Antibiotic Resistance in Non—Major Metropolitan Skilled Nursing Facilities: Prevalence and Interfacility Variation

Author(s): Christopher J. Crnich, MD, MS; Megan Duster, MT(ASCP); Timothy Hess, PhD; David R. Zimmerman, PhD; Paul Drinka, MD

Source: *Infection Control and Hospital Epidemiology*, Vol. 33, No. 11 (November 2012), pp. 1172-1174

Published by: The University of Chicago Press on behalf of The Society for Healthcare Epidemiology of America

Stable URL: http://www.jstor.org/stable/10.1086/668018

Accessed: 31/10/2013 13:46

Antibiotic Resistance in Non–Major Metropolitan Skilled Nursing Facilities: Prevalence and Interfacility Variation

Skilled nursing facilities (SNFs) represent ideal environments for the emergence and spread of antibiotic resistance.[1] Studies have found that residents of Veterans Affairs (VA) SNFs[2,3] and non-VA SNFs in major metropolitan areas[4,5] are frequently colonized with antibiotic-resistant bacteria (ARB). The extent to which residents of nonurban SNFs are colonized with ARB remains poorly understood. Intrinsic differences in patient populations, referral patterns, and other contextual factors may fuel very different patterns of antibiotic resistance in nonurban SNFs. Our group recently completed a longitudinal study to document patterns of antibiotic resistance in several SNFs located in nonurban counties of south-central Wisconsin. Here, we present the colonization results of surveillance cultures performed at the inception of the study cohort in 2008–2009.

The University of Wisconsin's Institutional Review Board approved this study. A potential pool of 39 SNFs (size, 60 or more beds) located in 9 south-central Wisconsin counties was constituted from a directory of licensed facilities maintained by the state of Wisconsin. A randomly assigned number was used to determine the order in which facilities were approached by the research team. Six of the first 10 facilities approached agreed to participate. Variables describing the characteristics of the facility and the resident population were constructed from annual data collected during the state survey process as well as data collected from medical records of subjects at study entry.

Residents of participating SNFs over the age of 18 years, including those with cognitive impairment, were eligible to participate. After written informed consent was obtained, multianatomical screening for colonization with methicillin-resistant *Staphylococcus aureus* (MRSA) and fluoroquinolone-resistant gram-negative bacteria (FQRGNB) was performed. Cultures of nares, skin of the axilla and groin, and perianal skin (or stool) were obtained from all subjects to detect MRSA colonization. Additional cultures of wounds, the insertion site of nonurinary indwelling medical devices, and urine collected from indwelling urinary devices were obtained, when applicable. The same body sites, exclusive of nares and axilla/groin, were sampled to detect FQRGNB colonization. MRSA specimens were enriched in trypticase soy broth supplemented with 6.5% NaCl for 24 hours before being plated onto selective medium—mannitol salt agar (Remel) containing 4 μg/mL cefoxitin. FQRGNB specimens were plated directly onto MacConkey agar (Remel) containing 4 μg/mL ciprofloxacin. All plates were incubated aerobically for 48 hours at 37°C and were identified to the species level using standard techniques. Cefoxitin and ciprofloxacin resistance was confirmed using the Kirby-Bauer disk diffusion method.

Point estimates and 95% confidence intervals (CIs) of the proportion of residents colonized with MRSA and FQRGNB were calculated. Pearson χ^2 tests were performed to identify whether a significant difference in the proportion of subjects colonized with MRSA and FQRGNB across study locations was present. When applicable, visual inspection of confidence limits was performed to identify facility pairs accounting for those differences.

The characteristics of the participating facilities, including characteristics of participating subjects in aggregate, are presented in Table 1. Of the 851 residents in the 6 participating SNFs, 449 (53%) were screened at baseline. An equal proportion of subjects were colonized with MRSA (22.3% [95% CI, 13.7%–30.9%]) and FQRGNB (21.3% [95% CI, 13.3%–29.3%]). Approximately 5% of participating subjects were cocolonized with MRSA and FQRGNB (95% CI, 2.8%–7.1%). Overall, 38.7% (95% CI, 32.9%–44.5%) of subjects screened were colonized with MRSA and/or FQRGNB.

Significant variation in the proportion of subjects colonized with MRSA (Pearson $\chi^2 = 14.6$, $P = .012$) and FQRGNB (Pearson $\chi^2 = 13.2$, $P = .022$) was identified across the 6 facilities. A significant difference in the prevalence of MRSA was identified between facility 3 (13.0%) and facility 4 (33.7%), and a significant difference in the prevalence of FQRGNB was identified between facility 2 (29.1%) and facility 6 (11.3%). The characteristics of facilities with the highest prevalence of MRSA or FQRGNB were not qualitatively different from those of facilities with a lower prevalence of MRSA or FQRGNB (Table 1).

The generalizability of our findings may be limited by the method in which study facilities were selected. Our study facilities, while representative of nonurban SNFs that cater to long-term-stay residents requiring nursing services of low complexity, may not be representative of urban SNFs that provide a more complex level of nursing care.[6] Nevertheless, the prevalence of MRSA in facilities in our study is not substantively different from that recently described for SNFs in a highly urbanized county in California.[7] Comparable data on the prevalence of FQRGNB in other SNFs are not available. However, recently published studies describing sharp increases in the proportion of clinical isolates obtained from residents of Northeastern SNFs that were resistant to fluoroquinolone antibiotics[8] as well as a high prevalence of FQRGNB colonization among SNF residents with an indwelling medical device in place[9] support the generalizability of our findings. In combination, these data suggest that a postfluoroquinolone era has begun to emerge in US SNFs.

Few studies have attempted to measure the variation in antibiotic resistance across SNFs within the same geographic region.[7,10] The 2-fold variation in FQRGNB prevalence and 3-fold variation in MRSA prevalence seen among SNFs in our study raise questions that require further study. Specifically, is variation being driven by differences in referral patterns, intrafacility antibiotic prescribing, intrafacility adherence to transmission-based precautions, or some combi-

TABLE 1. Facility Characteristics and Prevalence of Antibiotic-Resistant Bacteria for 6 Skilled Nursing Facilities in South-Central Wisconsin

	Skilled nursing facility					
Variable	1	2	3	4	5	6
Facility characteristics						
No. of beds	130	120	97	123	97	83
County urbanization[a]	Small metropolitan	Nonmetropolitan	Small metropolitan	Nonmetropolitan	Nonmetropolitan	Nonmetropolitan
Demographics	Freestanding, nonprofit	Freestanding, nonprofit	Freestanding, nonprofit	Hospital based, nonprofit	Freestanding, nonprofit	Freestanding, nonprofit
Medicare per diem,[b] %	3.7	19.0	19.6	7.4	11.5	10.3
Dementia unit	Yes	No	No	No	No	No
Rehabilitation unit	No	No	No	No	No	No
Resident characteristics[c]						
LOS, months	61.4	25.9	28.5	28.5	25.8	19.6
Hospitalization in prior 3 months, %	11.1	43.7	51.9	26.5	30.2	37.1
Antibiotic use in prior 3 months, %	37.0	42.7	37.7	39.8	53.5	59.7
Indwelling medical device,[d] %	9.9	17.5	6.5	12.1	11.6	17.7
Wound or ostomy, %	3.7	14.6	7.8	14.5	9.3	4.8
Colonization data						
MRSA prevalence, %	16.0	18.5	13.0	33.7	30.2	22.6
FQRGNB prevalence, %	24.7	29.1	28.6	13.3	20.9	11.3
Cocolonization prevalence, %	4.9	6.8	1.3	4.8	7.0	.5
Either MRSA or FQRGNB, %	35.8	40.8	40.3	42.2	44.2	29.0

NOTE. FQRGNB, fluoroquinolone-resistant gram-negative bacilli; LOS, length of stay; MRSA, methicillin-resistant *Staphylococcus aureus*.

[a] Level determined using US Department of Agriculture urban influence codes.

[b] Derived from cross-sectional census data collected during the facility's 2008 annual state survey.

[c] Aggregate baseline characteristics of subjects enrolled in the study.

[d] Counted as present when any of the following were present: (1) indwelling urinary catheter (either Foley or suprapubic), (2) percutaneous feeding tube, or (3) tracheostomy.

nation thereof? Pursuing the answers to these questions will be important for developing and implementing interventions to reduce the regional spread of antibiotic resistance.

In summary, our study affirms the notion that residents of SNFs are commonly colonized with MRSA and FQRGNB, even in nonurban facilities that provide a relatively low complexity of nursing care. Considerable variation in the prevalence of MRSA and FQRGNB in SNFs in the same geographic region exists. The explanations for this degree of interfacility variation remain poorly understood and deserve further study.

ACKNOWLEDGMENTS

Financial support. This work was supported by grant 1UL1RR025011 from the Clinical and Translational Science Award program of the National Center for Research Resources, National Institutes of Health. Additional support for this study was provided by a Wisconsin Partnership Program Education and Research Committee New Investigator Program Grant, as well as an Association of Speciality Professors/Infectious Diseases Society of America T. Franklin Williams Research Scholarship.

Potential conflicts of interest. All authors report no conflicts of interest relevant to this article. All authors submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and the conflicts that the editors consider relevant to this article are disclosed here.

Christopher J. Crnich, MD, MS;[1,2] **Megan Duster, MT(ASCP);**[1] **Timothy Hess, PhD;**[1] **David R. Zimmerman, PhD;**[3,4] **Paul Drinka, MD**[1,5]

Affiliations: 1. School of Medicine and Public Health, University of Wisconsin, Madison, Wisconsin; 2. William S. Middleton Veterans Affairs Hospital, Madison, Wisconsin; 3. School of Engineering, University of Wisconsin, Madison, Wisconsin; 4. Center for Health Systems Research and Analysis, University of Wisconsin, Madison, Wisconsin; 5. Medical College of Wisconsin, Milwaukee, Wisconsin.

Address correspondence to Christopher J. Crnich, MD, MS, 1685 Highland Avenue, MFCB 5217, Madison, WI 53705 (cjc@medicine.wisc.edu).

Received February 16, 2012; accepted June 7, 2012; electronically published September 21, 2012.

Infect Control Hosp Epidemiol 2012;33(11):1172-1174

 0899-823X/2012/3311-0020$15.00. DOI: 10.1086/668018

REFERENCES

1. Bonomo R. Multiple antibiotic-resistant bacteria in long-term-care facilities: an emerging problem in the practice of infectious diseases. *Clin Infect Dis* 2000;31(6):1414–1422.
2. Stone ND, Lewis DR, Johnson TM, et al. Methicillin-resistant *Staphylococcus aureus* (MRSA) nasal carriage in residents of Veterans Affairs long-term care facilities: role of antimicrobial exposure and MRSA acquisition. *Infect Control Hosp Epidemiol* 2012;33(6):551–557.

3. Shurland SM, Stine OC, Venezia RA, et al. Colonization sites of USA300 methicillin-resistant *Staphylococcus aureus* in residents of extended care facilities. *Infect Control Hosp Epidemiol* 2009;30(4):313–318.
4. Trick W, Weinstein R, Demarais P, et al. Colonization of skilled-care facility residents with antimicrobial-resistant pathogens. *J Am Geriatr Soc* 2001;49(3):270–276.
5. Pop-Vicas A, Mitchell SL, Kandel R, Schreiber R, D'Agata EMC. Multidrug-resistant gram-negative bacteria in a long-term care facility: prevalence and risk factors. *J Am Geriatr Soc* 2008;56(7): 1276–1280.
6. Furuno JP, Shurland SM, Zhan M, et al. Comparison of the methicillin-resistant *Staphylococcus aureus* acquisition among rehabilitation and nursing home residents. *Infect Control Hosp Epidemiol* 2011;32(3):244–249.
7. Reynolds C, Quan V, Kim D, et al. Methicillin-resistant *Staphylococcus aureus* (MRSA) carriage in 10 nursing homes in Orange County, California. *Infect Control Hosp Epidemiol* 2011;32(1): 91–93.
8. Viray M, Linkin D, Maslow J, et al. Longitudinal trends in antimicrobial susceptibilities across long-term-care facilities: emergence of fluoroquinolone resistance. *Infect Control Hosp Epidemiol* 2005;26(1):56–62.
9. Dommeti P, Wang L, Flannery EL, Symons K, Mody L. Patterns of ciprofloxacin-resistant gram-negative bacteria colonization in nursing home residents. *Infect Control Hosp Epidemiol* 2011; 32(2):177–180.
10. Lautenbach E, Marsicano R, Tolomeo P, Heard M, Serrano S, Stieritz DD. Epidemiology of antimicrobial resistance among gram-negative organisms recovered from patients in a multistate network of long-term care facilities. *Infect Control Hosp Epidemiol* 2009;30(8):790–793.

What Is the Optimal Period for Measuring Hand Hygiene Compliance: Are Longer Periods Better than 20-Minute Periods?

Direct observation of hand hygiene is considered the gold standard for measuring healthcare worker (HCW) hand hygiene compliance (HHC) for clinical audit and hand hygiene intervention trials. Many studies and audits observe for 20–30 minutes, but systematic review shows that others observe for 1–4 hours or more, without explaining the rationale for this longer observation period.[1] World Health Organization (WHO) guidance recommends observation for 20 minutes (with an additional 10 minutes of observation if necessary).[2] HCW hand hygiene may improve when HCWs are aware of being observed,[3] but it is unclear whether this reactivity increases or decreases over time or introduces systematic bias. Short periods of observation may not reflect 24-hour, 7-days-per-week behavior.[3] In addition, short observation periods may not provide enough observations to meet previously identified criteria for interobserver reliability, because compliance levels differ between observers by over 10% if less than 15 hand hygiene moments are observed.[4]

To our knowledge, no study has investigated whether there are significant differences between compliance recorded over 20 minutes, 1 hour, or longer. This study aimed to investigate whether compliance in the first 20 minutes or the first hour differed substantially from that observed over 4 hours. Findings informed the choice of the optimal observation period for a randomized controlled trial of a hand hygiene intervention (the Feedback Intervention Trial [FIT]; ISRCTN65246961).[5]

Observations were performed using a validated tool[4] by 1 of 3 observers, who were trained as described elsewhere.[6] Fifty-three 4-hour covert observation sessions (from 1000 to 1200 hours and from 1300 to 1500 hours) were performed from October 2006 through January 2007 on 13 intensive therapy units (ITUs) and 36 wards providing acute care to elderly patients (ACEs) at 13 hospitals across England and Wales during the FIT baseline phase. Data were collected in 20-minute segments. Ethical permission was obtained (05/MREC10/2).

Hour-to-hour variation in compliance was examined by use of a mixed-effects logistic regression model with a binary outcome of HHC, including hospital and ward within hospital as random effects. Ward type (ITU or ACE) and sequential hourly observation period (first hour, second hour, third hour, and fourth hour) were included as fixed effects. A similar analysis examined variation in compliance over sequential 20-minute periods. Ward type was excluded after showing no evidence of effect on trend or compliance.

A total of 3,989 hand hygiene moments and associated behaviors were observed. Overall compliance was 75%.

For sequential hour periods (Table 1), compliance was lowest in the first hour (71%), and the estimated odds ratios (ORs) for compliance increased significantly (OR [95% confidence interval {CI}], 1.32 [1.08–1.61]; $P = .007$) in the second hour and remained stable thereafter.

For sequential 20-minute periods (Table 1), compliance was lowest (69%) in the first 20 minutes, with the estimated ORs increasing significantly in the second 20-minute period (OR [95% CI], 1.42 [1.02–1.96]; $P = .04$), although not in the third 20-minute period. ORs then increased and remained stable from the fourth period onwards, although there was fluctuation between the last three 20-minute segments.

Compliance was slightly but significantly lower in the first hour of a 4-hour observation period. The odds of compliance increased significantly in the second hour and remained stable thereafter. This was reflected in the measurement of compliance in 20-minute sequences, where compliance was lowest in the first 20 minutes.

No earlier study has broken observation periods down into such discrete sequences. Study strengths include size, geographical spread, variety of patient groups, and use of a standardized tool. Results are probably representative of English and Welsh practice and generalizable to acute care hospitals. Limitations of our study include the use of a convenience sample of wards and difficulties ensuring that observation was entirely covert.