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ORIGINAL ARTICLE

Management of fever and neutropenia in children with cancer: A survey of Australian and New Zealand practice

Gabrielle M Haeusler [1,2,3,4,5] Monica A Slavin,[1,2,3,6,7] Penelope A Bryant,[8,9] Franz E Babl [8,10] Francoise Mechinaud[8,11] and Karin A Thursky[1,2,3,6,7,12]

[1]Department of Infectious Diseases, Peter MacCallum Cancer Centre, [2]NHMRC National Centre for Infections in Cancer, [3]Sir Peter MacCallum Department of Oncology, [6]Department of Medicine, and [8]Murdoch Children's Research Institute, Department of Paediatrics, University of Melbourne, [4]Paediatric Integrated Cancer Service, Victoria State Government, [5]Department of Infection and Immunity, Monash Children's Hospital, [7]Victorian Infectious Diseases Service, and [12]NHMRC National Centre for Antimicrobial Stewardship, The Peter Doherty Institute for Infection and Immunity, [9]Infectious Diseases Unit, [10]Department of Emergency Medicine, and [11]Children's Cancer Centre, Royal Children's Hospital, Melbourne, Victoria, Australia

Aim: Variation in the management of fever and neutropenia (FN) in children is well described. The aim of this study was to explore the current management of FN across Australia and New Zealand and highlight areas for improvement.

Methods: A practice survey was administered to paediatric health-care providers via four clinical and research networks. Using three clinical case vignettes, we explored risk stratification, empiric antibiotics, initial investigations, intravenous–oral switch, ambulatory management and antibiotic duration in children with cancer and FN.

Results: A response was received from 104 participants from 16 different hospitals. FN guideline compliance was rated as moderate or poor by 24% of respondents, and seven different fever definitions were described. There was little variation in the selected empiric monotherapy and dual-therapy regimens, and almost all respondents recommended first-dose antibiotics within 1 h. However, 27 different empiric antibiotic combinations were selected for beta-lactam allergy. An incorrect risk status was assigned to the low-risk case by 27% of respondents and to the high-risk case by 41%. Compared to current practice, significantly more respondents would manage the low-risk case in the ambulatory setting provided adequate resources were in place (43 vs. 85%, $P < 0.0001$). There was variation in the use of empiric glycopeptides as well as use of aminoglycosides beyond 48 h.

Conclusion: Although the antibiotics selected for empiric management of FN are appropriate and consistent, variation and inaccuracies exist in risk stratification, the selection of monotherapy over dual therapy, empiric antibiotics chosen for beta-lactam allergy, use of glycopeptides and duration of aminoglycosides.

Key words: cancer; children; febrile neutropenia; management; practice survey.

What is already known on this topic

1 Fever and neutropenia (FN) is one of the most common complications of the treatment of childhood cancer.
2 Variation in the assessment and empiric and ongoing management of FN across Australia and New Zealand has been described.
3 Risk stratification is rarely used and formal low-risk FN ambulatory programmes in Australia and New Zealand do not exist.

What this paper adds

1 Variation in the definition of fever used, empiric prescribing and duration of aminoglycoside treatment for FN continues to exist.
2 There are differences in clinicians' perception of low- and high-risk FN.
3 Opportunities exist to improve the assessment, risk stratification and empiric and ongoing management of FN across Australia and New Zealand; this has potential to reduce unwanted variation, improve patient safety and increase ambulatory management of low-risk FN.

In children with cancer, fever and neutropenia (FN) is a common complication of treatment and a leading cause of emergency department presentations.[1,2] Despite this, considerable variation in the approach to management, including empiric antibiotic choice and duration, risk stratification and treatment location, is described.[3–5] Although some differences in practice are due to geography and local microbiology, unwarranted variation can lead to incorrect prescribing, poor patient outcomes and increased health-care expenditures.[6–8]

Correspondence: Dr Gabrielle M Haeusler, Department of Infectious Diseases, Peter MacCallum Cancer Centre, 305 Grattan Street, Melbourne, Vic. 3000, Australia. Fax: +61 39656 1185; email: gabrielle.haeusler@petermac.org

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In Australia, there has been a move towards the publication of state-based guidelines for FN in children.[9–11] Each guideline focuses on empiric antibiotics, with some subtle differences depending on local antibiotic resistance patterns.[12] However, despite international recommendations for centres to incorporate a validated risk stratification strategy into routine management, no state-based guideline describes a framework for this.[13] This is perhaps not surprising given the absence of a nationally validated clinical decision rule (CDR) to assist clinicians in identifying low-risk patients suitable for oral antibiotics or ambulatory care.

Contemporary management of FN across Australia and New Zealand remains unknown. A local audit of FN at nine paediatric cancer treatment centres in 2002 identified that 18 different empiric antibiotic combinations were used.[3] The aim of this study is to explore the current management of paediatric FN across Australia and New Zealand and to highlight potential areas for improvement. Using three clinical case vignettes, we explored risk stratification, empiric antibiotic prescribing and ongoing antibiotic management of FN in children with cancer.

Methods

A clinical practice survey was used to explore current approaches to management of FN in children. The survey was developed by the steering group (comprising haematology/oncology, infectious diseases and emergency medicine clinicians) in consultation with senior haematology/oncology, infectious diseases, emergency medicine and general paediatric clinicians identified from the Australian Predicting Infectious Complications in Children with Cancer research group (ACTRN12616001440415). The survey was administered electronically to paediatric health-care providers via relevant clinical/research networks: Australian and New Zealand Haematology/Oncology Group (ANZCHOG), Australia and New Zealand Paediatric Infectious Diseases (ANZPID) Group of Australasian Society for Infectious Diseases, Paediatric Research in Emergency Departments International Collaborative (PREDICT) and Children's Healthcare Australasia (CHA).[14]

The survey was distributed to CHA (unknown number) in June 2015 and ANZCHOG (185 members), ANZPID (77 members) and PREDICT (8 members) in December 2015.

Survey

Three clinical case vignettes were described, and questions were asked about various aspects of FN management, including investigations, risk assessment and empiric and ongoing antibiotics. Anonymous demographic and hospital resource data as well as details of local hospital FN guidelines were also collected. The three cases and pre-allocated risk status are described in Table 1. In the absence of a locally validated CDR, risk status was assigned based on expert opinion and recognised paediatric sepsis criteria.[10] In case 2, aminoglycoside duration beyond 48 h was assessed using three different scenarios outlined in Table 1.

Partial responses were included if the demographic and general FN management details were completed. Where respondents indicated affiliation with more than one organisation, preference was given to ANZCHOG or ANZPID for the calculation of response rate. Responses to the cases were presented according to the themes: risk assessment, empiric antibiotic choice and timing, initial investigations, intravenous–oral switch, ambulatory management and aminoglycoside duration. Unless otherwise stated, data were presented according to the risk status selected

Table 1 Clinical scenario, specific management areas explored and risk status allocated by the steering group for each case

Case 1
Clinical scenario: A 10-year-old girl with standard-risk ALL presents with fever. She is receiving maintenance chemotherapy (daily 6-mercaptopurine, weekly methotrexate and monthly vincristine and steroid). On day 9 post vincristine and steroid, her absolute neutrophil count is 0.3×10^9/L (normal haemoglobin and platelet count), and she has a tympanic temperature measurement of 38.6°C. She is not clinically septic, has no history of rigours and no focal signs or symptoms of infection. She has a portacath *in situ* and no history of drug allergies
Areas explored: Risk status, treatment setting (inpatient vs. ambulatory), empiric antibiotics (type and timing) and antibiotic duration including intravenous–oral switch
Risk allocation by steering group: Low risk
Case 2
Clinical scenario: A 14-year-old boy with relapsed AML and recent re-induction treatment with IDA-FLAG (UK MRC protocol: idarubicin, fludarabine, cytarabine, G-CSF) presents to the emergency department with a temperature of 38.9°C. On examination, he is drowsy and has a heart rate of 130 bpm (normal 70–100 bpm) and a systolic blood pressure of 110 mmHg. He has oral mucositis but no other focus for infection. A total white cell count from earlier that day is 0.1×10^9/L. He has no drug allergies
At 48 h, you are notified that: (i) The patient has an *Escherichia coli* bacteraemia that is sensitive to piperacillin-tazobactam, is afebrile, clinically stable and repeat blood culture is negative; or (ii) the patient has a negative blood culture, is febrile but clinically stable; or (iii) the patient has a negative blood culture, is afebrile and clinically stable
Areas explored: Risk status, empiric antibiotics (type and timing), antibiotic allergy, indications for dual empiric therapy and glycopeptide and aminoglycoside duration beyond 48 h
Risk allocation by steering group: High risk
Case 3
Clinical scenario: A 4-year-old girl with stage 4 neuroblastoma presents to the emergency department with fever and vomiting. She completed vincristine, doxorubicin and cyclophosphamide 10 days previously. On examination, she has a temperature of 39°C, heart rate of 125 bpm (normal 80–130 bpm), normal blood pressure, oxygen saturations 98% and no clear focus for infection. Her full blood count is pending. She has a double lumen Broviac *in situ*
Areas explored: Risk status, empiric antibiotics (timing), fever and neutropenia investigations and factors contributing to delayed first dose antibiotic
Risk allocation by steering group: High risk

ALL, acute lymphoblastic leukaemia; G-CSF, granulocyte-colony stimulating factor; IDA-FLAG, idarubicin, fludarabine, cytarabine, G-CSF; MRC, Medical Research Council.

by the respondent. Factors guiding decision making in four key areas of management (dual therapy vs. monotherapy, glycopeptide use, intravenous-to-oral antibiotic switch and management in the ambulatory setting) were assessed using a 4-point Likert scale.

Given the range of expertise and experience of those surveyed, the options of 'unsure' and 'not applicable to my area of expertise' were provided.

Fisher's exact test was used to estimate *P* values for categorical data. All tests were two-tailed, and a *P* value <0.05 was considered statistically significant.

Study design and protocol were in accordance with a low-risk quality improvement exercise, as defined by the NHMRC, and ethics approval was therefore not required.

Table 2 Participant demographics

	No. of respondents (*n* = 104), *n* (%)
Specialty	
Haematology/Oncology	45 (43.3)
Haematology	3 (2.9)
Oncology	21 (20.2)
Infectious diseases	18 (17.3)
Emergency medicine	5 (4.8)
General paediatrics	8 (7.7)
Pharmacy	3 (2.9)
Other	1 (1.0)
Clinical role	
Head of unit	6 (5.8)
Consultant	49 (47.1)
Fellow/Registrar	18 (17.3)
Resident/Intern	1 (1.0)
Nurse practitioner	1 (1.0)
Registered nurse	19 (18.3)
Pharmacist	4 (3.8)
Other	6 (5.8)
Region	
Victoria	28 (26.9)
New South Wales	41 (39.4)
Queensland	15 (14.4)
Northern Territory	2 (1.9)
Western Australia	5 (4.8)
South Australia	1 (1.0)
Tasmania	1 (1.0)
New Zealand	11 (10.6)
Affiliation†	
ANZCHOG	70
ANZPID	19
CHA	9
PREDICT	4
Unknown	10

†Seven people had more than one affiliation (PREDICT/CHA, 3; ANZPID/CHA, 1; ANZCHOG/ANZPID, 1; ANZCHOG/CHA, 1; ANZCHOG/ANZPID/CHA, 1). ANZCHOG, Australian and New Zealand Haematology/Oncology Group; ANZPID, Australia and New Zealand Paediatric Infectious Diseases; CHA, Children's Healthcare Australasia; PREDICT, Paediatric Research in Emergency Departments International Collaborative.

Results

A response was received from 104 health-care providers (complete 79 and partial 25) from 16 different hospitals across Australia and New Zealand, with at least one response from all eight tertiary paediatric sites. The overall response rate was 38% (excluding CHA) (ANZCHOG 38%, ANZPID 25% and PREDICT 50%). All respondents worked in centres where chemotherapy is administered to paediatric patients, with 92 (88%) working in centres providing dose-intensive chemotherapy for haematological malignancies and solid tumours. Participant demographic data are available in Table 2.

A hospital- or state-wide guideline was available to 103 respondents (99%), with clinician compliance reported as good, moderate and poor in 64, 23 and 1%, respectively (12% unsure). Seven different fever definitions were described (Table 3).

Forty-three (41%) respondents, across nine hospitals, indicated that their institute had a CDR to distinguish low- and high-risk FN. Responses were inconsistent, with several respondents from four of these nine hospitals responding that they did not have a CDR. Of those who answered 'no' or 'unsure', 48 (79%) would consider using a CDR to assist with FN decision-making. A policy or guideline for nurse-initiated FN antibiotics was infrequent, described by 11 respondents across five hospitals.

The response rate for cases 1, 2 and 3 was 89, 80 and 76%, respectively (Table 4).

Risk assessment

In case 1, 68 (74%) respondents correctly identified the patient as low risk. In case 2, 83 (99%) identified the patient as high risk. In case 3, 47 (59%) correctly identified this patient as high risk. Risk assessment according to clinical specialty is available in Table 4.

Empiric antibiotic choice

For cases 1 and 2, respondents were asked about empiric antibiotic choice (Table 5). Of those assigning case 1 as low risk, significantly more would choose monotherapy (74 vs. 38%) over dual therapy (26 vs. 63%) compared to those identifying the case as high risk ($P = 0.0085$). In case 1, piperacillin-tazobactam was the

Table 3 Definition of fever used by each respondent

	No. of respondents (*n* = 104), *n* (%)
≥38.5°C once or ≥38.0°C sustained over a 1-h period	46 (44.2)
≥38.0°C once	44 (42.3)
≥38.5°C once	9 (8.6)
≥38.3°C once or ≥38.0°C sustained over a 1-h period	2 (1.9)
>38.5°C or >38.0°C on two sequential occasions in a 12-h period	1 (1)
>38.3°C or >38.0°C on two sequential occasions in a 12-h period	1 (1)
>37.5°C	1 (1)

Table 4 Proportion of respondents completing each case and risk assessment according to clinical specialty

	Haematology/ Oncology	Infectious diseases	Emergency medicine	General paediatrics	Pharmacy/ Other	Total (n = 104)†
Case 1						
Respondents, n (%)	62 (66.7)	17 (18.3)	4 (4.3)	7 (7.5)	3 (3.2)	93 (89.4)
High risk, n	14	1	1	5	1	22
Low risk, n	46	16	3	2	1	68
Unsure, n	2	0	0	0	1	3
Case 2						
Respondents, n (%)	56 (67.5)	17 (20.5)	4 (4.8)	5 (6.0)	1 (1.2)	83 (79.8)
High risk, n	55	17	4	5	1	82
Low risk, n	0	0	0	0	0	0
Unsure, n	1	0	0	0	0	1
Case 3						
Respondents, n (%)	52 (65.8)	17 (21.5)	4 (5.1)	5 (6.3)	1 (1.3)	79 (76)
High risk, n	36	7	2	2	0	47
Low risk, n	14	9	1	3	1	28
Unsure, n	2	1	1	0	0	4

†Expressed as a percentage of the number of partial or complete responses received.

monotherapy chosen by all respondents, while piperacillin-tazobactam and gentamicin was most commonly selected for dual therapy (n = 24), followed by piperacillin-tazobactam and amikacin (n = 3), ceftriaxone and gentamicin (n = 1) and ciprofloxacin and gentamicin (n = 1). One respondent who assessed case 1 as high risk added empiric vancomycin.

All respondents assigned case 2 as high risk. Piperacillin-tazobactam and gentamicin was most commonly selected for dual therapy (n = 31), followed by piperacillin-tazobactam and amikacin (n = 25) and piperacillin-tazobactam and vancomycin (n = 10). For those selecting monotherapy, piperacillin-tazobactam was the most common choice (n = 12), with one respondent opting for meropenem. Empiric vancomycin was added by 43 (52%) respondents. Factors guiding the decision to use dual therapy over monotherapy and to add empiric glycopeptide are presented in Figures 1 and 2. Additional factors considered very important in opting for dual therapy (with aminoglycoside) included renal impairment (n = 3), degree of immune suppression (n = 2), recent central venous access device (CVAD) access (n = 1), mucositis (n = 1) and presence of localising infective signs (n = 1).

In case 2, antibiotic allergy was addressed. Twenty-seven different antibiotic combinations were selected for non-life-threatening penicillin allergy, with cefepime being the most common (n = 10), followed by meropenem (n = 7), cefepime and gentamicin (n = 7) and cefepime and amikacin (n = 7). For life-threatening penicillin allergy, there were 22 different antibiotic combinations, including 7 (selected by nine respondents) that included a cephalosporin and 6 (selected by 37 respondents) that included a carbapenem.

Empiric antibiotic timing

Recommended timing of first-dose antibiotic was addressed in cases 1 and 2 (Fig. 3). Combining data from each case, there was

Table 5 Type of empiric antibiotic according to risk status

	Intravenous antibiotic, n			Oral antibiotic, n	Type of antibiotic – Unsure, n
	Monotherapy	Dual therapy	Unsure		
Case 1†					
High risk (n = 22)	6	10	2	0	4
Low risk (n = 68)	48	17	1	2	0
Unsure risk status (n = 3)	0	2	0	0	1
Case 2†					
High risk (n = 82)	13	66	3	0	0
Unsure risk status (n = 1)	0	0	0	0	1

†0 respondents assigned this case as low risk.

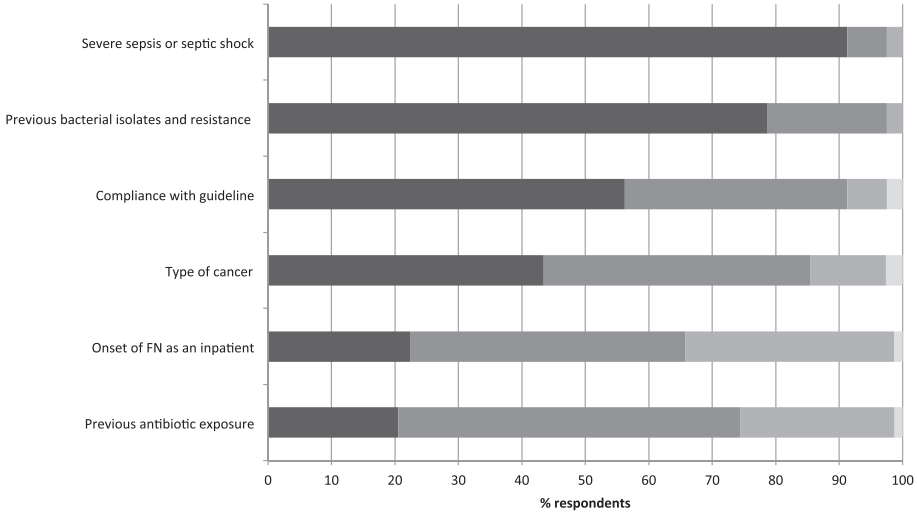

Fig. 1 Factors guiding decisions to use empiric antibiotic dual therapy over monotherapy. (■), Very important; (■), somewhat important; (■), not important; (■), unsure.

a significant difference in the recommended time to first-dose antibiotic depending on allocated risk status ($P < 0.0001$). For high-risk patients, 30 min was preferred over 60 min (64 vs. 34% respondents), while for low-risk patients, 60 min was preferred over 30 min (72 vs. 21% respondents).

Beyond risk status, factors influencing time to first-dose antibiotic was addressed in case 3. Only 6 respondents (8%) would await confirmation of neutropenia and, of the 47 non-haematology/oncology respondents, 14 (30%) would discuss the case with the treating haematology/oncology team before starting antibiotics. Factors most frequently identified as contributing to delayed first-dose antibiotic included arriving without anaesthetic cream on implantable port ($n = 28$), bypassing local hospital to attend tertiary facility ($n = 27$), waiting for 'business hours' to attend ($n = 24$), availability of staff trained to access paediatric CVADs ($n = 21$) and patient/family requesting a specific nurse to access CVAD ($n = 20$).

Initial FN investigations

The recommended number, type and site of initial blood cultures are presented in Figure 4. Serum biomarkers are routinely used by 23 (22%) respondents, with C-reactive protein (CRP) ($n = 18$) used most frequently.

Intravenous–oral antibiotic switch

For case 1, respondents were asked about switching from intravenous to oral antibiotics. Provided the patient's course was uneventful, 3 (17%) and 13 (20%) of those assigning high- and low-risk status, respectively, would switch from intravenous antibiotics to oral during this patient's FN episode. Factors guiding this decision are presented in Figure 5. Other factors identified as very important included the identification of an infective focus requiring intravenous antibiotics ($n = 7$), reliability of the caregiver to administer oral antibiotics ($n = 8$), previous infection history ($n = 2$), declining CRP ($n = 1$) and presence of a CVAD ($n = 1$).

Ambulatory management

Of those who identified case 1 as low risk ($n = 68$), 29 (43%) would currently manage this patient with home-based care (Fig. 6). In an ideal setting, where ambulatory services and infrastructure were adequate, significantly more ($n = 58$, 85%) would

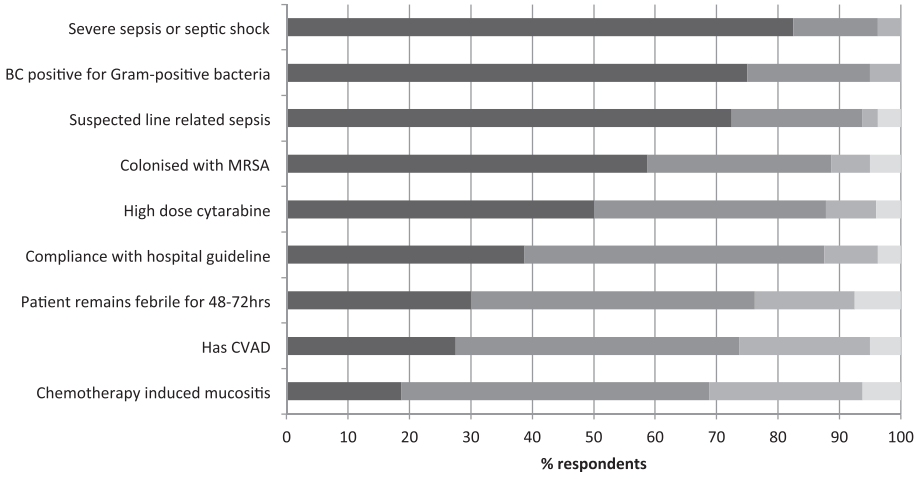

Fig. 2 Factors guiding decision to add a glycopeptide to empiric antibiotic therapy. (■), Very important; (■), somewhat important; (■), not important; (■), unsure. BC, blood culture; CVAD, central venous access device; MRSA, methicillin-resistant *Staphylococcus aureus*.

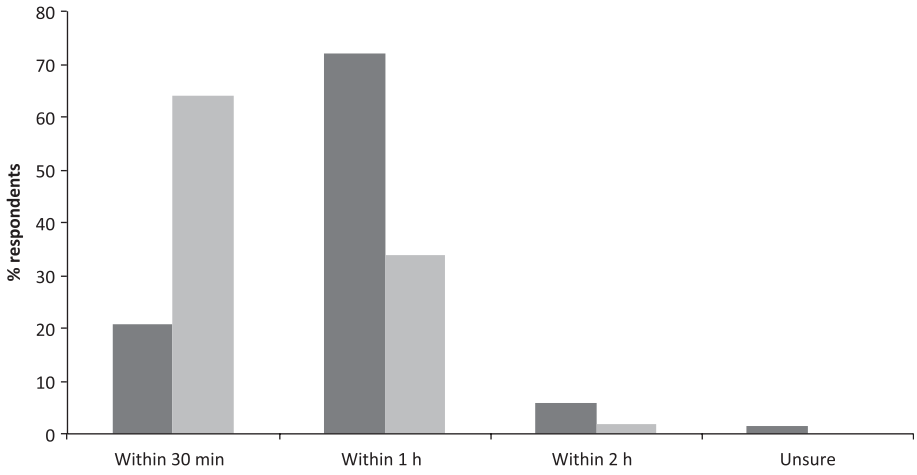

Fig. 3 Recommended timing of first-dose antibiotic according to allocated risk status for cases 1 and 2. (■), Low risk; (■), high risk.

use home-based care (RR 2.5, $P < 0.0001$). Factors guiding this decision are presented in Figure 7. Other factors identified as very important included proximity to hospital and ability to return ($n = 6$), presence of an infection ($n = 2$), language barrier ($n = 1$) and reliability of caregiver ($n = 1$).

Aminoglycoside duration

In case 2, the number of the haematology/oncology respondents who would cease the aminoglycoside for scenarios a, b and c (as outlined in Table 1) was 34 (61%), 20 (36%) and 46 (82%), respectively. Compared with the haematology/oncology group, the infectious diseases respondents were significantly more likely to cease the aminoglycoside and continue single-agent piperacillin-tazobactam for scenarios a and b, with 17 (100%) of the ID respondents ceasing aminoglycoside for all three scenarios (scenario a, $P = 0.0016$; scenario b, $P < 0.0001$).

Discussion

This is the first survey to explore paediatric FN management practices across Australia and New Zealand and across different craft groups. Variation exists in risk stratification, the definition of fever, empiric prescribing of antibiotics including for antibiotic allergy and duration of aminoglycoside treatment, both among and between specialty craft groups. We also highlight the potential for a significant increase in ambulatory management of low-risk FN provided appropriate resources are in place.

In Australia and New Zealand, a prospectively validated CDR to distinguish high- and low-risk FN has not been incorporated into routine practice and likely explains some of the inconsistencies in risk stratification in our survey. A typically low-risk FN episode was identified as high risk by a quarter of respondents, and conversely, a high-risk case was perceived as low risk by over one third. Failure to categorise low-risk patients represents a

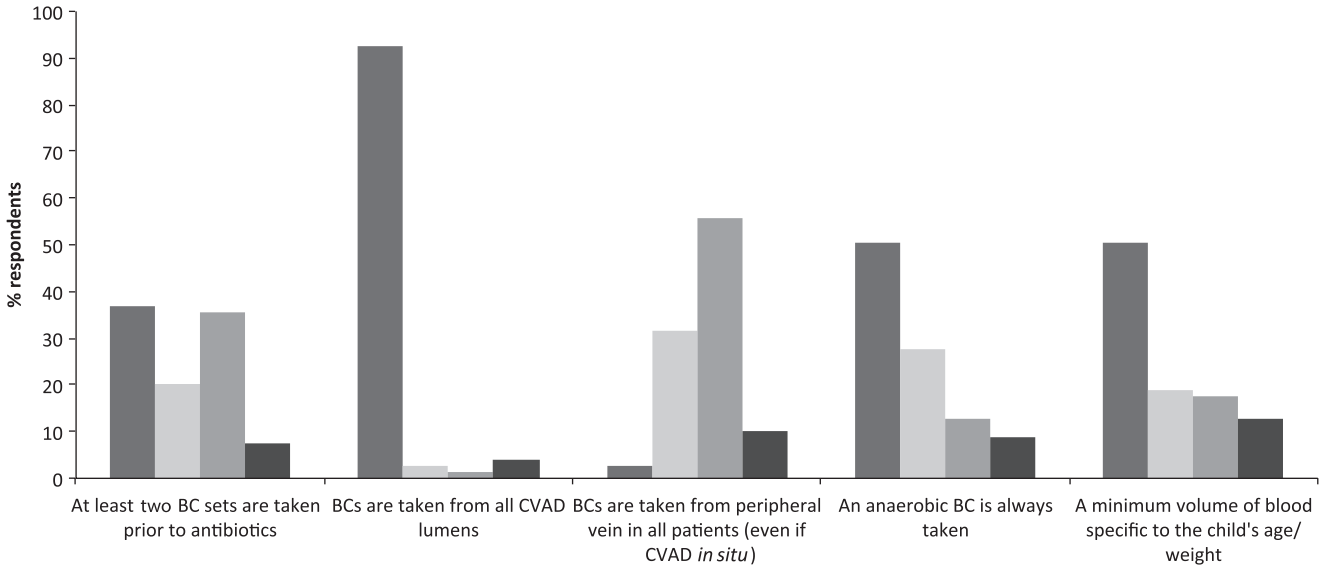

Fig. 4 Recommended number, type and site of blood cultures taken as part of initial diagnostic workup of fever and neutropenia. (■), Always; (■), sometimes; (■), never; (■), unsure. BC, blood culture; CVAD, central venous access device.

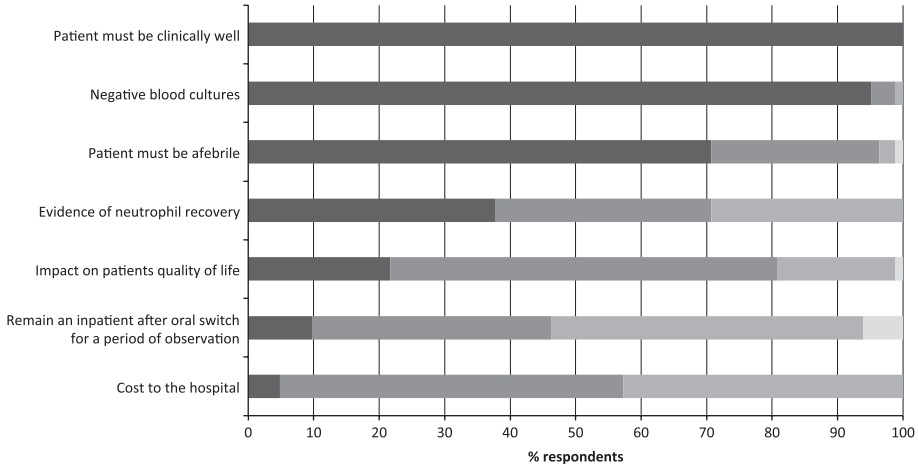

Fig. 5 Factors guiding decision to switch patients with fever and neutropenia from intravenous to oral antibiotics. (■), Very important; (■), somewhat important; (■), not important; (□), unsure.

missed opportunity for the use of empiric monotherapy over dual therapy, early intravenous–oral switch and entry into ambulatory management programmes.[13,15] Similarly, the accurate identification of high-risk patients may facilitate enhanced monitoring, early treatment and prevention of sepsis and other adverse events. A similar knowledge gap was evident in an Australian survey of risk stratification practices in the adult haematology/oncology population.[16]

In keeping with evidenced-based FN guidelines, the most commonly selected empiric monotherapy and dual-therapy regimens were piperacillin-tazobactam and piperacillin-tazobactam plus aminoglycoside, respectively.[9,10,13] This is in contrast with a 2002 Australian audit, where 18 different empiric combinations were used.[3] However, as many as 27 different empiric antibiotic combinations were selected for high-risk FN in the setting of beta-lactam allergy. Notably, a cephalosporin-containing regimen was selected by 11% for beta-lactam anaphylaxis despite the potential for 5% cross-reactivity with these agents.[17] Antibiotic allergy in the adult cancer population is associated with increased antibiotic duration, inappropriate prescribing and higher readmission rates, suggesting that guidelines should address allergy recommendations, and antibiotic allergy de-labelling strategies are employed.[18]

The majority of respondents appropriately identified severe sepsis as an important factor in guiding decisions to use aminoglycoside-containing dual therapy. However 16% still selected monotherapy for the high-risk example with severe sepsis, despite an aminoglycoside being recommended for this indication.[9,10,13] Conversely, for the low-risk example without sepsis, 25% would use still use aminoglycoside-containing dual therapy. Double Gram-negative cover should be reserved for patients who are clinically unstable, when a resistant infection is suspected or for centres with a high rate of resistant pathogens.[13] This is supported by robust data that showed no difference in the failure rate or mortality in patients with high-risk FN treated with monotherapy over dual therapy.[19]

Deviations from evidence-based guidelines were also evident in the use and duration of aminoglycoside and glycopeptides beyond the first 48 h.[13] In particular, over half of the haematology–oncology respondents would continue the aminoglycoside for ongoing fever despite negative blood cultures and clinical stability. In addition, remaining febrile at 48 h was considered a very important factor guiding the decision to use empiric vancomycin by 30%, despite placebo-controlled trial data indicating no benefit on time to defervescence and all-cause mortality.[20] Together, these data suggest clinically important

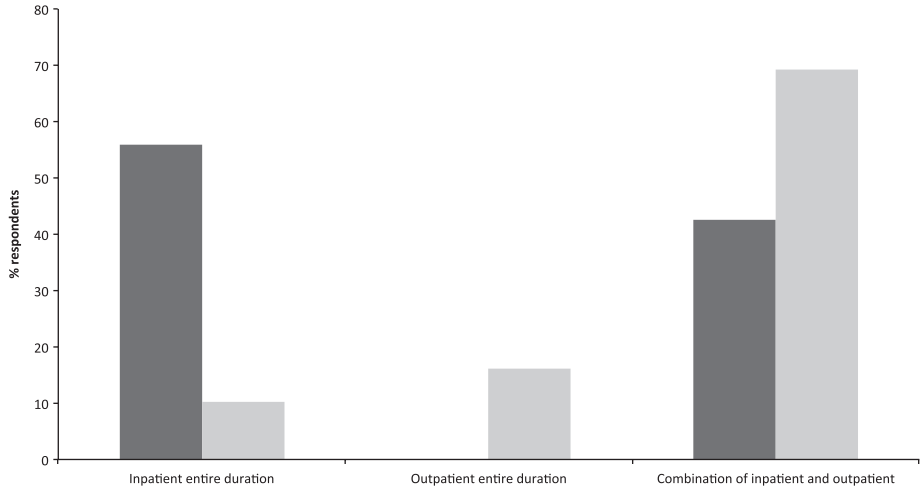

Fig. 6 Clinician preference for treatment setting for patients identified as low risk in case 1. (■), Current practice; (□), ideal practice.

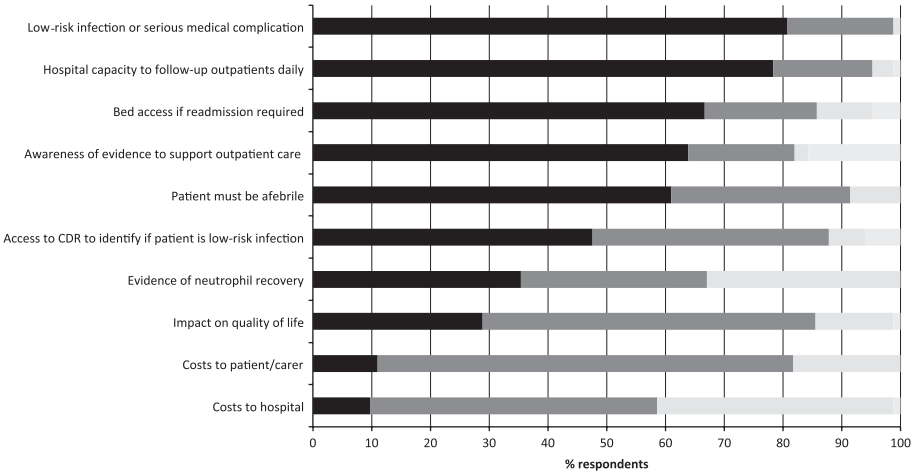

Fig. 7 Factors guiding decision to manage patients with fever and neutropenia in ambulatory setting. (■), Very important; (▩), somewhat important; (□), not important; (▯), unsure. CDR, clinical decision rule.

knowledge gaps in the assessment and management of severe sepsis, use of empiric monotherapy over dual therapy and duration of additional antibiotics with potential for toxicity. Guideline deviations may also represent a lack of confidence in clinical trial data and the applicability of the results from FN antibiotic trials to the clinicians' patient population.

Provided adequate resources were in place, significantly more respondents would manage the low-risk FN example at home compared to their current practice. In contrast to a 2002 practice audit, more respondents would now also consider a step down to oral antibiotics (20 vs. 9%).[3] These data suggest that, with structured low-risk programmes incorporating risk assessment, regular observation and appropriate safeguards, many more low-risk patients would benefit from reduced-intensity home-based care. Such treatment has been shown to be safe, improve quality of life and is significantly less expensive than routine inpatient care.[21–23]

Seven different definitions of fever were selected, with two used by 86% of respondents. This variability is not surprising as a consensus fever definition could not be achieved by an international panel of FN experts.[24] Few studies have explored the clinical impact of different fever definitions, with one study concluding that a higher temperature definition was not associated with a lower FN rate or with an increased rate of bacteraemia.[25] Regarding the use of biomarkers in the assessment of FN, CRP continues to be the most frequently used despite underwhelming evidence of its ability to accurately predict infection or adverse outcome.[26] Further translational research is required to identify novel biomarkers that can assist in risk stratification and guide antibiotic duration.

Although we provide a contemporary overview of paediatric FN management across Australia and New Zealand, the results can only be considered reflective of those who participated in the survey. However, while the response rate across the clinical research groups was less than 50%, there was representation from all tertiary paediatric hospitals, with almost 90% working in centres providing dose-intensive chemotherapy and therefore likely to see many children with FN. Clinical responsibilities and survey fatigue is likely to have contributed to this low response rate. The survey was also administered over a 6-month period due to concurrent survey activity within the research groups. As the principles of FN management have not changed, this is unlikely to have had a significant impact. In the absence of locally validated risk prediction rules, we relied on expert opinion and recognised sepsis criteria to develop low- and high-risk case examples.[10] This likely explains some of the variation in risk allocation.

Conclusion

We provide an overview of the assessment and management of FN across different craft groups in Australia and New Zealand. While the antibiotics selected for empiric FN management are consistent with evidence-based guidelines, variation and knowledge gaps exist in risk stratification, identification and management of severe sepsis; use of dual therapy and glycopeptides; selection of antibiotics for beta-lactam allergy; and antibiotic de-escalation. Our study adds insight into factors guiding decision making for empiric and ongoing prescribing and highlights the potential for a significant increase in the utilisation of ambulatory management of low-risk patients provided a structured programme is in place. National guidelines and targeted education addressing the barriers to best practice as identified in this survey, together with collaborative research efforts, have the potential to reduce unwanted variation, improve patient safety and increase ambulatory management of low-risk FN in Australia and New Zealand.

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