39.0	2	4	6
45.0	0	3	3
49.0	1	2	3
51.0	6	20	26
53.0	2	6	8
54.0	1	1	2
55.0	10	27	37
59.0	0	1	1

Total	55	131	186

DIED

AABC3	1	2	Total
3.0	2	3	5
4.0	2	8	10
5.0	0	1	1
6.0	0	1	1
8.0	0	1	1
11.0	0	1	1
12.0	1	1	2
14.0	1	6	7
15.0	0	1	1
17.0	0	4	4
25.0	2	0	2
26.0	2	1	3
29.0	2	3	5
30.0	0	1	1
32.0	0	1	1
33.0	8	12	20
34.0	0	1	1
36.0	1	0	1
39.0	1	5	6
49.0	1	1	2
51.0	4	11	15
53.0	1	1	2
54.0	0	3	3
55.0	4	13	17
57.0	1	1	2
Total	33	81	114

DIED

AABC4	1	2	Total
3.0	1	0	1
4.0	0	1	1
6.0	1	0	1
9.0	1	1	2
10.0	0	1	1
11.0	0	2	2
14.0	3	2	5
15.0	1	2	3
17.0	1	6	7
26.0	1	0	1
29.0	1	1	2
33.0	3	6	9
35.0	0	1	1
39.0	0	1	1
45.0	0	2	2
46.0	0	1	1
49.0	1	1	2

51.0	2	4	6
53.0	0	1	1
54.0	0	1	1
55.0	7	9	16
59.0	1	0	1
Total	24	43	67

	DIED		
AABC5	1	2	Total
3.0	0	1	1
11.0	1	2	3
14.0	1	1	2
15.0	1	0	1
24.0	1	0	1
25.0	1	0	1
26.0	1	0	1
33.0	4	4	8
39.0	0	2	2
41.0	0	1	1
43.0	0	1	1
51.0	2	1	3
54.0	0	1	1
55.0	1	4	5
Total	13	18	31

	DIED		
AABC6	1	2	Total
4.0	0	1	1
11.0	0	1	1
12.0	0	1	1
14.0	1	0	1
17.0	1	0	1
18.0	1	0	1
29.0	0	2	2
32.0	1	2	3
33.0	0	1	1
39.0	1	1	2
45.0	0	1	1
49.0	1	0	1
51.0	3	0	3
55.0	1	2	3
Total	10	12	22

	DIED		
AABC7	1	2	Total
1.0	0	1	1
15.0	1	0	1
17.0	1	0	1
26.0	1	0	1
33.0	0	1	1

44.0	0	1	1
54.0	1	1	2
Total	4	4	8

AABC8	DIED 1	2	Total
12.0	0	1	1
14.0	1	0	1
42.0	0	1	1
55.0	1	0	1
Total	2	2	4

NOAABC	DIED 1	2	Total
0.0	32	36	68
1.0	34	110	144
2.0	22	50	72
3.0	9	38	47
4.0	11	25	36
5.0	3	6	9
6.0	6	8	14
7.0	2	2	4
8.0	2	2	4
Total	121	277	398

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	230	1.901	3.823	1.955
2	277	532	1.921	2.515	1.586
Difference			-0.020		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	0.000	1.000	3.000	8.000	1.000
2	0.000	1.000	1.000	3.000	8.000	1.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.033	1	0.033	0.011	0.915462	0.106220
Within	1153.063	396	2.912			
Total	1153.095	397				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 7.676 deg freedom = 1 p-value = 0.005595

Bartlett's Test shows the variances in the samples to differ.
Use non-parametric results below rather than ANOVA.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 1.330
Degrees of freedom = 1
p value = 0.248775

APPAABC	DIED 1	2	Total
1.0	80	207	287
>	27.9%	72.1%	> 72.1%
	66.1%	74.7%	
2.0	41	70	111
>	36.9%	63.1%	> 27.9%
	33.9%	25.3%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		0.66
Cornfield 95% confidence limits for OR	0.40 < OR <	1.08
Maximum likelihood estimate of OR (MLE)		0.66
Exact 95% confidence limits for MLE	0.41 < OR <	1.08
Exact 95% Mid-P limits for MLE	0.42 < OR <	1.06
Probability of MLE <= 0.66 if population OR = 1.0		0.05143589
RISK RATIO(RR)(Outcome:DIED=1; Exposure:APPAABC=1.0)		0.75
95% confidence limits for RR	0.56 < RR <	1.02

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	3.11	0.07796829
Mantel-Haenszel:	3.10	0.07834298
Yates corrected:	2.69	0.10077607

LOT_AP	**DIED 1**	**2**	**Total**
0.0	**4**	**8**	**12**
1.0	**2**	**7**	**9**
2.0	**8**	**5**	**13**
3.0	**2**	**5**	**7**
4.0	**10**	**16**	**26**
5.0	**5**	**2**	**7**
6.0	**7**	**2**	**9**
7.0	**7**	**4**	**11**
8.0	**7**	**4**	**11**
9.0	**0**	**6**	**6**
10.0	**3**	**14**	**17**

11.0	0	9	9
12.0	3	6	9
13.0	3	12	15
14.0	6	18	24
15.0	2	4	6
16.0	2	3	5
17.0	3	4	7
18.0	0	1	1
19.0	0	2	2
20.0	3	3	6
21.0	2	2	4
22.0	3	4	7
23.0	2	4	6
25.0	0	1	1
26.0	4	5	9
27.0	0	6	6
28.0	5	8	13
30.0	0	4	4
31.0	2	2	4
32.0	0	1	1
33.0	0	1	1
34.0	0	2	2
35.0	0	2	2
38.0	0	1	1
40.0	0	7	7
42.0	1	3	4
43.0	0	6	6
44.0	0	3	3
45.0	2	6	8
47.0	0	5	5
49.0	0	2	2
50.0	0	1	1
51.0	0	3	3
55.0	0	1	1
56.0	0	1	1
58.0	0	1	1
63.0	0	1	1
73.0	1	1	2
97.0	0	2	2
102.0	0	1	1
141.0	0	1	1
182.0	0	1	1
Total	99	224	323

DIED	Obs	Total	Mean	Variance	Std Dev
1	99	1263	12.758	140.737	11.863
2	224	4955	22.121	501.927	22.404
Difference			-9.363		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	4.000	8.000	20.000	73.000	4.000
2	0.000	9.000	14.000	30.000	182.000	14.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	6018.760	1	6018.760	15.367	0.000108	3.920130
Within	125721.927	321	391.657			
Total	131740.687	322				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 44.811 deg freedom = 1 p-value = 0.000000

Bartlett's Test shows the variances in the samples to differ.
Use non-parametric results below rather than ANOVA.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 16.636
Degrees of freedom = 1
p value = 0.000045

	DIED		
MI	**1**	**2**	**Total**
0	**99**	**240**	**339**
	29.2%	**70.8%**	**85.2%**
	81.8%	**86.6%**	
1	**22**	**37**	**59**
	37.3%	**62.7%**	**14.8%**
	18.2%	**13.4%**	
Total	**121**	**277**	**398**
	30.4%	**69.6%**	

Single Table Analysis

Odds ratio		**0.69**
Cornfield 95% confidence limits for OR	**0.37 < OR <**	**1.29**
Maximum likelihood estimate of OR (MLE)		**0.69**
Exact 95% confidence limits for MLE	**0.38 < OR <**	**1.30**
Exact 95% Mid-P limits for MLE	**0.39 < OR <**	**1.25**
Probability of MLE <= 0.69 if population OR = 1.0		**0.13773884**
RISK RATIO(RR)(Outcome:DIED=1; Exposure:MI=0)		**0.78**
95% confidence limits for RR	**0.54 < RR <**	**1.13**

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	**1.55**	**0.21279063**
Mantel-Haenszel:	**1.55**	**0.21336625**
Yates corrected:	**1.19**	**0.27457151**

DIED

CHCF	1	2	Total
0	93	250	343
>	27.1%	72.9%	> 86.2%
	76.9%	90.3%	
1	28	27	55
>	50.9%	49.1%	> 13.8%
	23.1%	9.7%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		0.36
Cornfield 95% confidence limits for OR	0.19 < OR <	0.67
Maximum likelihood estimate of OR (MLE)		0.36
Exact 95% confidence limits for MLE	0.19 < OR <	0.67
Exact 95% Mid-P limits for MLE	0.20 < OR <	0.64
Probability of MLE <= 0.36 if population OR = 1.0		0.00048662

RISK RATIO(RR)(Outcome:DIED=1; Exposure:CHCF=0)		0.53
95% confidence limits for RR	0.39 < RR <	0.73

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	12.68	0.00036877 <---
Mantel-Haenszel:	12.65	0.00037511 <---
Yates corrected:	**11.58**	**0.00066505 <---**

	DIED		
PV	**1**	**2**	**Total**
0	**102**	**244**	**346**
>	**29.5%**	**70.5%**	**> 86.9%**
	84.3%	**88.1%**	
1	**19**	**33**	**52**
>	**36.5%**	**63.5%**	**> 13.1%**
	15.7%	**11.9%**	
Total	**121**	**277**	**398**
	30.4%	**69.6%**	

Single Table Analysis

Odds ratio		**0.73**
Cornfield 95% confidence limits for OR	**0.38 < OR <**	**1.41**
Maximum likelihood estimate of OR (MLE)		**0.73**
Exact 95% confidence limits for MLE	**0.38 < OR <**	**1.42**
Exact 95% Mid-P limits for MLE	**0.40 < OR <**	**1.36**
Probability of MLE <= 0.73 if population OR = 1.0		**0.19109684**

RISK RATIO(RR)(Outcome:DIED=1; Exposure:PV=0) **0.81**
95% confidence limits for RR **0.54 < RR < 1.20**

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	**1.06**	**0.30219093**
Mantel-Haenszel:	**1.06**	**0.30279908**
Yates corrected:	**0.76**	**0.38425720**

	DIED		
CD	1	2	Total
0	102	253	355
>	28.7%	71.3%	> 89.2%
|	84.3%	91.3%	|
1	19	24	43
>	44.2%	55.8%	> 10.8%
|	15.7%	8.7%	|
Total	121	277	398
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio		0.51
Cornfield 95% confidence limits for OR	0.25 < OR <	1.02
Maximum likelihood estimate of OR (MLE)		0.51
Exact 95% confidence limits for MLE	0.26 < OR <	1.03
Exact 95% Mid-P limits for MLE	0.27 < OR <	0.98
Probability of MLE <= 0.51 if population OR = 1.0		0.03080722

RISK RATIO(RR)(Outcome:DIED=1; Exposure:CD=0)		0.65
95% confidence limits for RR	0.45 < RR <	0.94

Ignore risk ratio if case control study

	Chi-Squares	P-values	
Uncorrected:	4.33	0.03747057	<---
Mantel-Haenszel:	4.32	0.03771082	<---
Yates corrected:	3.63	0.05676905	

	DIED		
PD	1	2	Total
0	92	238	330
>	27.9%	72.1%	> 82.9%
|	76.0%	85.9%	|
1	29	39	68
>	42.6%	57.4%	> 17.1%

```
           |      24.0%      14.1% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |
```

Single Table Analysis

Odds ratio	0.52
Cornfield 95% confidence limits for OR	0.29 < OR < 0.93
Maximum likelihood estimate of OR (MLE)	0.52
Exact 95% confidence limits for MLE	0.29 < OR < 0.93
Exact 95% Mid-P limits for MLE	0.30 < OR < 0.90
Probability of MLE <= 0.52 if population OR = 1.0	0.01300708
RISK RATIO(RR)(Outcome:DIED=1; Exposure:PD=0)	0.65
95% confidence limits for RR	0.47 < RR < 0.91

Ignore risk ratio if case control study

	Chi-Squares	P-values	
Uncorrected:	5.81	0.01592027	<---
Mantel-Haenszel:	5.80	0.01605303	<---
Yates corrected:	5.13	0.02345276	<---

```
                          DIED
DEM        |   1          2        | Total
-----------+----------------------+------
         0 |        107        265 |   372
           >      28.8%      71.2% > 93.5%
           |      88.4%      95.7% |
         1 |         14         12 |    26
           >      53.8%      46.2% >  6.5%
           |      11.6%       4.3% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |
```

Single Table Analysis

Odds ratio	0.35
Cornfield 95% confidence limits for OR	0.14 < OR < 0.83
Maximum likelihood estimate of OR (MLE)	0.35
Exact 95% confidence limits for MLE	0.14 < OR < 0.84
Exact 95% Mid-P limits for MLE	0.15 < OR < 0.78
Probability of MLE <= 0.35 if population OR = 1.0	0.00853893
RISK RATIO(RR)(Outcome:DIED=1; Exposure:DEM=0)	0.53
95% confidence limits for RR	0.36 < RR < 0.79

Ignore risk ratio if case control study

	Chi-Squares	P-values

Uncorrected:	7.23	0.00718649 <---
Mantel-Haenszel:	7.21	0.00725955 <---
Yates corrected:	6.09	0.01360303 <---

PAR	DIED 1	2	Total
0	112	264	376
>	29.8%	70.2%	> 94.5%
|	92.6%	95.3%	|
2	9	13	22
>	40.9%	59.1%	> 5.5%
|	7.4%	4.7%	|
Total	121	277	398
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio	**0.61**
Cornfield 95% confidence limits for OR	**0.23 < OR < 1.62**
Maximum likelihood estimate of OR (MLE)	**0.61**
Exact 95% confidence limits for MLE	**0.23 < OR < 1.68**
Exact 95% Mid-P limits for MLE	**0.25 < OR < 1.54**
Probability of MLE <= 0.61 if population OR = 1.0	**0.19189707**
RISK RATIO(RR)(Outcome:DIED=1; Exposure:PAR=0)	**0.73**
95% confidence limits for RR	**0.43 < RR < 1.23**

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	1.22	0.27034040
Mantel-Haenszel:	1.21	0.27094308
Yates corrected:	0.75	0.38766961

DIAEOD	DIED 1	2	Total
0	111	253	364
>	30.5%	69.5%	> 91.5%
|	91.7%	91.3%	|
2	10	24	34
>	29.4%	70.6%	> 8.5%
|	8.3%	8.7%	|
Total	121	277	398
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio	**1.05**

```
Cornfield 95% confidence limits for OR                    0.46 < OR <   2.47
Maximum likelihood estimate of OR (MLE)                                 1.05
Exact 95% confidence limits for MLE                       0.47 < OR <   2.55
Exact 95% Mid-P limits for MLE                            0.49 < OR <   2.37
Probability of MLE >=  1.05 if population OR = 1.0                 0.53381697

RISK RATIO(RR)(Outcome:DIED=1; Exposure:DIAEOD=0)                       1.04
95% confidence limits for RR                              0.60 < RR <   1.79

               Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.02     0.89557173
        Mantel-Haenszel:      0.02     0.89570226
        Yates corrected:      0.00     0.94923331


                              DIED
DIA         |   1           2         | Total
------------+-----------------------+------
          0 |          97         223 |   320
            >       30.3%       69.7% > 80.4%
            |       80.2%       80.5% |
          1 |          24          54 |    78
            >       30.8%       69.2% > 19.6%
            |       19.8%       19.5% |
------------+-----------------------+------
      Total |         121         277 |   398
            |       30.4%       69.6% |

                            Single Table Analysis

Odds ratio                                                              0.98
Cornfield 95% confidence limits for OR                    0.55 < OR <   1.74
Maximum likelihood estimate of OR (MLE)                                 0.98
Exact 95% confidence limits for MLE                       0.56 < OR <   1.76
Exact 95% Mid-P limits for MLE                            0.57 < OR <   1.70
Probability of MLE <=  0.98 if population OR = 1.0                 0.51898848

RISK RATIO(RR)(Outcome:DIED=1; Exposure:DIA=0)                          0.99
95% confidence limits for RR                              0.68 < RR <   1.43

               Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.01     0.93732646
        Mantel-Haenszel:      0.01     0.93740508
        Yates corrected:      0.00     0.95324835


                              DIED
RD          |   1           2         | Total
------------+-----------------------+------
```

0	98	232	330
>	29.7%	70.3% >	82.9%
	81.0%	83.8%	
2	23	45	68
>	33.8%	66.2% >	17.1%
	19.0%	16.2%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		**0.83**
Cornfield 95% confidence limits for OR	**0.46 < OR <**	**1.50**
Maximum likelihood estimate of OR (MLE)		**0.83**
Exact 95% confidence limits for MLE	**0.46 < OR <**	**1.51**
Exact 95% Mid-P limits for MLE	**0.48 < OR <**	**1.46**
Probability of MLE <= 0.83 if population OR = 1.0		**0.29545758**
RISK RATIO(RR)(Outcome:DIED=1; Exposure:RD=0)		**0.88**
95% confidence limits for RR	**0.61 < RR <**	**1.27**

Ignore risk ratio if case control study

	Chi-Squares	**P-values**
Uncorrected:	**0.45**	**0.50055929**
Mantel-Haenszel:	**0.45**	**0.50109794**
Yates corrected:	**0.28**	**0.59690998**

DIED

SLD	1	2	Total
0	102	259	361
>	28.3%	71.7% >	90.7%
	84.3%	93.5%	
3	19	18	37
>	51.4%	48.6% >	9.3%
	15.7%	6.5%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		0.37
Cornfield 95% confidence limits for OR	0.18 < OR <	0.78
Maximum likelihood estimate of OR (MLE)		0.37
Exact 95% confidence limits for MLE	0.18 < OR <	0.79
Exact 95% Mid-P limits for MLE	0.19 < OR <	0.75
Probability of MLE <= 0.37 if population OR = 1.0		0.00420411
RISK RATIO(RR)(Outcome:DIED=1; Exposure:SLD=0)		0.55
95% confidence limits for RR	0.39 < RR <	0.78

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	8.46	0.00362851 <---
Mantel-Haenszel:	8.44	0.00367118 <---
Yates corrected:	7.40	0.00650573 <---

MLD	DIED 1	2	Total
0	119	268	387
>	30.7%	69.3%	> 97.2%
	98.3%	96.8%	
1	2	9	11
>	18.2%	81.8%	> 2.8%
	1.7%	3.2%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio	**2.00**
Cornfield 95% confidence limits for OR	**0.39 < OR < 13.79***
***May be inaccurate**	
Maximum likelihood estimate of OR (MLE)	**2.00**
Exact 95% confidence limits for MLE	**0.40 < OR < 19.25**
Exact 95% Mid-P limits for MLE	**0.47 < OR < 13.73**
Probability of MLE >= 2.00 if population OR = 1.0	**0.29917274**
RISK RATIO(RR)(Outcome:DIED=1; Exposure:MLD=0)	**1.69**
95% confidence limits for RR	**0.48 < RR < 5.98**

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	**0.80**	**0.37157145**
Mantel-Haenszel:	**0.80**	**0.37217298**
Yates corrected:	**0.31**	**0.57467991**

Fisher exact: 1-tailed P-value: 0.2991727
2-tailed P-value: 0.5156519

An expected value is less than 5; recommend Fisher exact results.

PEP	DIED 1	2	Total
0	112	265	377
>	29.7%	70.3%	> 94.7%
	92.6%	95.7%	

```
         1 |          9         12 |    21
           >      42.9%      57.1% >  5.3%
           |       7.4%       4.3% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |
```

Single Table Analysis

Odds ratio		0.56
Cornfield 95% confidence limits for OR	0.21 < OR <	1.51
Maximum likelihood estimate of OR (MLE)		0.56
Exact 95% confidence limits for MLE	0.21 < OR <	1.56
Exact 95% Mid-P limits for MLE	0.23 < OR <	1.43
Probability of MLE <= 0.56 if population OR = 1.0		0.15128740
RISK RATIO(RR)(Outcome:DIED=1; Exposure:PEP=0)		0.69
95% confidence limits for RR	0.41 < RR <	1.16

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	1.63	0.20234126
Mantel-Haenszel:	1.62	0.20290916
Yates corrected:	1.06	0.30244946

```
                          DIED
TUM        |   1          2        | Total
-----------+----------------------+------
         0 |        112        260 |   372
           >      30.1%      69.9% > 93.5%
           |      92.6%      93.9% |
         2 |          9         17 |    26
           >      34.6%      65.4% >  6.5%
           |       7.4%       6.1% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |
```

Single Table Analysis

Odds ratio		0.81
Cornfield 95% confidence limits for OR	0.33 < OR <	2.06
Maximum likelihood estimate of OR (MLE)		0.81
Exact 95% confidence limits for MLE	0.33 < OR <	2.14
Exact 95% Mid-P limits for MLE	0.35 < OR <	1.97
Probability of MLE <= 0.81 if population OR = 1.0		0.38761986
RISK RATIO(RR)(Outcome:DIED=1; Exposure:TUM=0)		0.87
95% confidence limits for RR	0.50 < RR <	1.51

Ignore risk ratio if case control study

	Chi-Squares	P-values

	Chi-Squares	P-values
Uncorrected:	**0.23**	**0.62902452**
Mantel-Haenszel:	**0.23**	**0.62945576**
Yates corrected:	**0.07**	**0.79285683**

LYM	DIED 1	2	Total
0	113	271	384
>	29.4%	70.6%	> 96.5%
|	93.4%	97.8%	|
2	8	6	14
>	57.1%	42.9%	> 3.5%
|	6.6%	2.2%	|
Total	121	277	398
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio		0.31
Cornfield 95% confidence limits for OR	0.09 < OR <	1.03
Maximum likelihood estimate of OR (MLE)		0.31
Exact 95% confidence limits for MLE	0.09 < OR <	1.06
Exact 95% Mid-P limits for MLE	0.10 < OR <	0.95
Probability of MLE <= 0.31 if population OR = 1.0		0.03151846

RISK RATIO(RR)(Outcome:DIED=1; Exposure:LYM=0)		0.51
95% confidence limits for RR	0.32 < RR <	0.83

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	4.90	0.02679793 <---
Mantel-Haenszel:	4.89	0.02698983 <---
Yates corrected:	3.68	0.05502315

Fisher exact: 1-tailed P-value: 0.0315185 <---
2-tailed P-value: 0.0371645 <---

An expected value is less than 5; recommend Fisher exact results.

LEU	DIED 1	2	Total
0	118	276	394
>	29.9%	70.1%	> 99.0%
|	97.5%	99.6%	|
2	3	1	4
>	75.0%	25.0%	> 1.0%
|	2.5%	0.4%	|
Total	121	277	398

```
           |      30.4%      69.6% |

                          Single Table Analysis

Odds ratio                                                              0.14
Cornfield 95% confidence limits for OR                  0.01 < OR <
1.57*
                    *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 0.14
Exact 95% confidence limits for MLE                     0.00 < OR <   1.81
Exact 95% Mid-P limits for MLE                          0.01 < OR <   1.36
Probability of MLE <=  0.14 if population OR = 1.0              0.08571132

RISK RATIO(RR)(Outcome:DIED=1; Exposure:LEU=0)                          0.40
95% confidence limits for RR                            0.22 < RR <   0.72

              Ignore risk ratio if case control study

                        Chi-Squares   P-values
                        -----------   --------


        Uncorrected:         3.80     0.05130755
        Mantel-Haenszel:     3.79     0.05160088
        Yates corrected:     1.97     0.16071888

        Fisher exact: 1-tailed P-value: 0.0857113
                      2-tailed P-value: 0.0857113


An expected value is less than 5; recommend Fisher exact results.

                            DIED
AIDS       |   1          2        | Total
-----------+----------------------+------
         0 |        121        271 |   392
           >      30.9%      69.1% > 98.5%
           |     100.0%      97.8% |
         6 |          0          6 |     6
           >       0.0%     100.0% >  1.5%
           |       0.0%       2.2% |
-----------+----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |

                          Single Table Analysis

Odds ratio                                                            ??????
Maximum likelihood estimate of OR (MLE)                               ??????
Exact 95% confidence limits for MLE                     0.52 < OR < ??????
Exact 95% Mid-P limits for MLE                          0.68 < OR < ??????
Probability of MLE >= ?????? if population OR = 1.0            0.11177612

RISK RATIO(RR)(Outcome:DIED=1; Exposure:AIDS=0)                       ??????
95% confidence limits for RR                          ?????? < RR < ??????

              Ignore risk ratio if case control study
```

	Chi-Squares	P-values
Uncorrected:	2.66	0.10283251
Mantel-Haenszel:	2.65	0.10326573
Yates corrected:	1.40	0.23635995

Fisher exact: 1-tailed P-value: 0.1117761
2-tailed P-value: 0.1839563

An expected value is less than 5; recommend Fisher exact results.

METCA	DIED 1	2	Total
0	109	264	373
>	29.2%	70.8%	> 93.7%
|	90.1%	95.3%	|
6	12	13	25
>	48.0%	52.0%	> 6.3%
|	9.9%	4.7%	|
Total	121	277	398
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio		0.45
Cornfield 95% confidence limits for OR	0.18 < OR <	1.09
Maximum likelihood estimate of OR (MLE)		0.45
Exact 95% confidence limits for MLE	0.18 < OR <	1.11
Exact 95% Mid-P limits for MLE	0.20 < OR <	1.03
Probability of MLE <= 0.45 if population OR = 1.0		0.04331625
RISK RATIO(RR)(Outcome:DIED=1; Exposure:METCA=0)		0.61
95% confidence limits for RR	0.39 < RR <	0.94

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	3.90	0.04816315 <---
Mantel-Haenszel:	3.89	0.04844520 <---
Yates corrected:	3.07	0.07988334

RHE	**DIED 1**	**2**	**Total**
0	**114**	**267**	**381**
>	**29.9%**	**70.1%**	**> 95.7%**
|	**94.2%**	**96.4%**	**|**
1	**7**	**10**	**17**
>	**41.2%**	**58.8%**	**> 4.3%**
|	**5.8%**	**3.6%**	**|**

```
-----------+-----------------------+------

     Total |        121        277 |   398
           |      30.4%      69.6% |
```

Single Table Analysis

Odds ratio		0.61
Cornfield 95% confidence limits for OR	0.21 < OR <	1.84
Maximum likelihood estimate of OR (MLE)		0.61
Exact 95% confidence limits for MLE	0.20 < OR <	1.94
Exact 95% Mid-P limits for MLE	0.22 < OR <	1.74
Probability of MLE <= 0.61 if population OR = 1.0		0.23196311
RISK RATIO(RR)(Outcome:DIED=1; Exposure:RHE=0)		0.73
95% confidence limits for RR	0.40 < RR <	1.31

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.97	0.32360655
Mantel-Haenszel:	0.97	0.32421517
Yates corrected:	0.51	0.47298820

```
                      DIED
IDU        |   2        | Total
-----------+------------+------
         0 |         10 |    10
           >     100.0% >100.0%
           |     100.0% |
-----------+------------+------
     Total |         10 |    10
           |     100.0% |
```

Chi square = 0.00
Degrees of freedom = 0
p value = 1.00000000

```
                          DIED
  CCISCORE   |   1          2        | Total
-------------+----------------------+------
           1.0 |         79        102 |   181
               >      43.6%      56.4% > 45.5%
               |      65.3%      36.8% |
           2.0 |         42        175 |   217
               >      19.4%      80.6% > 54.5%
               |      34.7%      63.2% |
-------------+----------------------+------
       Total |        121        277 |   398
             |      30.4%      69.6% |
```

Single Table Analysis

Odds ratio	3.23
Cornfield 95% confidence limits for OR	2.01 < OR < 5.20
Maximum likelihood estimate of OR (MLE)	3.22
Exact 95% confidence limits for MLE	2.02 < OR < 5.18
Exact 95% Mid-P limits for MLE	2.06 < OR < 5.06
Probability of MLE >= 3.22 if population OR = 1.0	0.00000013
RISK RATIO(RR)(Outcome:DIED=1; Exposure:CCISCORE=1.0)	2.26
95% confidence limits for RR	1.64 < RR < 3.10

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	27.52	0.00000016 <---
Mantel-Haenszel:	27.45	0.00000016 <---
Yates corrected:	26.39	0.00000028 <---

	DIED		
CCISCORE	1	2	Total
1.0	79	102	181
2.0	42	175	217
Total	121	277	398

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	163	1.347	0.229	0.478
2	277	452	1.632	0.233	0.483
Difference			-0.285		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	1.000	1.000	1.000	2.000	2.000	1.000
2	1.000	1.000	2.000	2.000	2.000	2.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	6.824	1	6.824	29.417	0.000000	5.423749
Within	91.862	396	0.232			
Total	98.686	397				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.019 deg freedom = 1 p-value = 0.889724

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 27.452
Degrees of freedom = 1
p value = 0.000000

SICU	DIED 1	2	Total
1	26	24	50
>	52.0%	48.0%	> 12.9%
	22.4%	8.9%	
2	90	247	337
>	26.7%	73.3%	> 87.1%
	77.6%	91.1%	
Total	116	271	387
	30.0%	70.0%	

Single Table Analysis

Odds ratio		2.97
Cornfield 95% confidence limits for OR	1.55 < OR <	5.72
Maximum likelihood estimate of OR (MLE)		2.96
Exact 95% confidence limits for MLE	1.55 < OR <	5.70
Exact 95% Mid-P limits for MLE	1.61 < OR <	5.47
Probability of MLE >= 2.96 if population OR = 1.0		0.00039113
RISK RATIO(RR)(Outcome:DIED=1; Exposure:SICU=1)		1.95
95% confidence limits for RR	1.41 < RR <	2.68

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	13.27	0.00026951 <---
Mantel-Haenszel:	13.24	0.00027449 <---
Yates corrected:	12.09	0.00050598 <---

SRI	DIED 1	2	Total
1	29	27	56
>	51.8%	48.2%	> 14.3%
	24.2%	10.0%	
2	91	244	335
>	27.2%	72.8%	> 85.7%
	75.8%	90.0%	
Total	120	271	391
	30.7%	69.3%	

Single Table Analysis

```
Odds ratio                                                              2.88
Cornfield 95% confidence limits for OR                  1.55 < OR <     5.36
Maximum likelihood estimate of OR (MLE)                                 2.87
Exact 95% confidence limits for MLE                     1.55 < OR <     5.34
Exact 95% Mid-P limits for MLE                          1.61 < OR <     5.15
Probability of MLE >=  2.87 if population OR = 1.0                 0.00029916

RISK RATIO(RR)(Outcome:DIED=1; Exposure:SRI=1)                          1.91
95% confidence limits for RR                            1.40 < RR <     2.59

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:        13.67     0.00021747 <---
        Mantel-Haenszel:    13.64     0.00022156 <---
        Yates corrected:    12.54     0.00039816 <---


                            DIED
SHD         |   1          2         | Total
------------+----------------------+------
          1 |          19          18 |    37
            >       51.4%       48.6% >  9.7%
            |       16.8%        6.7% |
          2 |          94         250 |   344
            >       27.3%       72.7% > 90.3%
            |       83.2%       93.3% |
------------+----------------------+------
      Total |         113         268 |   381
            |       29.7%       70.3% |

                           Single Table Analysis

Odds ratio                                                              2.81
Cornfield 95% confidence limits for OR                  1.33 < OR <     5.92
Maximum likelihood estimate of OR (MLE)                                 2.80
Exact 95% confidence limits for MLE                     1.33 < OR <     5.93
Exact 95% Mid-P limits for MLE                          1.40 < OR <     5.62
Probability of MLE >=  2.80 if population OR = 1.0                 0.00295622

RISK RATIO(RR)(Outcome:DIED=1; Exposure:SHD=1)                          1.88
95% confidence limits for RR                            1.31 < RR <     2.69

              Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:         9.24     0.00236360 <---
        Mantel-Haenszel:     9.22     0.00239513 <---
        Yates corrected:     8.13     0.00435982 <---


                            DIED
SRD         |   1          2         | Total
```

```
-----------+-----------------------+------
         1 |         38         23 |    61
           >      62.3%      37.7% > 15.8%
           |      32.5%       8.5% |
         2 |         79        247 |   326
           >      24.2%      75.8% > 84.2%
           |      67.5%      91.5% |
-----------+-----------------------+------
     Total |        117        270 |   387
           |      30.2%      69.8% |
```

Single Table Analysis

Odds ratio		5.17
Cornfield 95% confidence limits for OR	2.78 < OR <	9.64
Maximum likelihood estimate of OR (MLE)		5.14
Exact 95% confidence limits for MLE	2.80 < OR <	9.63
Exact 95% Mid-P limits for MLE	2.90 < OR <	9.26
Probability of MLE >= 5.14 if population OR = 1.0		0.00000001
RISK RATIO(RR)(Outcome:DIED=1; Exposure:SRD=1)		2.57
95% confidence limits for RR	1.95 < RR <	3.38

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	35.29	0.00000000 <---
Mantel-Haenszel:	35.20	0.00000000 <---
Yates corrected:	33.51	0.00000001 <---

```
                          DIED
ND         |   1          2         | Total
-----------+-----------------------+------
         1 |         53         19 |    72
           >      73.6%      26.4% > 18.5%
           |      44.9%       7.0% |
         2 |         65        253 |   318
           >      20.4%      79.6% > 81.5%
           |      55.1%      93.0% |
-----------+-----------------------+------
     Total |        118        272 |   390
           |      30.3%      69.7% |
```

Single Table Analysis

Odds ratio		10.86
Cornfield 95% confidence limits for OR	5.76 < OR <	20.63
Maximum likelihood estimate of OR (MLE)		10.77
Exact 95% confidence limits for MLE	5.81 < OR <	20.69
Exact 95% Mid-P limits for MLE	6.02 < OR <	19.82
Probability of MLE >= 10.77 if population OR = 1.0		0.00000000
RISK RATIO(RR)(Outcome:DIED=1; Exposure:ND=1)		3.60
95% confidence limits for RR	2.78 < RR <	4.66

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	78.65	0.00000000 <---
Mantel-Haenszel:	78.45	0.00000000 <---
Yates corrected:	76.15	0.00000000 <---

SSS	DIED 1	2	Total
1	47	13	60
>	78.3%	21.7%	> 15.3%
|	39.5%	4.8%	|
2	72	260	332
>	21.7%	78.3%	> 84.7%
|	60.5%	95.2%	|
Total	119	273	392
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio	13.06
Cornfield 95% confidence limits for OR	6.38 < OR < 27.14
Maximum likelihood estimate of OR (MLE)	12.95
Exact 95% confidence limits for MLE	6.47 < OR < 27.58
Exact 95% Mid-P limits for MLE	6.75 < OR < 26.07
Probability of MLE >= 12.95 if population OR = 1.0	0.00000000
RISK RATIO(RR)(Outcome:DIED=1; Exposure:SSS=1)	3.61
95% confidence limits for RR	2.83 < RR < 4.61

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	77.13	0.00000000 <---
Mantel-Haenszel:	76.93	0.00000000 <---
Yates corrected:	74.47	0.00000000 <---

SCO	DIED 1	2	Total
0	94	266	360
>	26.1%	73.9%	> 93.0%
|	81.7%	97.8%	|
1	21	6	27
>	77.8%	22.2%	> 7.0%
|	18.3%	2.2%	|
Total	115	272	387

| 29.7% 70.3% |

Single Table Analysis

Odds ratio	0.10
Cornfield 95% confidence limits for OR	0.03 < OR < 0.28
Maximum likelihood estimate of OR (MLE)	0.10
Exact 95% confidence limits for MLE	0.03 < OR < 0.27
Exact 95% Mid-P limits for MLE	0.04 < OR < 0.25
Probability of MLE <= 0.10 if population OR = 1.0	0.00000012
RISK RATIO(RR)(Outcome:DIED=1; Exposure:SCO=0)	0.34
95% confidence limits for RR	0.26 < RR < 0.44

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	32.10	0.00000001 <---
Mantel-Haenszel:	32.02	0.00000002 <---
Yates corrected:	29.68	0.00000005 <---

	DIED		
SICOUNT	1	2	Total
0.0	37	208	245
1.0	26	38	64
2.0	17	16	33
3.0	16	7	23
4.0	9	4	13
5.0	9	1	10
6.0	5	3	8
7.0	2	0	2
Total	121	277	398

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	233	1.926	3.636	1.907
2	277	130	0.469	1.091	1.044
Difference			1.456		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	0.000	1.000	3.000	7.000	0.000
2	0.000	0.000	0.000	0.000	6.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	178.602	1	178.602	95.924	0.000000	9.794071
Within	737.320	396	1.862			
Total	915.922	397				

Bartlett's test for homogeneity of variance

Bartlett's chi square = 67.115 deg freedom = 1 p-value = 0.000000

Bartlett's Test shows the variances in the samples to differ.
Use non-parametric results below rather than ANOVA.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 82.908
Degrees of freedom = 1
p value = 0.000000

	DIED		
CCICOUNT	1	2	Total
0.0	10	65	75
1.0	13	63	76
2.0	19	47	66
3.0	29	37	66
4.0	14	21	35
5.0	11	16	27
6.0	11	11	22
7.0	6	10	16
8.0	5	2	7
9.0	2	2	4
11.0	1	1	2
12.0	0	2	2
Total	121	277	398

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	426	3.521	5.352	2.313
2	277	637	2.300	5.218	2.284
Difference			1.221		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	2.000	3.000	5.000	11.000	3.000
2	0.000	1.000	2.000	3.000	12.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	125.554	1	125.554	23.877	0.000001	4.886384
Within	2082.328	396	5.258			
Total	2207.882	397				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.027 deg freedom = 1 p-value = 0.869939

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

```
Kruskal-Wallis H (equivalent to Chi square) =      29.266
                        Degrees of freedom =           1
                                   p value =    0.000000
```

	DIED		
SYN	**1**	**2**	**Total**
1	**0**	**13**	**13**
	0.0%	**100.0%**	**3.3%**
	0.0%	**4.7%**	
2	**121**	**264**	**385**
	31.4%	**68.6%**	**96.7%**
	100.0%	**95.3%**	
Total	**121**	**277**	**398**
	30.4%	**69.6%**	

Single Table Analysis

Odds ratio	**0.00**
Cornfield 95% confidence limits for OR	**0.00 < OR < 0.89**
Maximum likelihood estimate of OR (MLE)	**0.00**
Exact 95% confidence limits for MLE	**0.00 < OR < 0.73**
Exact 95% Mid-P limits for MLE	**0.00 < OR < 0.58**
Probability of MLE <= 0.00 if population OR = 1.0	**0.00823381**
RISK RATIO(RR)(Outcome:DIED=1; Exposure:SYN=1)	**0.00**
95% confidence limits for RR	**?????? < RR < ??????**

Ignore risk ratio if case control study

	Chi-Squares	**P-values**
Uncorrected:	**5.87**	**0.01539713 <---**
Mantel-Haenszel:	**5.86**	**0.01552669 <---**
Yates corrected:	**4.48**	**0.03431250 <---**

Fisher exact: 1-tailed P-value: 0.0082338 <---
2-tailed P-value: 0.0121057 <---

An expected value is less than 5; recommend Fisher exact results.

	DIED		
PLUE	**1**	**2**	**Total**
1	**8**	**12**	**20**
	40.0%	**60.0%**	**5.0%**
	6.6%	**4.3%**	
2	**113**	**265**	**378**
	29.9%	**70.1%**	**95.0%**
	93.4%	**95.7%**	
Total	**121**	**277**	**398**
	30.4%	**69.6%**	

Single Table Analysis

Odds ratio		1.56
Cornfield 95% confidence limits for OR	0.56 < OR <	4.28
Maximum likelihood estimate of OR (MLE)		1.56
Exact 95% confidence limits for MLE	0.54 < OR <	4.29
Exact 95% Mid-P limits for MLE	0.59 < OR <	3.95
Probability of MLE >= 1.56 if population OR = 1.0		0.23515930
RISK RATIO(RR)(Outcome:DIED=1; Exposure:PLUE=1)		1.34
95% confidence limits for RR	0.77 < RR <	2.34

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.92	0.33831200
Mantel-Haenszel:	0.91	0.33891959
Yates corrected:	0.50	0.47888121

	DIED		
PERI	1	2	Total
1	0	1	1
>	0.0%	100.0%	> 0.3%
|	0.0%	0.4%	|
2	121	276	397
>	30.5%	69.5%	> 99.7%
|	100.0%	99.6%	|
Total	121	277	398
|	30.4%	69.6%	|

Single Table Analysis

Odds ratio		0.00
Cornfield 95% confidence limits for OR	0.00 < OR <	40.63*
*May be inaccurate		
Maximum likelihood estimate of OR (MLE)		0.00
Exact 95% confidence limits for MLE	0.00 < OR <	89.28
Exact 95% Mid-P limits for MLE	0.00 < OR <	43.50
Probability of MLE <= 0.00 if population OR = 1.0		0.69597990
RISK RATIO(RR)(Outcome:DIED=1; Exposure:PERI=1)		0.00
95% confidence limits for RR	?????? < RR <	??????

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.44	0.50812644
Mantel-Haenszel:	0.44	0.50865981
Yates corrected:	0.18	0.66967967

```
        Fisher exact: 1-tailed P-value: 0.6959799
                      2-tailed P-value: 1.0000000

An expected value is less than 5; recommend Fisher exact results.

                              DIED
ASC         |   1          2         | Total
------------+----------------------+------
          1 |          2          15 |    17
            >      11.8%       88.2% >  4.3%
            |       1.7%        5.4% |
          2 |        119         262 |   381
            >      31.2%       68.8% > 95.7%
            |      98.3%       94.6% |
------------+----------------------+------
      Total |        121         277 |   398
            |      30.4%       69.6% |

                           Single Table Analysis

Odds ratio                                                              0.29
Cornfield 95% confidence limits for OR                 0.05 < OR <      1.39
Maximum likelihood estimate of OR (MLE)                                 0.29
Exact 95% confidence limits for MLE                    0.03 < OR <      1.30
Exact 95% Mid-P limits for MLE                         0.04 < OR <      1.15
Probability of MLE <=  0.29 if population OR = 1.0                0.06824468

RISK RATIO(RR)(Outcome:DIED=1; Exposure:ASC=1)                          0.38
95% confidence limits for RR                           0.10 < RR <      1.40

               Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          2.92     0.08774640
        Mantel-Haenszel:      2.91     0.08814579
        Yates corrected:      2.07     0.15044566


                              DIED
TIS         |   1          2         | Total
------------+----------------------+------
          1 |          4          41 |    45
            >       8.9%       91.1% > 11.3%
            |       3.3%       14.8% |
          2 |        117         236 |   353
            >      33.1%       66.9% > 88.7%
            |      96.7%       85.2% |
------------+----------------------+------
      Total |        121         277 |   398
            |      30.4%       69.6% |

                           Single Table Analysis

Odds ratio                                                              0.20
```

```
Cornfield 95% confidence limits for OR                    0.06 < OR <   0.60
Maximum likelihood estimate of OR (MLE)                                 0.20
Exact 95% confidence limits for MLE                       0.05 < OR <   0.56
Exact 95% Mid-P limits for MLE                            0.06 < OR <   0.52
Probability of MLE <=  0.20 if population OR = 1.0                 0.00030563

RISK RATIO(RR)(Outcome:DIED=1; Exposure:TIS=1)                          0.27
95% confidence limits for RR                              0.10 < RR <   0.69

               Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:        11.10     0.00086440 <---
        Mantel-Haenszel:    11.07     0.00087749 <---
        Yates corrected:     9.98     0.00158176 <---


                            DIED
CSF         |   1          2         | Total
------------+----------------------+------
          1 |          1          5 |     6
            >      16.7%       83.3% >  1.5%
            |       0.8%        1.8% |
          2 |        120        272 |   392
            >      30.6%       69.4% > 98.5%
            |      99.2%       98.2% |
------------+----------------------+------
      Total |        121        277 |   398
            |      30.4%       69.6% |

                           Single Table Analysis

Odds ratio                                                              0.45
Cornfield 95% confidence limits for OR                    0.02 < OR <
4.09*
                     *May be inaccurate
Maximum likelihood estimate of OR (MLE)                                 0.45
Exact 95% confidence limits for MLE                       0.01 < OR <   4.12
Exact 95% Mid-P limits for MLE                            0.02 < OR <   3.32
Probability of MLE <=  0.45 if population OR = 1.0                 0.41011973

RISK RATIO(RR)(Outcome:DIED=1; Exposure:CSF=1)                          0.54
95% confidence limits for RR                              0.09 < RR <   3.28

               Ignore risk ratio if case control study

                         Chi-Squares   P-values
                         -----------   --------

        Uncorrected:          0.54     0.46112579
        Mantel-Haenszel:      0.54     0.46168939
        Yates corrected:      0.08     0.77192757

        Fisher exact: 1-tailed P-value: 0.4101197
                      2-tailed P-value: 0.6721499
```

An expected value is less than 5; recommend Fisher exact results.

BLOOD	Freq	Percent	Cum.
1	320	80.4%	80.4%
2	78	19.6%	100.0%
Total	398	100.0%	

Current selection: BLOOD <> 1

SYN	DIED 1	DIED 2	Total
1	0	12	12
>	0.0%	100.0%	> 15.4%
|	0.0%	17.1%	|
2	8	58	66
>	12.1%	87.9%	> 84.6%
|	100.0%	82.9%	|
Total	8	70	78
|	10.3%	89.7%	|

Single Table Analysis

Odds ratio	0.00
Cornfield 95% confidence limits for OR	0.00 < OR < 3.88
Maximum likelihood estimate of OR (MLE)	0.00
Exact 95% confidence limits for MLE	0.00 < OR < 3.29
Exact 95% Mid-P limits for MLE	0.00 < OR < 2.50
Probability of MLE <= 0.00 if population OR = 1.0	0.24496103
RISK RATIO(RR)(Outcome:DIED=1; Exposure:SYN=1)	0.00
95% confidence limits for RR	?????? < RR < ??????

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	1.62	0.20298317
Mantel-Haenszel:	1.60	0.20590321
Yates corrected:	0.57	0.44970789

Fisher exact: 1-tailed P-value: 0.2449610
2-tailed P-value: 0.3456634

An expected value is less than 5; recommend Fisher exact results.

Current selection: BLOOD <> 1

PLUE	DIED 1	DIED 2	Total

```
         1 |          5          7 |    12
           >      41.7%      58.3% > 15.4%
           |      62.5%      10.0% |
         2 |          3         63 |    66
           >       4.5%      95.5% > 84.6%
           |      37.5%      90.0% |
-----------+----------------------+------
     Total |          8         70 |    78
           |      10.3%      89.7% |
```

Single Table Analysis

Odds ratio	15.00
Cornfield 95% confidence limits for OR	2.34 < OR < 107.79*

*May be inaccurate

Maximum likelihood estimate of OR (MLE)	14.07
Exact 95% confidence limits for MLE	2.22 < OR < 111.13
Exact 95% Mid-P limits for MLE	2.71 < OR < 85.55
Probability of MLE >= 14.07 if population OR = 1.0	0.00163248
RISK RATIO(RR)(Outcome:DIED=1; Exposure:PLUE=1)	9.17
95% confidence limits for RR	2.52 < RR < 33.38

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	15.20	0.00009665 <---
Mantel-Haenszel:	15.01	0.00010716 <---
Yates corrected:	11.44	0.00072047 <---

Fisher exact: 1-tailed P-value: 0.0016325 <---
2-tailed P-value: 0.0016325 <---

An expected value is less than 5; recommend Fisher exact results.

Current selection: BLOOD <> 1

```
                          DIED
PERI       |   1          2        | Total
-----------+----------------------+------
         2 |          8         70 |    78
           >      10.3%      89.7% >100.0%
           |     100.0%     100.0% |
-----------+----------------------+------
     Total |          8         70 |    78
           |      10.3%      89.7% |
```

```
          Chi square =       0.00
     Degrees of freedom =       0
                p value = 1.00000000
```

Current selection: BLOOD <> 1

ASC	DIED 1	2	Total
1	2	13	15
>	13.3%	86.7% >	19.2%
	25.0%	18.6%	
2	6	57	63
>	9.5%	90.5% >	80.8%
	75.0%	81.4%	
Total	8	70	78
	10.3%	89.7%	

Single Table Analysis

Odds ratio		1.46
Cornfield 95% confidence limits for OR	0.18 < OR <	9.75
Maximum likelihood estimate of OR (MLE)		1.45
Exact 95% confidence limits for MLE	0.13 < OR <	9.43
Exact 95% Mid-P limits for MLE	0.18 < OR <	7.79
Probability of MLE >= 1.45 if population OR = 1.0		0.48087105
RISK RATIO(RR)(Outcome:DIED=1; Exposure:ASC=1)		1.40
95% confidence limits for RR	0.31 < RR <	6.26

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	0.19	0.66206869
Mantel-Haenszel:	0.19	0.66410827
Yates corrected:	0.00	0.97094622

Fisher exact: 1-tailed P-value: 0.4808711
2-tailed P-value: 0.6460484

An expected value is less than 5; recommend Fisher exact results.

Current selection: BLOOD <> 1

TIS	DIED 1	2	Total
1	1	37	38
>	2.6%	97.4% >	48.7%
	12.5%	52.9%	
2	7	33	40
>	17.5%	82.5% >	51.3%
	87.5%	47.1%	
Total	8	70	78
	10.3%	89.7%	

Single Table Analysis

Odds ratio		0.13
Cornfield 95% confidence limits for OR	0.01 < OR <	1.15
Maximum likelihood estimate of OR (MLE)		0.13
Exact 95% confidence limits for MLE	0.00 < OR <	1.10
Exact 95% Mid-P limits for MLE	0.01 < OR <	0.90
Probability of MLE <= 0.13 if population OR = 1.0		0.03349528
RISK RATIO(RR)(Outcome:DIED=1; Exposure:TIS=1)		0.15
95% confidence limits for RR	0.02 < RR <	1.17

Ignore risk ratio if case control study

	Chi-Squares	P-values
Uncorrected:	4.68	0.03050924 <---
Mantel-Haenszel:	4.62	0.03159457 <---
Yates corrected:	3.20	0.07344061

Fisher exact: 1-tailed P-value: 0.0334953 <---
2-tailed P-value: 0.0571110

An expected value is less than 5; recommend Fisher exact results.

Current selection: BLOOD <> 1

	DIED		
CSF	1	2	Total
1	1	3	4
>	25.0%	75.0%	> 5.1%
|	12.5%	4.3%	|
2	7	67	74
>	9.5%	90.5%	> 94.9%
|	87.5%	95.7%	|
Total	8	70	78
|	10.3%	89.7%	|

Single Table Analysis

Odds ratio		3.19
Cornfield 95% confidence limits for OR	0.00 < OR <	45.58*
*May be inaccurate		
Maximum likelihood estimate of OR (MLE)		3.12
Exact 95% confidence limits for MLE	0.05 < OR <	45.59
Exact 95% Mid-P limits for MLE	0.11 < OR <	33.65
Probability of MLE >= 3.12 if population OR = 1.0		0.35720770
RISK RATIO(RR)(Outcome:DIED=1; Exposure:CSF=1)		2.64
95% confidence limits for RR	0.42 < RR <	16.61

Ignore risk ratio if case control study

```
                        Chi-Squares   P-values
                        -----------   --------

        Uncorrected:         1.00     0.31835210
        Mantel-Haenszel:     0.98     0.32147424
        Yates corrected:     0.02     0.87930782

        Fisher exact: 1-tailed P-value: 0.3572077
                      2-tailed P-value: 0.3572077

An expected value is less than 5; recommend Fisher exact results.

                             DIED
SOURCE      |   1          2        | Total
------------+----------------------+------
          C |         20         66 |    86
            >      23.3%      76.7% > 21.6%
            |      16.5%      23.8% |
          N |        101        211 |   312
            >      32.4%      67.6% > 78.4%
            |      83.5%      76.2% |
------------+----------------------+------
      Total |        121        277 |   398
            |      30.4%      69.6% |


                           Single Table Analysis

Odds ratio                                                          0.63
Cornfield 95% confidence limits for OR                0.35 < OR <   1.14
Maximum likelihood estimate of OR (MLE)                             0.63
Exact 95% confidence limits for MLE                   0.34 < OR <   1.13
Exact 95% Mid-P limits for MLE                        0.36 < OR <   1.09
Probability of MLE <=  0.63 if population OR = 1.0            0.06562754

RISK RATIO(RR)(Outcome:DIED=1; Exposure:SOURCE=C)                   0.72
95% confidence limits for RR                          0.47 < RR <   1.09

               Ignore risk ratio if case control study

                        Chi-Squares   P-values
                        -----------   --------

        Uncorrected:         2.65     0.10369625
        Mantel-Haenszel:     2.64     0.10413127
        Yates corrected:     2.23     0.13496447


                             DIED
  NOTHORGC    |   1          2        | Total
--------------+----------------------+------
            0.0 |        111        263 |   374
                >      29.7%      70.3% >100.0%
                |     100.0%     100.0% |
--------------+----------------------+------
        Total |        111        263 |   374
```

```
             |      29.7%      70.3% |


          Chi square =       0.00
     Degrees of freedom =          0
                p value = 1.00000000
```

LOTEMCAT	DIED 1	DIED 2	Total
0	76	175	251
>	30.3%	69.7%	> 63.1%
|	62.8%	63.2%	|
1	25	74	99
>	25.3%	74.7%	> 24.9%
|	20.7%	26.7%	|
2	18	22	40
>	45.0%	55.0%	> 10.1%
|	14.9%	7.9%	|
3+	2	6	8
>	25.0%	75.0%	> 2.0%
|	1.7%	2.2%	|
Total	121	277	398
|	30.4%	69.6%	|

```
          Chi square =       5.38
     Degrees of freedom =          3
                p value = 0.14590955
```

LOTEMDAY	DIED 1	DIED 2	Total
0.0	76	175	251
>	30.3%	69.7%	> 63.1%
|	62.8%	63.2%	|
1.0	25	74	99
>	25.3%	74.7%	> 24.9%
|	20.7%	26.7%	|
2.0	18	22	40
>	45.0%	55.0%	> 10.1%
|	14.9%	7.9%	|
3.0	2	3	5
>	40.0%	60.0%	> 1.3%
|	1.7%	1.1%	|
4.0	0	3	3
>	0.0%	100.0%	> 0.8%
|	0.0%	1.1%	|

Total	121	277	398
	30.4%	69.6%	

DIED	Obs	Total	Mean	Variance	Std Dev
1	121	67	0.554	0.649	0.806
2	277	139	0.502	0.606	0.778
Difference			0.052		

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	0.000	0.000	1.000	3.000	0.000
2	0.000	0.000	0.000	1.000	4.000	0.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	0.227	1	0.227	0.367	0.545200	0.605490
Within	245.150	396	0.619			
Total	245.377	397				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 0.199 deg freedom = 1 p-value = 0.655172

The variances are homogeneous with 95% confidence.
If samples are also normally distributed, ANOVA results can be used.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 0.212
Degrees of freedom = 1
p value = 0.644874

	DIED		
APPROPRIAT	1	2	Total
1.0	37	124	161
	23.0%	77.0%	40.5%
	30.6%	44.8%	
2.0	84	153	237
	35.4%	64.6%	59.5%
	69.4%	55.2%	
Total	121	277	398
	30.4%	69.6%	

Single Table Analysis

Odds ratio		0.54
Cornfield 95% confidence limits for OR	0.33 < OR <	0.88
Maximum likelihood estimate of OR (MLE)		0.54
Exact 95% confidence limits for MLE	0.33 < OR <	0.87
Exact 95% Mid-P limits for MLE	0.34 < OR <	0.85
Probability of MLE <= 0.54 if population OR = 1.0		0.00518935

```
RISK RATIO(RR)(Outcome:DIED=1; Exposure:APPROPRIAT=1.0)                  0.65
95% confidence limits for RR                              0.47 < RR <    0.90

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:          7.04     0.00798736 <---
        Mantel-Haenszel:      7.02     0.00806660 <---
        Yates corrected:      6.46     0.01103494 <---

                             DIED
  SICAT       |   1          2        | Total
--------------+-----------------------+------
           1.0 |          84          69 |   153

               >       54.9%       45.1% > 38.4%
               |       69.4%       24.9% |
           2.0 |          37          208 |   245
               >       15.1%       84.9% > 61.6%
               |       30.6%       75.1% |
--------------+-----------------------+------
       Total |         121         277 |   398
             |      30.4%       69.6% |

                           Single Table Analysis

Odds ratio                                                               6.84
Cornfield 95% confidence limits for OR                    4.14 < OR <   11.36
Maximum likelihood estimate of OR (MLE)                                  6.80
Exact 95% confidence limits for MLE                       4.16 < OR <   11.31
Exact 95% Mid-P limits for MLE                            4.26 < OR <   11.01
Probability of MLE >=  6.80 if population OR = 1.0                0.00000000

RISK RATIO(RR)(Outcome:DIED=1; Exposure:SICAT=1.0)                       3.64
95% confidence limits for RR                              2.61 < RR <    5.06

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:         70.51     0.00000000 <---
        Mantel-Haenszel:     70.33     0.00000000 <---
        Yates corrected:     68.64     0.00000000 <---


                             DIED
OUTCOME     |   1          2        | Total
------------+-----------------------+------
          1 |         102           0 |   102
            >      100.0%        0.0% > 25.6%
            |       84.3%        0.0% |
          2 |          19           0 |    19
            >      100.0%        0.0% >  4.8%
```

```
           |      15.7%       0.0% |
         3 |          0         43 |    43
           >       0.0%     100.0% > 10.8%
           |       0.0%      15.5% |
         4 |          0         19 |    19
           >       0.0%     100.0% >  4.8%
           |       0.0%       6.9% |
         5 |          0        127 |   127
           >       0.0%     100.0% > 31.9%
           |       0.0%      45.8% |
         6 |          0         81 |    81
           >       0.0%     100.0% > 20.4%
           |       0.0%      29.2% |
         7 |          0          7 |     7
           >       0.0%     100.0% >  1.8%
           |       0.0%       2.5% |
-----------+-----------------------+------
     Total |        121        277 |   398
           |      30.4%      69.6% |
```

An expected value is < 5. Chi square not valid.

```
           Chi square =     398.00
     Degrees of freedom =          6
                p value = 0.00000000 <---
```

DIED	Freq	Percent	Cum.
1	121	30.4%	30.4%
2	277	69.6%	100.0%
Total	398	100.0%	

	MRSA		
APPROPRIAT	MRSA	MSSA	Total
1.0	46	115	161
	28.6%	71.4%	40.5%
	23.1%	57.8%	
2.0	153	84	237
	64.6%	35.4%	59.5%
	76.9%	42.2%	
Total	199	199	398
	50.0%	50.0%	

Single Table Analysis

Odds ratio		0.22
Cornfield 95% confidence limits for OR	0.14 < OR <	0.35
Maximum likelihood estimate of OR (MLE)		0.22
Exact 95% confidence limits for MLE	0.14 < OR <	0.35
Exact 95% Mid-P limits for MLE	0.14 < OR <	0.34
Probability of MLE <= 0.22 if population OR = 1.0		0.00000000

```
RISK RATIO(RR)(Outcome:MRSA=MRSA; Exposure:APPROPRIAT=1.0)              0.44
95% confidence limits for RR                              0.34 < RR <   0.58

               Ignore risk ratio if case control study

                          Chi-Squares   P-values
                          -----------   --------

        Uncorrected:         49.66     0.00000000 <---
        Mantel-Haenszel:     49.54     0.00000000 <---
        Yates corrected:     48.23     0.00000000 <---

                              DIED
LOTAPCAT   |   1          2         | Total
-----------+----------------------+------
         0 |          13          23 |    36
           >      36.1%       63.9% >  9.9%
           |      11.5%        9.2% |
         1 |          24          49 |    73
           >      32.9%       67.1% > 20.1%
           |      21.2%       19.5% |
         2 |          38          71 |   109
           >      34.9%       65.1% > 29.9%
           |      33.6%       28.3% |
         3 |          38         108 |   146
           >      26.0%       74.0% > 40.1%
           |      33.6%       43.0% |
-----------+----------------------+------
     Total |         113         251 |   364
           |      31.0%       69.0% |

             Chi square =       3.01
     Degrees of freedom =          3
                p value = 0.39083219


                              DIED
 LOTWKAPP   |   1          2         | Total
------------+----------------------+------
1 week      |          67         102 |   169
            >      39.6%       60.4% > 42.5%
            |      55.4%       36.8% |
2 weeks     |          22          69 |    91
            >      24.2%       75.8% > 22.9%
            |      18.2%       24.9% |
3+ weeks    |          32         106 |   138
            >      23.2%       76.8% > 34.7%
            |      26.4%       38.3% |
------------+----------------------+------
      Total |         121         277 |   398
            |      30.4%       69.6% |

             Chi square =      11.88
     Degrees of freedom =          2
                p value = 0.00262608 <---
```

LOTAPDAY	DIED 1	2	Total
0.0	13	23	36
	36.1%	63.9%	9.9%
	11.7%	9.2%	
1.0	24	49	73
	32.9%	67.1%	20.2%
	21.6%	19.5%	
2.0	38	71	109
	34.9%	65.1%	30.1%
	34.2%	28.3%	
3.0	17	32	49
	34.7%	65.3%	13.5%
	15.3%	12.7%	
4.0	7	24	31
	22.6%	77.4%	8.6%
	6.3%	9.6%	
5.0	1	14	15
	6.7%	93.3%	4.1%
	0.9%	5.6%	
6.0	1	7	8
	12.5%	87.5%	2.2%
	0.9%	2.8%	
7.0	4	5	9
	44.4%	55.6%	2.5%
	3.6%	2.0%	
9.0	1	5	6
	16.7%	83.3%	1.7%
	0.9%	2.0%	
10.0	1	5	6
	16.7%	83.3%	1.7%
	0.9%	2.0%	
12.0	2	7	9
	22.2%	77.8%	2.5%
	1.8%	2.8%	
14.0	0	3	3
	0.0%	100.0%	0.8%
	0.0%	1.2%	
16.0	0	1	1
	0.0%	100.0%	0.3%
	0.0%	0.4%	
17.0	2	0	2
	100.0%	0.0%	0.6%
	1.8%	0.0%	
19.0	0	5	5
	0.0%	100.0%	1.4%
	0.0%	2.0%	
Total	111	251	362
	30.7%	69.3%	

DIED	Obs	Total	Mean	Variance	Std Dev
1	111	295	2.658	8.736	2.956
2	251	862	3.434	13.815	3.717

Difference -0.777

DIED	Minimum	25%ile	Median	75%ile	Maximum	Mode
1	0.000	1.000	2.000	3.000	17.000	2.000
2	0.000	1.000	2.000	4.000	19.000	2.000

ANOVA
(For normally distributed data only)

Variation	SS	df	MS	F statistic	p-value	t-value
Between	46.418	1	46.418	3.785	0.052484	1.945572
Within	4414.656	360	12.263			
Total	4461.075	361				

Bartlett's test for homogeneity of variance
Bartlett's chi square = 7.488 deg freedom = 1 p-value = 0.006213

Bartlett's Test shows the variances in the samples to differ.
Use non-parametric results below rather than ANOVA.

Mann-Whitney or Wilcoxon Two-Sample Test (Kruskal-Wallis test for two groups)

Kruskal-Wallis H (equivalent to Chi square) = 4.014

8.2.5 Died vs. Lived hierarchical logistic regression – SPSS output

Logistic Regression

Notes

Output Created		14-AUG-2012 14:18:54
Comments		
Input	Data	C:\WORK\PhD\match13.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	398
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing

Syntax		LOGISTIC REGRESSION VARIABLES died /METHOD=ENTER AGE2 ccicount DEVICES2 immthe neutro /METHOD=ENTER mrsa BLOODYN SSS2 ND2 SCO2 /METHOD=ENTER appempab lotemday /CONTRAST (immthe)=Indicator /CONTRAST (neutro)=Indicator /CONTRAST (mrsa)=Indicator /CONTRAST (SSS2)=Indicator /CONTRAST (ND2)=Indicator /CONTRAST (SCO2)=Indicator /CONTRAST (appempab)=Indicator /CONTRAST (BLOODYN)=Indicator /CLASSPLOT /CASEWISE OUTLIER(2) /PRINT=GOODFIT CORR ITER(1) CI(95) /CRITERIA=PIN(0.05) POUT(0.10) ITERATE(20) CUT(0.5).
Resources	Processor Time	00:00:00.09
	Elapsed Time	00:00:00.09

[DataSet1] C:\WORK\PhD\match13.sav

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	398	100.0
	Missing Cases	0	.0
	Total	398	100.0
Unselected Cases		0	.0

Total	398	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
1	0
2	1

Block 0: Beginning Block

Iteration History[a,b,c]

Iteration		-2 Log likelihood	Coefficients
			Constant
Step 0	1	489.095	.784
	2	488.929	.828
	3	488.929	.828

a. Constant is included in the model.

b. Initial -2 Log Likelihood: 488.929

c. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

Classification Table[a,b]

Observed			Predicted		
			died		Percentage Correct
			1	2	
Step 0	died	1	0	121	.0
		2	0	277	100.0
	Overall Percentage				69.6

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.828	.109	57.767	1	.000	2.289

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	AGE2	19.093	1	.000
		ccicount	22.633	1	.000
		DEVICES2	5.967	1	.015
		immthe(1)	5.488	1	.019
		neutro(1)	6.454	1	.011
	Overall Statistics		49.435	5	.000

Block 1: Method = Enter

Iteration History[a,b,c,d]

Iteration		-2 Log likelihood	Coefficients					
			Constant	AGE2	ccicount	DEVICES2	immthe(1)	neutro(1)
Step 1	1	440.375	1.725	-.324	-.139	.394	.447	1.101
	2	435.583	2.661	-.476	-.174	.542	.570	1.310
	3	435.489	2.838	-.504	-.178	.564	.589	1.346
	4	435.489	2.842	-.505	-.179	.565	.589	1.347
	5	435.489	2.842	-.505	-.179	.565	.589	1.347

a. Method: Enter

b. Constant is included in the model.

c. Initial -2 Log Likelihood: 488.929

d. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	53.440	5	.000
	Block	53.440	5	.000
	Model	53.440	5	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	435.489[a]	.126	.178

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	6.106	8	.635

Contingency Table for Hosmer and Lemeshow Test

		died = 1		died = 2		Total
		Observed	Expected	Observed	Expected	
Step 1	1	22	25.141	18	14.859	40
	2	20	19.350	20	20.650	40
	3	21	16.219	19	23.781	40
	4	12	14.287	28	25.713	40
	5	14	12.211	26	27.789	40
	6	12	10.381	28	29.619	40
	7	8	8.886	32	31.114	40
	8	6	7.239	35	33.761	41
	9	5	4.782	35	35.218	40
	10	1	2.503	36	34.497	37

Classification Table[a]

	Observed		Predicted		
			died		Percentage Correct
			1	2	
Step 1	died	1	28	93	23.1
		2	25	252	91.0
	Overall Percentage				70.4

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	AGE2	-.505	.119	17.900	1	.000	.604	.478	.763
	ccicount	-.179	.050	12.527	1	.000	.836	.758	.923
	DEVICES2	.565	.264	4.591	1	.032	1.759	1.049	2.949
	immthe(1)	.589	.309	3.634	1	.057	1.802	.984	3.303
	neutro(1)	1.347	.580	5.399	1	.020	3.844	1.234	11.969
	Constant	2.842	1.157	6.034	1	.014	17.152		

a. Variable(s) entered on step 1: AGE2, ccicount, DEVICES2, immthe, neutro.

Correlation Matrix

		Constant	AGE2	ccicount	DEVICES2	immthe(1)	neutro(1)
Step 1	Constant	1.000	-.755	-.221	-.344	-.145	-.413
	AGE2	-.755	1.000	.022	-.058	-.103	-.088
	ccicount	-.221	.022	1.000	.150	.135	-.007
	DEVICES2	-.344	-.058	.150	1.000	.141	.099
	immthe(1)	-.145	-.103	.135	.141	1.000	-.094
	neutro(1)	-.413	-.088	-.007	.099	-.094	1.000

Block 2: Method = Enter

Iteration History[a,b,c,d]

Iteration		-2 Log likelihood	Coefficients									
			Constant	AGE2	ccicount	DEVICES2	immthe(1)	neutro(1)	mrsa(1)	BLOODYN(1)	SSS2(1)	ND2(1)	SCO2(1)
Step 1	1	364.609	.226	-.236	-.089	.111	.356	.201	-.125	.567	1.259	1.100	-.348
	2	351.732	1.092	-.406	-.130	.180	.541	.270	-.195	.990	1.592	1.303	-.572
	3	350.961	1.439	-.467	-.141	.201	.594	.300	-.219	1.165	1.682	1.339	-.645
	4	350.956	1.469	-.472	-.142	.203	.598	.303	-.220	1.184	1.689	1.341	-.651
	5	350.956	1.469	-.472	-.142	.203	.598	.303	-.220	1.184	1.689	1.341	-.651

a. Method: Enter

b. Constant is included in the model.

c. Initial -2 Log Likelihood: 435.489

d. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	84.532	5	.000
	Block	84.532	5	.000
	Model	137.972	10	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	350.956[a]	.293	.414

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	13.800	8	.087

Contingency Table for Hosmer and Lemeshow Test

		died = 1		died = 2		Total
		Observed	Expected	Observed	Expected	
Step 1	1	35	35.728	5	4.272	40
	2	21	26.032	19	13.968	40
	3	19	16.555	21	23.445	40
	4	18	11.909	22	28.091	40
	5	11	9.527	29	30.473	40
	6	10	7.672	30	32.328	40
	7	3	5.727	37	34.273	40
	8	3	3.808	37	36.192	40
	9	0	2.640	40	37.360	40
	10	1	1.401	37	36.599	38

Classification Table[a]

	Observed		Predicted		
			died		Percentage Correct
			1	2	
Step 1	died	1	61	60	50.4
		2	26	251	90.6
	Overall Percentage				78.4

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	AGE2	-.472	.137	11.911	1	.001	.624	.477	.816
	ccicount	-.142	.057	6.218	1	.013	.867	.776	.970
	DEVICES2	.203	.303	.447	1	.504	1.225	.676	2.219
	immthe(1)	.598	.349	2.945	1	.086	1.819	.918	3.602
	neutro(1)	.303	.724	.174	1	.676	1.353	.327	5.598
	mrsa(1)	-.220	.269	.672	1	.413	.802	.474	1.359
	BLOODYN(1)	1.184	.430	7.598	1	.006	3.268	1.408	7.584
	SSS2(1)	1.689	.412	16.815	1	.000	5.414	2.415	12.137
	ND2(1)	1.341	.364	13.536	1	.000	3.822	1.871	7.807
	SCO2(1)	-.651	.641	1.031	1	.310	.522	.149	1.832
	Constant	1.469	1.390	1.116	1	.291	4.344		

a. Variable(s) entered on step 1: mrsa, BLOODYN, SSS2, ND2, SCO2.

Correlation Matrix

		Constant	AGE2	ccicount	DEVICES2	immthe(1)	neutro(1)	mrsa(1)	BLOODYN(1)	SSS2(1)	ND2(1)	SCO2(1)
Step 1	Constant	1.000	-.713	-.211	-.307	-.143	-.399	-.162	.019	-.101	-.168	-.176
	AGE2	-.713	1.000	.025	-.049	-.106	-.105	.040	.000	-.074	.080	.015
	ccicount	-.211	.025	1.000	.160	.125	.011	.018	.034	-.024	-.026	-.150
	DEVICES2	-.307	-.049	.160	1.000	.101	.082	.044	-.108	-.018	-.071	.026
	immthe(1)	-.143	-.106	.125	.101	1.000	-.071	-.021	-.034	.000	.089	.033
	neutro(1)	-.399	-.105	.011	.082	-.071	1.000	.002	-.048	-.071	-.060	.157
	mrsa(1)	-.162	.040	.018	.044	-.021	.002	1.000	-.007	.055	.020	.030
	BLOODYN(1)	.019	.000	.034	-.108	-.034	-.048	-.007	1.000	.072	-.060	-.049
	SSS2(1)	-.101	-.074	-.024	-.018	.000	-.071	.055	.072	1.000	-.293	.150
	ND2(1)	-.168	.080	-.026	-.071	.089	-.060	.020	-.060	-.293	1.000	.127
	SCO2(1)	-.176	.015	-.150	.026	.033	.157	.030	-.049	.150	.127	1.000

Block 3: Method = Enter

Iteration History[a,b,c,d]

Iteration		-2 Log likelihood	Coefficients											
			Constant	AGE2	ccicount	DEVICES2	immthe(1)	neutro(1)	mrsa(1)	BLOODYN(1)	SSS2(1)	ND2(1)	SCO2(1)	appempab(1)	lotemday
Step 1	1	357.489	-.412	-.214	-.083	.117	.387	.213	.050	.620	1.325	1.047	-.368	.507	.011
	2	341.672	.079	-.378	-.124	.194	.616	.252	.117	1.098	1.729	1.251	-.643	.836	.011
	3	340.480	.363	-.445	-.136	.222	.694	.261	.145	1.316	1.852	1.299	-.753	.955	.004
	4	340.468	.397	-.452	-.138	.225	.702	.262	.148	1.344	1.864	1.303	-.765	.967	.003
	5	340.468	.397	-.453	-.138	.225	.702	.262	.148	1.345	1.864	1.303	-.765	.967	.003

a. Method: Enter

b. Constant is included in the model.

c. Initial -2 Log Likelihood: 350.956

d. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	10.488	2	.005
	Block	10.488	2	.005
	Model	148.461	12	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	340.468[a]	.311	.440

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	8.328	8	.402

Contingency Table for Hosmer and Lemeshow Test

		died = 1		died = 2		Total
		Observed	Expected	Observed	Expected	
Step 1	1	35	35.988	5	4.012	40
	2	24	26.409	16	13.591	40
	3	21	17.543	19	22.457	40
	4	13	12.703	27	27.297	40
	5	13	9.562	27	30.438	40
	6	7	6.807	33	33.193	40
	7	6	5.152	34	34.848	40
	8	1	3.606	39	36.394	40
	9	0	2.197	40	37.803	40
	10	1	1.034	37	36.966	38

Classification Table[a]

	Observed		Predicted		
			died		Percentage Correct
			1	2	
Step 1	died	1	60	61	49.6
		2	22	255	92.1
	Overall Percentage				79.1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	AGE2	-.453	.140	10.400	1	.001	.636	.483	.837
	Ccicount	-.138	.058	5.598	1	.018	.871	.777	.977
	DEVICES2	.225	.307	.535	1	.465	1.252	.686	2.286
	immthe(1)	.702	.361	3.780	1	.052	2.017	.994	4.093
	neutro(1)	.262	.736	.127	1	.721	1.300	.307	5.502
	mrsa(1)	.148	.300	.242	1	.623	1.159	.643	2.088
	BLOODYN(1)	1.345	.445	9.151	1	.002	3.838	1.606	9.172
	SSS2(1)	1.864	.427	19.012	1	.000	6.449	2.790	14.907
	ND2(1)	1.303	.371	12.339	1	.000	3.680	1.779	7.614
	SCO2(1)	-.765	.653	1.374	1	.241	.465	.129	1.672
	appempab(1)	.967	.312	9.608	1	.002	2.630	1.427	4.848
	Lotemday	.003	.182	.000	1	.988	1.003	.701	1.434
	Constant	.397	1.476	.073	1	.788	1.488		

a. Variable(s) entered on step 1: appempab, lotemday.

Correlation Matrix

		Constant	AGE2	ccicount	DEVICES2	immthe(1)	neutro(1)	mrsa(1)	BLOODYN(1)	SSS2(1)	ND2(1)	SCO2(1)	appempab(1)	lotemday
Step 1	Constant	1.000	-.701	-.193	-.309	-.160	-.385	-.215	-.002	-.163	-.166	-.179	-.200	-.091
	AGE2	-.701	1.000	.013	-.042	-.109	-.097	.036	.000	-.054	.075	.028	.007	.026
	ccicount	-.193	.013	1.000	.160	.134	.008	.022	.020	-.015	-.036	-.149	.011	-.058
	DEVICES2	-.309	-.042	.160	1.000	.096	.089	.049	-.091	-.007	-.070	.025	.028	.008
	immthe(1)	-.160	-.109	.134	.096	1.000	-.078	.037	-.026	.041	.081	.020	.123	-.038
	neutro(1)	-.385	-.097	.008	.089	-.078	1.000	-.021	-.064	-.073	-.051	.169	-.027	.039
	mrsa(1)	-.215	.036	.022	.049	.037	-.021	1.000	.036	.126	.016	-.014	.411	-.143
	BLOODYN(1)	-.002	.000	.020	-.091	-.026	-.064	.036	1.000	.084	-.063	-.069	.120	.052
	SSS2(1)	-.163	-.054	-.015	-.007	.041	-.073	.126	.084	1.000	-.274	.164	.161	.089
	ND2(1)	-.166	.075	-.036	-.070	.081	-.051	.016	-.063	-.274	1.000	.124	-.002	.048
	SCO2(1)	-.179	.028	-.149	.025	.020	.169	-.014	-.069	.164	.124	1.000	-.087	.120
	appempab(1)	-.200	.007	.011	.028	.123	-.027	.411	.120	.161	-.002	-.087	1.000	-.217
	lotemday	-.091	.026	-.058	.008	-.038	.039	-.143	.052	.089	.048	.120	-.217	1.000