Original Article

Prospective Audit of Post-chemotherapy Febrile Neutropenia in Patients with Solid Cancer and Lymphoma in Two Singaporean Cancer Centres

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Abstract

Introduction: Febrile neutropenia (FN) is a significant cause of mortality and morbidity in oncology and haematology units worldwide. The overall mortality in hospital surveys in Singapore surveys on post-chemotherapy FN has ranged between 3.0% and 8.8%. However, recent evidence indicates that outpatient management of patients with low-risk FN is safe and cost-effective. Materials and Methods: We conducted a prospective audit on a cohort of adult patients with post-chemotherapy FN seen at 2 local public sector cancer centres over a 1-year period in order to define their epidemiological characteristics and outcomes, and also to assess the uptake of early discharge/outpatient management strategies for these patients. Results: We reviewed 306 FN episodes from 248 patients. Patient characteristics and outcomes were similar between both institutions. Eleven (3.7%) FN episodes were managed as outpatient and none developed complications. Overall 30-day mortality was 6.6%, while the median length of stay (LOS) was 7 days (IQR: 4 to 11 days). The only independent risk factor for mortality was severe sepsis (OR:13.19; 95% CI: 1.98 to 87.7; *P* = 0.008). Factors independently associated with a longer LOS were vancomycin prescription (coefficient: 0.25; 95% CI: 0.08 to 0.41; *P* = 0.003), longer duration of intravenous antibiotics (coefficient: 0.08; 95% CI: 0.06 to 0.10; *P* <0.001), and prior review by an infectious diseases physician (coefficient: 0.16; 95% CI: 0.01 to 0.31; *P* = 0.034). Conclusion: This audit demonstrated that mortality from FN in our 2 cancer centres is low and comparable to international institutions. It also demonstrates that outpatient management of FN is safe in selected patients, and can be further expanded for right-siting of resources.

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Key words: Carbapenems , MASCC score, Outpatient management, Vancomycin

Introduction

Despite advances in medical care, febrile neutropenia (FN) remains a significant cause of mortality and morbidity in oncology and haematology units worldwide. In local surveys spanning from 1990 to 2009, the overall mortality associated with post-chemotherapy FN remained unchanged, ranging between 3.0% and 8.8%,[1-3] similar to results from European and American studies.[4,5]

However, it is now known that only a relatively small proportion of patients with post-chemotherapy FN are at high-risk of life-threatening complications.[6] One recent avenue of research has focused on the accurate identification of patients who are at low risk for FN-associated complications, thus permitting less resource-intensive and more convenient (especially for the patients) care that is equally safe compared to the traditional management strategy of hospitalisation and intravenous antibiotics.[6] Outpatient management of low-risk FN with oral antibiotics has seen increasing acceptance by the oncology community, with the most commonly used tool for risk-stratification being the Multinational Association for Supportive Care in Cancer risk-index score (MASCC score).[7]

We conducted a prospective audit on a cohort of adult patients with post-chemotherapy FN at 2 public sector cancer centres in Singapore in order to define their epidemiological characteristics and outcomes, and also to assess the uptake

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of early discharge/outpatient management strategies for these patients.

Materials and Methods

Audit Population

All adult patients with solid cancers or lymphoma and post-chemotherapy FN reviewed and/or hospitalised at the National Cancer Centre Singapore (NCCS) and National University Cancer Institute, Singapore (NCIS) between 1 December 2009 and 30 November 2010 were prospectively evaluated. The unit of audit was an episode of FN, defined as a single episode of fever ≥38.3°C (oral/tympanic) or fever ≥38.0°C for at least one hour and an absolute neutrophil count (ANC) of <1.0 x 10^9/L with a predicted decrease to <0.5 x 10^9/L. Each patient may have more than one FN episode within a single hospitalisation. If the above criteria were met again after at least 7 intervening days where the patient had been afebrile, it was counted as a new episode of FN.

Data Collection

Patient characteristics during each FN period—including demographics, clinical data and outcomes—were collected from inpatient and outpatient treatment and laboratory records. The MASCC score, which was computed by trained research assistants, was used to stratify each FN episode as being high- or low-risk for complications,[7] while a separate assessment was carried out to determine if criteria for severe sepsis/septic shock were met.[8] Other covariates included age, gender, ethnicity, subsidised care (B2 or C-class), cancer type, chemotherapy intent (curative, adjuvant, neo-adjuvant or palliative), autologous haematopoietic stem cell transplantation (HSCT), antimicrobial prophylaxis (fluoroquinolones and/or azoles), absolute neutrophil counts (ANC) at FN presentation and nadir, bacterial cultures, presence of probable or definite invasive fungal disease (IFD),[9] type and duration of antibiotic therapy, upgrade of antibiotics (defined as switch to a more broad-spectrum antibacterial agent and/or addition of another antibacterial agent), antifungal therapy, therapeutic granulocyte colony stimulating factor (G-CSF) prescription, duration of fever, and review by infectious diseases physicians (ID review). The primary audit outcome was 30-day mortality, while the secondary outcome was length of hospitalisation post-development of FN in survivors (LOS).

Protocol

The management protocol for adult FN at NCIS was recently published,[3] while physicians at NCCS generally followed the guidelines published by the Infectious Diseases Society of America (IDSA) in 2002.[10]

The management of cancer and its assorted complications in NCCS is stratified according to major cancer oncology groups, whereas haematologists manage the majority of lymphoma cases at NCIS.

Statistics

Intercooled Stata 11.1 (StataCorp, Texas, USA) was used for all statistical calculations. As there was serial autocorrelation due to the repeated measurements of both outcome and covariates for subjects with repeated FN episodes, generalised estimating equation (GEE) models were used to analyse the association between each outcome and variable.[11] For mortality—a binary outcome variable—we specified a binomial distribution along with a logit link function. LOS—a continuous variable—was first transformed on the natural logarithmic scale due to non-normality in the residuals of the errors prior to assignment to a Gaussian family along with an identity link. All covariates were then included in multivariate models to identify independent factors associated with each outcome (P <0.05).

Funding

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Results

During the 1-year audit period, there were 301 FN episodes occurring in 248 patients (170 from NCCS), with 2 patients having 5 FN episodes (1 from NCCS). Both were patients with lymphoma (Burkitt's and tonsillar diffuse large B-cell lymphoma) who underwent repeated cycles of chemotherapy. The demographic and clinical characteristics of the FN episodes segregated according to institution are shown in Table 1. Only 11 (3.7%) FN episodes from both institutions were managed as outpatient; none developed complications or had unexpected readmissions. Overall 30-day mortality was 6.6% (20 deaths), while the median LOS for those managed as inpatients was 7 days, with an interquartile range (IQR) of 4 to 11 days.

Patients at both institutions were similar in terms of age, ethnicity, underlying malignancy, chemotherapy intent and severity of FN. There were more male patients with FN at NCIS, and more lymphoma patients at NCIS who had received high dose chemotherapy and HSCT. The management of FN showed several inter-institutional differences: therapeutic G-CSF was prescribed more

Table 1. Demographic and Clinical Characteristics of Audited Solid Cancer or Lymphoma Patients with Febrile Neutropenia Managed at the National Cancer Centre Singapore (NCCS) and the National University Cancer Institute, Singapore (NCIS)

Characteristic	NCCS (n = 196)	NCIS (n = 105)	Combined (n = 301)
Median age, years (IQR[a])	53 (44 to 62)	56 (45 to 64)	54 (44 to 62)
Male gender (%)*	91 (46.4)	63 (60.0)	154 (51.2)
Ethnicity (%)			
- Chinese	142 (72.5)	65 (61.9)	207 (68.8)
- Malay	22 (11.2)	22 (21.0)	44 (14.6)
- Indian	13 (6.6)	11 (10.5)	24 (8.0)
- Others	19 (9.7)	7 (6.7)	26 (8.6)
Subsidised hospital class (%)	151 (78.7)	75 (71.4)	226 (75.1)
Underlying malignancy (%)			
- Breast	48 (25.0)	20 (19.1)	68 (22.6)
- Gastrointestinal tract[†]	13 (6.6)	8 (7.6)	21 (7.0)
- Head & neck[‡]	8 (4.1)	3 (2.9)	11 (3.7)
- Lung	12 (6.1)	6 (5.7)	18 (6.0)
- Germ cell & sarcoma	11 (5.6)	8 (7.6)	19 (6.3)
- Lymphoma	87 (44.4)	60 (57.1)	147 (47.8)
- Gynaecological[§]	7 (3.6)	0 (0)	7 (2.3)
- Genitourinary[‖]	8 (4.1)	0 (0)	8 (2.7)
- Others[¶]	2 (1.0)	0 (0)	2 (0.7)
Chemotherapy intent (%)			
- Curative	93 (47.5)	55 (52.4)	148 (49.2)
- Adjuvant	35 (17.9)	12 (11.4)	47 (15.6)
- Neoadjuvant	7 (3.6)	4 (3.8)	11 (3.7)
- Palliative	61 (31.1)	34 (32.4)	95 (31.6)
Autologous stem cell transplant (%)*	3 (1.5)	11 (10.5)	14 (4.7)
Fluoroquinolone prophyl axis (%)	34 (17.4)	19 (18.1)	53 (17.6)
Azole prophylaxis (%)*	27 (13.8)	30 (28.6)	57 (18.9)
High-risk febrile neutropenia[#] (%)	36 (18.4)	18 (17.1)	54 (17.9)
Severe sepsis (%)	24 (12.2)	8 (7.6)	32 (10.6)
Median ANC[a]			
- At presentation (IQR[a])	0.16 (0.06 – 0.50)	0.23 (0.11 – 0.35)	0.21 (0.08 – 0.36)
- Nadir (IQR[a])	0.12 (0.03 – 0.29)	0.13 (0.06 – 0.26)	0.12 (0.05 – 0.26)
Therapeutic G-CSF[a] prescription (%)*	157 (80.1)	54 (51.4)	211 (70.1)

Table 1. (Con't) Demographic and Clinical Characteristics of Audited Solid Cancer or Lymphoma Patients with Febrile Neutropenia Managed at the National Cancer Centre Singapore (NCCS) and the National University Cancer Institute, Singapore (NCIS)

Characteristic	NCCS (n = 196)	NCIS (n = 105)	Combined (n = 301)
Bacterial cultures (%)			
- Positive initial blood culture*	20 (10.2)	25 (23.8)	45 (15.0)
- Gram-negative bacteremia	8 (4.1)	11 (10.5)	19 (6.3)
- Positive initial cultures*	40 (20.4)	35 (33.3)	75 (24.9)
- Positive subsequent cultures**	11 (5.6)	7 (6.7)	18 (6.0)
Fungal infection (%)			
- Invasive fungal infection	10 (5.1)	2 (1.9)	12 (4.0)
- Receipt of antifungal therapy*	29 (14.8)	7 (6.7)	36 (12.0)
Time to ANC[a] recovery, days (IQR[a])*	3 (2 – 4)	5 (3 – 8)	3 (2 – 6)
Time to fever resolution, days (IQR[a])	3 (2-5)	3 (1-5)	3 (1 – 5)
Infectious diseases physician review (%)*	51 (26.0)	60 (57.1)	111 (36.9)
Antibiotic therapy (%)			
- Carbapenem usage	72 (36.7)	48 (45.7)	120 (39.9)
- Duration of carbapenems, days (IQR[a])	6 (4 to 9)	5 (3 to 8)	6 (3 to 8)
- Vancomycin usage*	85 (43.4)	29 (27.6)	114 (37.9)
- Duration of vancomycin, days (IQR[a])*	4 (3 to 7)	2 (2 to 5)	4 (2 to 7)
- Antibiotic upgrade	88 (44.9)	43 (41.0)	131 (43.5)
- Median IV antibiotic duration, days (IQR[a])*	5 (4 to 8)	4 (3 to 8)	5 (3 to 8)
- Median antibiotic duration, days (IQR[a])*	10 (7 to 12)	9 (7 to 10)	9 (7 to 12)

[a]IQR = interquartile range; ANC = absolute neutrophil count; G-CSF = granulocyte colony-stimulating factor

*Significant difference ($P < 0.05$) between NCCS and NCIS

[†]Comprising oesophageal, stomach, colorectal and hepatocellular carcinomas.

[‡]Includes nasopharyngeal cancer.

[§]Comprises cervical, endometrial and ovarian cancers.

[‖]Comprises bladder, ureteric, renal cell and prostate carcinomas.

[¶]One case of primary peritoneal cancer and adenocarcinoma of unknown origin each.

[#]Defined as MASCC score <21.

**Eight (44.4%) were positive blood cultures.

frequently at NCCS (with a correspondingly shorter time to ANC recovery) along with a longer duration of antibiotics, particularly vancomycin. More patients at NCIS had been reviewed by infectious diseases (ID) physicians.

The micro-organisms identified on initial blood cultures performed on FN presentation are listed in Table 2. There

Table 2. Breakdown of Microorganisms Isolated from Initial Blood Cultures in Adult FN Patients, by Institution

Initial blood cultures	NCCS (n = 196)†	NCIS (n = 105)‡	Combined (n = 301)
Gram-negative (%)			
- ESBL*-positive *E. coli*	1 (0.5)	1 (1.0)	2 (0.7)
- ESBL*-negative *E. coli*	4 (2.0)	2 (1.9)	6 (2.0)
- ESBL*-positive *Klebsiella* spp.	1 (0.5)	2 (1.9)	3 (1.0)
- ESBL*-negative *Klebsiella* spp.	3 (1.5)	1 (1.0)	4 (1.3)
- *Enterobacter cloacae*	0 (0)	1 (1.0)	1 (0.3)
- Carbapenem-resistant *Pseudomonas aeruginosa*	0 (0)	0 (0)	0 (0)
- Carbapenem-susceptible *P. aeruginosa*	5 (2.6)	4 (3.8)	9 (3.0)
Gram-positive (%)			
- Methicillin-susceptible *Staphylococcus aureus*	0	1 (1.0)	1 (0.3)
- Methicillin-resistant *S. aureus* (MRSA)	1 (0.5)	1 (1.0)	2 (0.7)
- *Streptococcus pneumoniae*	0	1 (1.0)	1 (0.3)
- Streptococcus spp.	2 (1.0)	1 (1.0)	3 (1.0)
Skin bacteria (%)			
- Coagulase-negative staphylococci	4 (2.0)	3 (2.9)	7 (2.3)
- *Bacillus* spp.	2 (1.0)	7 (6.7)	9 (3.0)
- *Corynebacterium* spp.	1 (0.5)	0 (0.0)	1 (0.3)
Anaerobes (%)			
- *Fusobacterium nucleatum*	1 (0.5)	0 (0.0)	1 (0.3)
Fungi (%)			
- *Candida tropicalis*	1 (0.5)	1 (1.0)	2 (0.7)
- *C. albicans*	1 (0.5)	0 (0.0)	1 (0.3)

*ESBL = extended-spectrum beta-lactamase

†1 patient with both CoNS and *Corynebacterium* spp. cultured from blood; 1 patient with both *P. aeruginosa* and *K. pneumoniae* cultured from blood; 2 patients with both ESBL-negative *E. coli* and *K. pneumoniae* cultured from blood; 1 patient with both *P. aeruginosa* and *E. coli* cultured from blood; 1 patient with coagulase-negative staphylococci and *C. albicans* cultured from blood.

‡1 patient with both methicillin-susceptible *S. aureus* and *S. pneumoniae* cultured from blood.

were marginally more cases of Gram-positive bacteraemia (22 of 45 FN episodes with positive blood cultures, 48.9%) compared to Gram-negative bacteraemia (46.7%), but the majority (72.7%) of the former comprised low virulence skin-colonising bacteria. The majority (71.4%) of Gram-negative bacteria were sensitive to first-line non-carbapenem antibiotics recommended for FN.[3,10] Three lymphoma patients with recurrent FN and previous broad-spectrum antibiotic prescription who were not on azole prophylaxis developed candidaemia.

Micro-organisms cultured from subsequent blood cultures during the same episode of FN were far more antibiotic-resistant, including extended spectrum beta-lactamase (ESBL)-positive Enterobacteriaceae (2 cases, 25.0%), carbapenem resistant *Acinetobacter baumannii* (12.5%) and *Pseudomonas aeruginosa* (12.5%), and a case of candidemia (12.5%).

The results of univariate analysis for association of subject characteristics with outcomes are shown in Table 3. The large number of cancer groups with small frequencies in several groups precluded its use as a variable for analysis. However, lymphoma (presence/absence of) was used separately as a variable owing to the potential differences in risk and outcomes between this and other solid cancers with regards to FN. Fever duration, ANC recovery time and duration of antibiotic therapy were not analysed with regards to 30-day mortality due to potential intrinsic bias in these results (patients may die before ANC recovery or resolution of fever, as an example).

The results of multivariate analysis are shown in Table 4. Severe sepsis was the only risk factor independently associated with 30-day mortality. All patients assessed as having severe sepsis also had high-risk FN by MASCC score, and removing severe sepsis from the multivariate model resulted in high-risk FN emerging as an independent variable for mortality (OR: 4.67; 95% CI: 1.68 to 13.00; $P = 0.003$). The variables independently associated with LOS were vancomycin prescription, longer duration of IV antibiotics and prior ID review.

Discussion

This is the first cross-institutional audit on FN in Singapore. NCCS manages a far larger patient population than NCIS, hence it is not surprising that there were almost twice as many FN episodes occurring at NCCS within the same time period. However, it is important to note that there were intrinsically few differences between the patients with FN seen at both centres in terms of demographics, cancer type and therapy, and severity of FN, although the practical management of the condition differed with regards to usage of intravenous antibiotics and therapeutic G-CSF. Overall mortality did not vary from previous results,[1-3] and despite the differences in clinical management, treatment for FN at either centre did not result in significant differences in the outcomes measured.

The results of the multivariate analysis on variables associated with outcomes were largely unsurprising. Severe sepsis/septic shock is associated with high mortality rates in general.[8] A longer duration of IV antibiotics is a reason for longer LOS, given that neutropenic patients are excluded from outpatient antibiotic therapy at both institutes.

Table 3. Generalised Estimating Equation Univariate Analysis of the Impact of Cohort Characteristics on 30-day Mortality and Length of Stay Post-development of Febrile Neutropenia

Characteristic	30-day mortality			Length of stay post-development of febrile neutropenia*		
	Odds ratio	95% confidence interval	*P* value	Coefficient	95% confidence interval	*P* value
Hospitalisation at NCCS	1.26	0.47 to 3.34	0.647	0.03	-0.16 to 0.22	0.737
Higher age	1.03	0.99 to 1.07	0.098	0.00	-0.01 to 0.01	0.795
Male gender	2.38	0.89 to 6.35	0.083	0.21	0.03 to 0.39	0.023
Ethnicity (%)						
- Chinese	1.00	-	-	0	-	-
- Malay	0.71	0.16 to 3.22	0.655	-0.04	-0.43 to 0.35	0.842
- Indian	0.63	0.08 to 5.04	0.665	-0.76	-1.27 to -0.25	0.004
- Others	2.69	0.81 to 8.96	0.106	0.30	-0.43 to 1.02	0.426
Subsidized hospital class	0.93	0.33 to 2.63	0.886	-0.10	-0.30 to 0.11	0.360
Lymphoma diagnosis	0.84	0.34 to 2.09	0.712	0.46	0.39 to 0.62	<0.001
Chemotherapy intent						
- Palliative chemotherapy	2.55	1.01 to 6.45	0.048	-0.07	-0.14 to -0.01	0.031
Autologous stem cell transplant	2.48	0.52 to 11.91	0.257	0.24	-0.20 to 0.68	0.287
Fluoroquinolone prophylaxis	0.49	0.11 to 2.21	0.355	0.31	0.09 to 0.52	0.005
Azole prophylaxis	0.21	0.03 to 1.61	0.134	0.36	0.15 to 0.56	0.001
High-risk febrile neutropenia†	6.80	2.67 to 17.29	<0.001	0.20	-0.03 to 0.43	0.083
Severe sepsis	20.00	7.40 to 54.03	<0.001	0.25	-0.07 to 0.57	0.130
Higher ANC‡ count at presentation	0.87	0.09 to 8.23	0.902	0.00	-0.41 to 0.40	0.992
Higher ANC‡nadir	0.76	0.12 to 4.94	0.775	-0.30	-0.80 to 0.20	0.237
Longer ANC‡ recovery, days	-	-	-	0.06	0.04 to 0.09	<0.001
Therapeutic G-CSF‡ prescription	4.07	0.93 to 17.85	0.063	0.29	0.10 to 0.47	0.002
Bacterial cultures						
- Positive initial blood cultures	2.76	1.01 to 7.53	0.047	0.57	0.33 to 0.80	<0.001
- Gram-negative bacteraemia	-§	-§	-§	0.37	0.05 to 0.70	0.025
- Positive initial cultures	2.20	0.87 to 5.59	0.096	0.46	0.27 to 0.66	<0.001
- Subsequent positive cultures	6.93	2.18 to 22.04	0.001	0.63	0.25 to 1.00	0.001
Invasive fungal disease	8.52	2.32 to 31.32	0.001	0.44	-0.05 to 0.93	0.077
ID review‡	2.22	0.89 to 5.54	0.088	0.48	0.31 to 0.64	<0.001
Antibiotic use						
- Carbapenems	3.85	1.44 to 10.33	0.007	0.73	0.58 to 0.88	<0.001
- Vancomycin	2.63	1.04 to 6.65	0.041	0.72	0.57 to 0.88	<0.001
- Antifungal therapy	3.57	1.28 to 10.00	0.015	0.63	0.37 to 0.89	<0.001
- Antibiotic upgrade	5.78	1.88 to 17.78	0.002	0.72	0.58 to 0.87	<0.001
- Duration of IV antibiotics, days	-	-	-	0.12	0.10 to 0.13	<0.001
- Duration of all antibiotics, days	-	-	-	0.05	0.03 to 0.07	<0.001

*The length of stay was transformed to the natural logarithmic scale prior to analysis.

†Defined as MASCC score < 21.

‡ANC = absolute neutrophil count; G-CSF = granulocyte colony-stimulating factor; ID review = infectious diseases physician review

§All patients with Gram-negative bacteraemia survived, hence an odds ratio could not be calculated.

On the other hand, it is less clear how vancomycin prescription and ID physician reviews are associated with a longer LOS. It is plausible that patients who are hospitalised longer have a more complicated course of FN, and these patients are more frequently referred to an ID physician. The converse—that an ID review actually results in a longer LOS—is less plausible but there is insufficient data to disprove this at present.

The audit was useful in highlighting 2 areas of practice for future improvement. Firstly, very few FN episodes

Table 4. Significant Cohort Characteristics on Multivariate Analysis with 30-day Mortality and Length of Stay Post-development of Febrile Neutropenia

Characteristic	30-day mortality		
	Odds Ratio	95% Confidence interval	*P* value
Severe sepsis	15.12	5.31 to 43.08	<0.001
Characteristic	**Length of stay post-development of febrile neutropenia***		
	Coefficient	95% Confidence interval	*P* value
Longer duration of IV antibiotics	0.08	0.06 to 0.10	<0.001
Vancomycin prescription	0.25	0.08 to 0.41	0.003
Infectious diseases physician review	0.16	0.01 to 0.31	0.034

*The length of stay was transformed to the natural logarithmic scale prior to analysis.

were managed as outpatient or resulted in early discharge,[12] although it is likely that more patients may have fulfilled the necessary criteria for such care. It is probable that many oncologists are uncomfortable with such a management strategy, preferring traditional inpatient care that is more in line with their experience and training.

Secondly, many patients were prescribed IV vancomycin even though there was no apparent need for these agents —few patients had bacteriological evidence of methicillin-resistant *Staphylococcus aureus* infection, severe mucositis, catheter-related sepsis and/or hypotension.[10] A previous meta-analysis by Vardakas et al[13] had also suggested that glycopeptides should not be routinely used as part of the initial empirical therapy for FN because of the lack of clinical benefit and higher risk of nephrotoxicity.

A substantial proportion of patients received therapeutic G-CSF, although not many met the currently recommended indications for the use of G-CSF in established FN, namely: patients at high-risk for infection-associated complications or who possess prognostic factors predictive of poor clinical outcomes.[14,15] It is plausible that G-CSF was prescribed by oncologists wishing to derive other reported benefits for the patients, including reduced duration of neutropenia and hospitalisation.[16]

This study has several limitations. We did not audit the impact of FN beyond mortality and LOS. It would be useful to study other outcomes, including financial costs and delay in subsequent cycles of chemotherapy (which might impact on cancer response). Other individual comorbidities that may have had an impact on outcomes such as diabetes mellitus, liver cirrhosis and disease, etc were not captured. Other than for vancomycin, we were unable to determine whether the duration or choice of antibiotics, particularly when antibiotics were "upgraded" for more broad-spectrum coverage, were appropriate. Given the paucity of positive microbiological cultures, it is plausible that a significant proportion of antibiotic changes may not have been unnecessary, and had little impact on the final outcomes beyond prolonging LOS.

Conclusion

In summary, this audit showed that mortality from FN in our two cancer centres is low and comparable to international institutes. However, it is possible to modify the care in several areas, including more outpatient management of FN episodes for carefully selected patients with more appropriate use of resources and closer adherence to guidelines for antibiotic and G-CSF prescription.

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