



Point-prevalence surveys of antimicrobial consumption and resistance at a paediatric and an adult tertiary referral hospital in Yangon, Myanmar

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SUMMARY

Background: Antimicrobial resistance is increasingly prevalent worldwide. The inappropriate use of antimicrobials, including in the hospital setting, is considered a major driver of antimicrobial resistance.

Aim: To inform improvements in antimicrobial stewardship, we undertook point prevalence surveys of antimicrobial prescribing at Yangon Children's Hospital and Yangon General Hospital in Yangon, Myanmar.

Methods: We conducted our surveys using the Global Point-Prevalence Survey of Antimicrobial Consumption and Resistance (Global-PPS) method. All inpatients who were prescribed an antimicrobial on the day of the survey were included in the analysis.

Findings: We evaluated a total of 1,980 patients admitted to two hospitals during December 2019. Of these, 1,255 (63.4%) patients were prescribed a total of 2,108 antimicrobials. Among antimicrobials prescribed, 722 (34.3%) were third-generation cephalosporins, the most commonly prescribed antimicrobial class. A total of 940 (44.6%) antimicrobials were prescribed for community-acquired infection, and 724 (34.3%) for surgical prophylaxis. Of 2,108 antimicrobials, 317 (15.0%) were prescribed for gastrointestinal tract prophylaxis, 305 (14.5%) for skin, soft tissue, bone and joint prophylaxis, and 303 (14.4%) for pneumonia treatment. A stop or review date was documented for 350 (16.6%) antimicrobial prescriptions, 673 (31.9%) antimicrobial prescriptions were guideline compliant, and 1,335 (63.3%) antimicrobials were administered via the parenteral route. Of 1,083 antimicrobials prescribed for a therapeutic use, 221 (20.4%) were targeted therapy.

Conclusion: Our findings underscore the need to update and expand evidence-based guidelines for antimicrobial use, promote the benefits of targeted antimicrobial

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therapy, and support the implementation of hospital-based antimicrobial stewardship programmes at the hospitals surveyed.

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Introduction

Inappropriate antimicrobial use, particularly inappropriate use of broad-spectrum antimicrobials, is a major driver of antimicrobial resistance (AMR) [1]. AMR reduces the options for the effective treatment and prevention of many common infections in humans and can lead to increased morbidity and mortality, and greater hospital costs [2]. AMR is of particular concern in low- and middle-income countries (LMICs) due to the relatively high burden of infectious diseases [3] and limited healthcare resources for laboratory diagnosis and patient care compared to high-income countries [4].

Studies of antimicrobial use in some high-income countries suggest that as much as 20% of antimicrobial use occurs in hospitals [5,6]. As such, hospitals are important sites for monitoring and management of antimicrobial use. Hospital-based antimicrobial stewardship programmes (ASPs) aim to reduce inappropriate antimicrobial use [7], that in turn may reduce the selective pressures that lead to the emergence and spread of AMR [8]. Although inappropriate antimicrobial use is recognised as a major contributor to AMR, data on antimicrobial use in Myanmar hospitals are scant and the implementation of policies for appropriate antimicrobial use has been limited [9,10].

Point-prevalence surveys (PPS) are an established means for pragmatically collecting data on antimicrobial consumption within hospitals [11,12]. Data from PPS can inform the introduction of specific ASP interventions [11]. We sought to describe antimicrobial consumption at two tertiary hospitals in Yangon, Myanmar, to inform the development and maintenance of evidence-based ASPs.

Methods

Study design and setting

We conducted a survey of antimicrobial consumption and resistance at two public tertiary referral hospitals in Yangon, Myanmar, using the standardised and validated Global Point-Prevalence Survey of Antimicrobial Consumption and Resistance (Global-PPS) method [13]. Yangon Children's Hospital (YCH) is a 750-bed public hospital for infants and children aged 0–14 years. Yangon General Hospital (YGH) is a 2,000-bed public hospital for adolescents and adults aged ≥ 12 years. Each hospital is the main tertiary referral hospital for their respective patient population in Lower Myanmar.

Data were collected for patients admitted to medical wards, surgical wards, and intensive care units. Each hospital was assigned unique identifier in accordance with its name, geographic location, and type of hospital. Consistent with the Global-PPS method, data were collected using two forms, one for ward-level data and one for patient-level data [13]. The study population included all inpatients on any ward of YCH and YGH at 08:00 hours on the day of the survey. We did not

collect data on patients discharged before 08:00 hours, or on patients admitted after that time.

Data collection

Each ward was surveyed once during the survey period. Data collected from the ward-level included the date of the survey, ward name, ward type (e.g., adult medical ward), and total number of available beds and admitted patients by healthcare activity. All patients present on ward at 08:00 hours on the day of data collection were included in the survey. Antimicrobials, excluding those used topically, prescribed to any patient were recorded. Patient-level data included age, sex, antimicrobials received, diagnoses, and indication for treatment. We used two categories to classify indications for treatment: therapeutic and prophylactic. The therapeutic category comprised antimicrobial prescribing for both community-acquired infections (i.e., infections where symptoms were present on hospital admission or started < 48 hours after hospital admission), and healthcare-associated infections (i.e., infections with onset of symptoms ≥ 48 hours after hospital admission). The prophylactic category included antimicrobial prescribing for both medical and surgical prophylaxis. Medical prophylaxis was defined as medication or treatment used to prevent an infection from occurring in patients with medical conditions and surgical prophylaxis was defined as the use of antimicrobials to prevent infections at the surgical site [13]. Indicators of antimicrobial prescribing quality included documentation of the diagnosis in the patient's medical record at the start of treatment, documentation of a stop or review date for the antimicrobial in the notes, and whether the choice of antimicrobial was compliant with local guidelines. We assessed antimicrobial prescriptions at YCH and YGH for compliance with the Myanmar Paediatric Society's Paediatric Management Guidelines [14] and the Myanmar Medical Association's Internal Medicine Therapeutic Manual [15], respectively. These guidelines were endorsed by both study hospitals and available for use by clinical staff. We also recorded whether treatment choice was based on biomarker values such as C-reactive protein (CRP), procalcitonin, and other biomarkers, or a microbiology laboratory test result which defined targeted therapy [16]. For patients receiving surgical prophylaxis, we coded the duration of prophylaxis as single dose, ≤ 1 day, or > 1 day.

Data analysis

We reported the prevalence of antimicrobial use as a percentage of the total number of patients receiving an antimicrobial at the time of the survey divided by the number of patients admitted. We calculated the proportion of antimicrobials prescribed for each ward type, treatment indication, and diagnosis. We classified antimicrobials using the World Health Organization (WHO) Anatomical Therapeutic Chemical (ATC) classification system [17]. We reported

agreement with quality indicators as a percentage of the total number of antimicrobials prescribed at each hospital. For treatment based on biomarker data or microbiology laboratory test results, the denominator was number of antimicrobials prescribed for therapeutic use.

Research ethics

This study was reviewed and approved by the University of Public Health Institutional Review Board, Yangon, Myanmar, (UOPH-IRB 2019/Research/46) and the University of Otago Human Ethics Committee (Health), Dunedin, New Zealand. The Medical Superintendent of YCH and the Rector and Medical Superintendent of YGH provided permission on behalf of hospital staff. We did not have direct contact with patients and collected only de-identified patient data. Data collection forms and electronic data were only accessible to study investigators. The participation of each hospital was voluntary.

Results

We conducted data collection from 9 December 2019 through 31 December 2019. A total of 1,980 patients were included in our surveys: 507 (25.6%) at YCH and 1,473 (74.4%) at YGH. Antimicrobials were prescribed to 306 (60.4%) patients at YCH and 949 (64.4%) patients at YGH, respectively. [Table I](#) shows prevalence of antimicrobial use by hospital and ward type. Antimicrobials were prescribed to all 13 (100%) patients admitted to a neonatal medical ward at YCH, eleven (84.6%) of 13 patients admitted to a paediatric intensive care unit (ICU) at YCH, and 17 (89.5%) of 19 patients admitted to an adult ICU at YGH.

The classification of antimicrobials prescribed by ATC therapeutic subgroup and chemical subgroup is provided in [Table II](#). A total of 2,108 antimicrobials were prescribed overall: 506 (24.0%) at YCH and 1,602 (76.0%) at YGH. Antibacterials for systemic use accounted for 1,808 (85.8%) of all antimicrobial prescriptions, including 406 (80.2%) antimicrobial prescriptions at YCH and 1,402 (87.5%) antimicrobial

prescriptions at YGH. Third-generation cephalosporins accounted for 722 (34.3%) antimicrobial prescriptions, including 189 (37.4%) antimicrobials at YCH and 533 (33.3%) antimicrobials at YGH.

[Table III](#) shows antimicrobial prescription by indication category. Of 2,108 antimicrobials prescribed, 940 (44.6%) were for community-acquired infection, 143 (6.8%) for hospital-acquired infection, 263 (12.5%) medical prophylaxis, and 724 (34.3%) for surgical prophylaxis. Of 506 antimicrobial prescriptions at YCH, 232 (45.8%) were for community-acquired infection and 162 (32.0%) for surgical prophylaxis. Of 1,602 antimicrobials prescribed at YGH, 708 (44.2%) were for community-acquired infection and 562 (35.3%) for surgical prophylaxis.

In total, 317 (15.0%) of 2,108 antimicrobial prescriptions were for gastrointestinal tract prophylaxis for gastrointestinal surgery, 305 (14.5%) for skin, soft tissue, bone and joint prophylaxis, and 303 (14.4%) for pneumonia treatment ([Table IV](#)). Gastrointestinal tract prophylaxis accounted for 114 (22.5%) of 506 antimicrobial prescriptions at YCH, and pneumonia treatment accounted for 256 (16.0%) of 1,602 antimicrobial prescriptions at YGH.

The quality indicators for antimicrobials prescription are shown in [Table V](#). A reason for antimicrobial prescription and a stop or review date was recorded in the medical notes for 1,360 (64.5%) and 350 (16.6%) of 2,108 antimicrobial prescriptions, respectively. A total of 1,335 (63.3%) antimicrobials were given via the parenteral route and 673 (31.9%) of total antimicrobial prescriptions were compliant with a local guideline. Of 1,083 antimicrobials given for therapeutic use, 584 (53.9%) were based on biomarker data, exclusively CRP, and 221 (20.4%) were given as targeted therapy. Of 724 antimicrobials prescribed for surgical prophylaxis, 39 (5.4%) were given as a single dose, 120 (16.6%) for ≤ 1 day, and 565 (78.0%) for > 1 day.

Of 506 antimicrobial prescriptions at YCH, 286 (56.6%) had a reason for antimicrobial prescription and 121 (23.9%) had a stop or review date recorded in the medical notes. A total of 308 (60.9%) were given by the parenteral route and 218 (43.1%) were guideline compliant. Of 258 antimicrobials in therapeutic use, 222 (86.0%) were based on biomarker data, exclusively

Table I

Prevalence of antimicrobial use by hospital and ward type, Point-Prevalence Survey of Antimicrobial Consumption and Resistance, Yangon Children's Hospital and Yangon General Hospital, Myanmar, 2019

Ward types	Admitted		Prescribed an antimicrobial	
	N		N	(%)
Yangon Children's Hospital				
Neonatal Intensive Care Unit	10		4	(40.0)
Neonatal Medical Ward	13		13	(100.0)
Paediatric Intensive Care Unit	13		11	(84.6)
Paediatric Haematology-Oncology Ward	63		25	(39.7)
Paediatric Medical Ward	195		80	(41.0)
Paediatric Surgical Ward	213		173	(81.2)
Total	507		306	(60.4)
Yangon General Hospital				
Adult Intensive Care Unit	19		17	(89.5)
Adult Intensive Care Unit	255		149	(58.4)
Adult Haematology-Oncology Ward	528		325	(61.6)
Adult Surgical Ward	671		458	(68.3)
Total	1,473		949	(64.4)

Table II

Classification of antimicrobials prescribed by Anatomical Therapeutic Chemical classification system therapeutic subgroup and chemical subgroup, Point-prevalence Survey of Antimicrobial Consumption and Resistance, Yangon Children's Hospital and Yangon General Hospital, Myanmar, 2019

Antimicrobial classification	ATC code	Total		YCH		YGH	
		N	(%)	N	(%)	N	(%)
Antibacterials for systemic use	J01	1,808	(85.8)	406	(80.2)	1402	(87.5)
Third-generation cephalosporins	J01DD	722	(34.3)	189	(37.4)	533	(33.3)
Imidazole derivatives	J01XD	252	(12.0)	19	(3.8)	233	(14.5)
Combinations of penicillins ^a	J01CR	241	(11.4)	61	(12.1)	180	(11.2)
Fluoroquinolones	J01MA	205	(9.7)	9	(1.8)	196	(12.2)
Other Aminoglycosides ^b	J01GB	77	(3.7)	44	(8.7)	33	(2.1)
Macrolides	J01FA	60	(2.8)	5	(1.0)	55	(3.4)
Carbapenems	J01DH	59	(2.8)	13	(2.6)	46	(2.9)
Sulfonamide and trimethoprim combinations	J01EE	37	(1.8)	15	(3.0)	22	(1.4)
Beta-lactamase sensitive penicillins	J01CE	27	(1.3)	2	(0.4)	25	(1.6)
Fourth-generation cephalosporins	J01DE	26	(1.2)	2	(0.4)	24	(1.5)
Penicillins with extended spectrum ^c	J01CA	36	(1.7)	29	(5.7)	7	(0.4)
Beta-lactamase resistant penicillins	J01CF	26	(1.2)	9	(1.8)	17	(1.1)
Glycopeptide antibacterials	J01XA	24	(1.1)	9	(1.8)	15	(0.9)
Other antibacterials	J01XX	6	(0.3)	-	-	6	(0.4)
Tetracycline antibacterials	J01AA	4	(0.2)	-	-	4	(0.2)
Combinations of antibacterials	J01RA	2	(0.1)	-	-	2	(0.1)
Second-generation cephalosporin	J01DC	2	(0.1)	-	-	2	(0.1)
Amphenicols	J01B	1	(0.0)	-	-	1	(<0.1)
Other cephalosporins	J01DI	1	(0.0)	-	-	1	(<0.1)
Antimycobacterials	J04	148	(7.0)	41	(8.1)	107	(6.7)
Antibiotics for treatment of tuberculosis	J04AB	148	(7.0)	41	(8.1)	107	(6.7)
Antidiarrheals, intestinal anti-inflammatories, or anti-infective	A07	51	(2.4)	14	(2.8)	37	(2.3)
Antibiotics	A07AA	51	(2.4)	14	(2.8)	37	(2.3)
Antivirals for systemic use	J05	49	(2.3)	5	(1.0)	44	(2.7)
Nucleosides and nucleotides	J05AF	49	(2.3)	5	(1.0)	44	(2.7)
Antiprotozoals	P01	38	(1.8)	36	(7.1)	2	(0.1)
Nitroimidazole derivatives	P01AB	31	(1.5)	31	(6.1)	-	-
Aminoquinolines	P01BA	6	(0.3)	4	(0.8)	2	(0.1)
Artemisinin and derivatives	P01BE	1	(0.0)	1	(0.2)	-	-
Antimycotics for systemic use	J02	14	(0.7)	4	(0.8)	10	(0.6)
Triazole derivatives	J02AC	14	(0.7)	4	(0.8)	10	(0.6)
Total		2,108	(100.0)	506	(100.0)	1602	(100.0)

YCH, Yangon Children's Hospital; YGH, Yangon General Hospital; ATC, Anatomical Therapeutic Chemical. ^a Combinations of penicillins includes combinations of two or more penicillins, and penicillin and enzyme inhibitor combinations. ^b Other aminoglycosides includes gentamicin, neomycin, and amikacin. ^c Penicillins with extended-spectrum includes ampicillin, amoxicillin, and piperacillin. Other antibacterials include glycopeptide antibacterials, polymyxins, steroid antibacterials, Combinations of antibacterials include two group of antibacterial such as sulphonamides with trimethoprim, penicillin with other antibacterials; ATC code, Anatomical Therapeutic Chemical classification code.

Table III

Indication for antimicrobial use by hospital, Point-Prevalence Survey of Antimicrobial Consumption and Resistance at Yangon Children's Hospital and Yangon General Hospital, Myanmar, 2019

Hospital	Antimicrobial		Therapeutic use						Prophylactic use						
			Prescriptions		CAI		HAI		MP		SP		Other		Unknown
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N
Total	2,108	(100.0)	940	(44.6)	143	(6.8)	263	(12.5)	724	(34.3)	5	(0.2)	33	(1.6)	
YCH	506	(100.0)	232	(45.8)	26	(5.1)	77	(15.2)	162	(32.0)	4	(0.8)	5	(0.9)	
YGH	1,602	(100.0)	708	(44.3)	117	(7.3)	186	(11.6)	562	(35.3)	1	(0.1)	28	(0.9)	

YCH, Yangon Children's Hospital; YGH, Yangon General Hospital; CAI, Community-acquired infection; HAI, Hospital-acquired infection; MP, Medical prophylaxis; SP, Surgical prophylaxis.

Table IV

Ten most common diagnoses for antimicrobial prescription by hospital, Point-Prevalence Survey of Antimicrobial Consumption and Resistance, Yangon Children's Hospital and Yangon General Hospital, Myanmar, 2019

Diagnosis	Total		YCH		YGH	
	N	(%)	N	(%)	N	(%)
Total antimicrobials prescribed	2,108	(100.0)	506	(100.0)	1,602	(100.0)
Gastrointestinal tract prophylaxis	317	(15.0)	114	(22.5)	203	(12.7)
Skin, soft tissue, bone and joint prophylaxis	305	(14.5)	51	(10.1)	254	(15.9)
Pneumonia	303	(14.4)	47	(9.3)	256	(16.0)
Skin and soft tissues infections	184	(8.7)	40	(7.9)	144	(9.0)
Tuberculosis	106	(5.0)	33	(6.5)	73	(4.6)
Medical prophylaxis without targeting a specific site	102	(4.8)	14	(2.8)	88	(5.5)
Infections of the central nervous system	87	(4.1)	14	(2.8)	73	(4.6)
Prophylaxis for central nervous system	86	(4.1)	6	(1.2)	80	(5.0)
Cardiac, vascular surgery, or endocarditis prophylaxis	82	(3.9)	—	—	82	(5.1)
Neutropenic fever	67	(3.2)	45	(8.9)	22	(1.4)

YCH, Yangon Children's Hospital; YGH, Yangon General Hospital.

Table V

Quality indicators of antimicrobial prescriptions by hospital, Point-Prevalence Survey of Antimicrobial Consumption and Resistance at Yangon Children's Hospital and Yangon General Hospital, Myanmar, 2019

Quality indicators of antimicrobial prescriptions	Total		YCH		YGH	
	N	(%)	N	(%)	N	(%)
Total antimicrobials prescribed	2,108	(100.0)	506	(100.0)	1,602	(100.0)
Reason for antimicrobial prescription recorded	1,360	(64.5)	286	(56.5)	1,074	(67.0)
Stop or review date recorded	350	(16.6)	121	(23.9)	229	(14.3)
Parenteral route	1,335	(63.3)	308	(60.9)	1,027	(64.1)
Guideline compliant	673	(31.9)	218	(43.1)	455	(28.4)
Biomarker data ^a	584	(53.9)	222	(86.0)	362	(43.9)
Targeted therapy ^a	221	(20.4)	15	(5.8)	206	(25.0)
Antimicrobials for surgical prophylaxis	724	(34.3)	162	(32.0)	562	(35.1)
Single dose ^b	39	(5.4)	6	(3.7)	33	(5.9)
≤1 day ^b	120	(16.6)	27	(16.7)	93	(16.5)
>1 day ^b	565	(78.0)	129	(79.6)	436	(77.6)

YCH, Yangon Children's Hospital; YGH, Yangon General Hospital.

^a Denominator is number of antimicrobials prescribed for therapeutic use (Total, N = 1,083; YCH, N = 258; YGH, N = 825).

^b Denominator is number of antimicrobials prescribed for surgical prophylaxis.

CRP, and 15 (5.8%) were given as targeted therapy. A total of 129 (79.6%) of 162 antimicrobials prescribed for surgical prophylaxis at YCH were given for >1 day. Of 1,602 antimicrobial prescriptions at YGH, 1,074 (67.0%) had a reason for antimicrobial prescription and 229 (14.3%) had a stop or review date recorded in the medical notes. A total of 1,027 (64.1%) were given by the parenteral route and 455 (28.4%) were guideline compliant. Of 825 antimicrobials for therapeutic use, 362 (43.9%) were based on biomarker data, and 206 (25.0%) were given as targeted therapy. A total of 436 (77.6%) of 562 antimicrobials prescribed for surgical prophylaxis at YGH were given for >1 day.

Discussion

To our knowledge, based on a search of the literature at the time of writing, our study represents the first published surveys of antimicrobial consumption and resistance performed in Myanmar. Antimicrobials were prescribed to a large proportion of patients at each hospital, with antibacterials for systemic

use the most prescribed group. A majority of antimicrobials prescribed were administered via the parenteral route. Third-generation cephalosporins were the most commonly prescribed antimicrobials at both hospitals, accounting for more than one-third of all antimicrobials prescribed. Fewer than one-quarter of antimicrobial prescriptions had a stop or review date recorded in the patient medical notes. Local antimicrobial treatment guidelines were often not available for antimicrobial prescriptions that we reviewed, and most antimicrobials prescribed for surgical prophylaxis at both hospitals were given for a duration >1 day.

The prevalence of antimicrobial consumption observed at YCH (60.4%) was similar to the prevalence reported in a 2016 PPS at six hospitals in India where 61.5% of paediatric patients were prescribed an antimicrobial [18]. In contrast, the prevalence observed at YCH was considerably higher than the prevalence reported in a 2012 PPS at six Australian children's hospitals and a 2011 PPS of paediatric patients at 17 tertiary hospitals across the United Kingdom (UK) where 46.0% and 43.0% of patients were prescribed an antimicrobial,

respectively [19,20]. The prevalence of antimicrobial consumption at YGH (64.4%) was similar to surveys conducted in hospitals in Kenya, Botswana, and from west and central Asian countries that reported antimicrobial use prevalences of 67.7%, 70.6%, and 69.1%, respectively [21–23]. However, the prevalence of antimicrobial use at YGH was higher than that reported from hospitals in North America (38.6%–50.0%), Turkey (30.6%), and Scotland (28.3%) [12,23–27]. The higher prevalence of antimicrobial prescribing observed in our surveys, and surveys in other hospitals in LMICs, compared to these high-income countries may reflect a higher burden of infectious diseases, more severe illnesses, or less restrictive antimicrobial prescribing policies [28,29]. The most common indication for antimicrobial prescription at both hospitals was community-acquired infection followed by surgical prophylaxis. The proportion of antimicrobial prescriptions for both medical and surgical prophylaxis was higher in our study than in several other studies [26,30,31]. However, as our study did not investigate the reasons for antimicrobial use for prophylaxis, further studies are warranted to determine whether current proportion of antimicrobial use allocated to prophylaxis is appropriate or if an intervention is warranted. Notably, prescriptions for hospital-acquired infections were lower in our study than in other settings [19,20,32].

Oral treatments have been shown to reduce the risk of hospital-acquired infections and confer both clinical and economic benefits [31]. Almost two-thirds of antimicrobials at YCH and YGH were administered by the parenteral route. This was similar to a 2017 study of Belgian acute care hospitals, where antimicrobials were administered to 64.6% of patients via the parenteral route [33]. It is likely that the proportion of antimicrobials administered parenterally at YCH and YGH in part reflects the frequent use of ceftriaxone, cefotaxime, and other parenteral antimicrobials for which no equivalent oral formulation is available [20]. Nonetheless, regular clinician review of the need for parenteral therapy could increase the frequency with which oral treatment is used.

We observed that a reason for antimicrobial use was recorded in the patient's medical notes for almost two-thirds of antimicrobials prescribed at our study hospitals. However, a stop or review date was recorded in the patient's medical notes for only 16% of prescriptions. The proportion with a reason for antimicrobial use being recorded in the medical record was lower than observed overall in the 2012 Worldwide Antibiotic Resistance and Prescribing in European Children study [20], but comparable to that observed in studies conducted in the Latin America region and India [23,31,34]. We suggest that appropriate documentation of antimicrobial prescribing information is a key target for quality improvement as it ensures communication of diagnosis and treatment among clinicians and other healthcare providers which can reinforce other ASP interventions [8,35].

We showed that only 31.9% of prescriptions were compliant with a local treatment guideline but that guidelines frequently did not address conditions identified during the survey. Research indicates that antimicrobial prescribing is heavily influenced by availability of antimicrobial agents, staffing policies, and implementation of regulations, as well as the knowledge, beliefs, and qualifications of the health workers [36,37]. Hence, we recommend that resources be allocated to updating and expanding local antimicrobial prescribing guidelines to include common therapeutic and prophylactic indications.

We observed widespread use of third-generation cephalosporins and other broad-spectrum antimicrobials at YCH and YGH. The reliance on broad-spectrum antimicrobials is consistent with findings from other antimicrobial consumption surveys conducted in Asian [31] and African countries [21,22] but contrasts with the higher use of narrow-spectrum penicillins and penicillin-enzyme inhibitor combinations observed in the 2012 Australian PPS [19,38]. One reason for frequent prescription of broad spectrum antimicrobials in our study may be the high prevalence of antimicrobial resistance among several key organisms. Studies of bloodstream infections done at YGH in 2014 and 2020 identified a high prevalence of antimicrobial resistance [10,39]. Judicious use of broad-spectrum antimicrobials may be supported by increased use of high-quality clinical microbiology laboratory services. Clinical microbiology results can be used in aggregate to inform hospital empiric therapy guidelines, and to rationalise the treatment of individual patients [40].

The Global-PPS 2015 showed that across 53 countries, 37.9% of therapeutic antimicrobial prescribing was based on a microbiology result [23]. By contrast, we found that only 5.8% of prescriptions at YCH and 25.0% of prescriptions at YGH were based on a microbiology result. The high prevalence of empiric therapy in YCH and YGH may be related to the limited use of diagnostic services at the hospitals. We suggest that efforts be made to further strengthen clinical microbiology services at both YCH and YGH, to encourage clinicians to use them, and to prepare, disseminate, and regularly update antibiograms to inform empiric treatment decisions at each hospital.

International guidelines on surgical prophylaxis recommend that a single dose of narrow-spectrum antibacterial be administered within the 24-hour preoperative period [41–43]. Surgical prophylaxis at YCH and YGH was frequently given for duration >1 day and often involved the use of broad-spectrum antimicrobials, such as ceftriaxone and cefotaxime. Prolonged surgical prophylaxis offers no benefit to the patient, but increases the risk of antimicrobial resistance and adverse events [41–43] including acute kidney injury and *Clostridioides difficile* infection [44]. We suggest that adoption and use of surgical prophylaxis guidelines at YCH and YGH would represent an important opportunity to improve patient safety and control AMR.

Our study had several limitations. First, we only collected antimicrobial prescribing data on each ward on a single day and cannot be certain that the prescribing practices observed were representative of typical prescribing practices. Second, we did not measure the severity and acuity of infection, the duration of antimicrobial use, or whether clinical staff altered the route of antimicrobial administration over time or adjusted the antimicrobial prescription based on the microbiology test result after their ward had been surveyed. Third, we could not always assess guideline compliance fully. For example, hospital-specific treatment guidelines were not available for all encountered diagnoses, and some guidelines that recommended antimicrobial use did not specify which antimicrobials should be used. Fourth, we did not assess guideline compliance in relation to antimicrobial dose, timing of administration, spectrum of antimicrobial activity, or appropriateness of therapy decisions. Finally, the prevalence of identified pathogen-directed antimicrobial prescription was likely underestimated due to limited health care resources, including laboratory services in hospital. This likely resulted in the true prevalence of appropriate indication for empirical therapy being overestimated.

Conclusion

Our study demonstrated that antimicrobials are commonly prescribed at YCH and YGH and that broad-spectrum antimicrobials are frequently used. Our findings support the need to create awareness and support for ASP interventions at YCH and YGH. Data from our surveys can be used to provide a baseline for a series of PPS to monitor antimicrobial prescribing and the effect of ASP interventions at YCH and YGH over time. Dissemination of our findings may also encourage other hospitals in Myanmar to implement, or review and update, their own ASPs. Effective ASPs, at YCH, YGH, and elsewhere, should be resourced to review and develop further evidence-based antimicrobial prescribing guidelines, improve documentation of antimicrobial prescribing, increase the use of microbiology testing and support for microbiological laboratory services, and evaluate the implementation and success of ASP interventions.

CRedit author statement

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Conflict of interest statement

None declared.

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