ARTICLE

Antimicrobial stewardship: attitudes, perceptions, and practices of healthcare workers in a pediatric tertiary hospital

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OBJECTIVES: This study aims to determine the healthcare workers' (HCWs) attitudes, perceptions, and practices regarding Antimicrobial Stewardship (AMS) at the Philippine Children's Medical Center (PCMC).

MATERIALS AND METHODS: This cross-sectional study employed a validated online survey.

RESULTS: The study included 288 healthcare workers, predominantly female (77.35%) and aged 31-40 years (47.74%), with physicians being the largest professional group (57.14%). HCWs had positive attitudes toward AMS. They perceived moderate to high antimicrobial resistance (AMR) levels in different contexts but believed the hospital had lower AMR levels than the country. HCWs agreed that AMR impacts antimicrobial choices, patient outcomes, and safety. Contributors to AMR were prescribing inappropriate antimicrobials, unnecessary prescriptions, poor patient adherence, and inadequate infection control measures. HCWs, except medical technologists, were aware of the Antimicrobial Stewardship Program (ASP) and its interventions. Only nurses and pharmacists were aware of the hospital policies against AMR. Barriers to AMS implementation include inadequate training in antimicrobial use, lack of infectious disease/ microbiology services, lack of electronic medication management services, and personnel shortages. HCWs had high self-reported AMS practices, but a practice gap in single-dose surgical antibiotic prophylaxis was identified, with low physician adherence (50.6%).

CONCLUSION: This study revealed positive attitudes and high self-reported AMS practices among HCWs. They also perceived moderate to high AMR in different contexts but believed that the hospital has lower AMR levels than the country. Addressing the identified barriers to implementation and practice gaps is crucial for achieving antimicrobial stewardship goals.

KEYWORDS: *Antimicrobial stewardship, AMS, ASP, Healthcare workers, Pediatric.*

Introduction

Antimicrobial resistance (AMR) is a significant global health concern. In 2019, drug-resistant infections caused 1.27 million deaths, with a disease burden of 4.95 million (1). Developing nations, including the Philippines, bear a disproportionate share of this problem. To address this, the World Health Organization (WHO) endorsed the Global Action Plan (GAP) in 2015, urging nations to adopt One-Health-based national action plans (NAP) against AMR (2). In response, the Philippines initiated its Philippine Action Plan to Combat AMR and National Policy on Infection Prevention and Control in 2015 and 2016 (2). These policies underscored the importance of antimicrobial stewardship (AMS) and the establishment of Antimicrobial Stewardship Programs (ASPs) as essential tools against AMR. AMS is a comprehensive set of actions promoting the responsible use of antimicrobials. ASP, an integral component of AMS, is a multidisciplinary, coordinated approach designed to ensure the judicious use of antimicrobials to curb AMR while optimizing patient care (3). Notably, it was not until 2019 that the Philippine Children's Medical Center (PCMC) formally implemented its ASP, marking a crucial milestone in addressing AMR within the institution.

A fundamental objective within the ASP is to enhance comprehension, foster positive attitudes, and promote prudent practices concerning prescribing, dispensing, administering, and utilizing antimicrobial agents (4). While numerous studies have acknowledged the role of healthcare workers (HCWs), including nurses, pharmacists, medical technologists, and physicians (5-9), in combatting AMR, there is little research on their attitudes, perceptions, and practices concerning AMS, especially within local contexts (10,11). Given the AMR's persistent challenges and the pivotal role HCWs play, examining their views and practices concerning AMS is imperative.

This study aims to determine the HCWs' attitudes, perceptions, and practices related to AMS at the Philippine Children's Medical Center. Specifically, we aim to determine their socio-demographic profile and the relationship between their attitudes, perceptions, and practices, considering their professions and years of experience at the institution. The insights gained from this research will serve as valuable guidance for enhancing policies and guidelines at PCMC, contributing to our efforts to combat the enduring threat of AMR.

Materials and Methods

This cross-sectional study was conducted at PCMC, a pediatric tertiary hospital with a 200-bed capacity. HCWs, including physician prescribers (residents, fellows, consultants), nurses, pharmacists, and medical technologists, were recruited via purposive sampling. Eligibility criteria

included HCWs with a valid Professional Regulation Commission (PRC) license currently serving in the hospital and returning a completed questionnaire. Medical technologists not involved in microbial tests and cultures and HCWs from other institutions were excluded. The calculated sample size was 246 using proportion sampling techniques, a design effect 1.0, an anticipated frequency of 50%, a 95% confidence interval, and a 5% margin of error.

The survey questionnaire entitled "Antimicrobial stewardship: Attitudes and practices of Healthcare providers in selected health facilities in Uganda" (12), was adapted for local use in the Philippines with permission from its original authors. Content validity was ensured through expert panel evaluation, applying COSMIN criteria for item relevance. Items with an item-level content validity index (I-CVI) above 0.80 were accepted. Face validity was assessed by seeking stakeholders' input to refine the survey instrument. After validation, the questionnaire underwent pilot testing with 30 randomly selected HCWs to assess completion time and gather feedback.

The final questionnaire consisted of four parts. The first part was a checklist of the respondents' personal information--age, sex, profession (nurse, pharmacist, medical technologist, physician prescriber), and years of experience at PCMC. The second section comprised nine questions on the attitudes of HCWs regarding AMS. These questions employed a 4-point Likert scale (1= Strongly disagree, 2= Disagree, 3= Agree, 4= Strongly agree). The third part included 25 questions on HCWs' perception of the level of AMR, the impact of AMR, policies to combat AMR, ASP and ASP intervention, and the barriers to effective AMS in the hospital. The questions were 4- and 5-point Likert-type (1= Strongly disagree, 2= Disagree, 3= Agree, 4= Strongly agree; 1=Not important, 2=Slightly important, 3= Moderately important, 4= Very important, 5= Extremely important; 1= Very low, 2=Low, 3=Moderate, 4=High, 5=Very high), close-ended (yes, no, or I don't know), and multiple choice questions. The fourth part included 18 questions on practices related to antimicrobial stewardship and required "yes," "no," or "I don't know" answers.

The survey was conducted after obtaining approval from the Institutional Research–Ethics Committee (IR-EC). The survey questionnaire was distributed to the target respondents via online announcement platforms, including section and hospital announcement Viber groups. Before participating in the survey, respondents were provided with informed consent, which explained the confidentiality of their information, the maintenance of anonymity, and the voluntary nature of their participation. Respondents were given 10-15 minutes to complete the survey, with the flexibility to do so at their convenience, during breaks or outside their work or duty hours. Data collection spanned over one month.

Survey responses were automatically collected and tallied using Google Sheets, with all valid data included in the subsequent analysis. All information collected was prospectively reviewed and coded in Microsoft Excel and JASP 0.16.3. Frequency and distribution percentages were used to determine the socio-demographic profile of healthcare workers according to age, sex, profession, and years of experience. When grouped according to the profession, Kruskal-Wallis and Friedman's tests determined the significant difference between healthcare workers' attitudes, perceptions, and practices about AMS. The Spearman correlation test correlated the years of experience with attitudes.

RESULTS

Table 1 provides an overview of the demographic characteristics of the 288 respondents in our study. The largest age group was 31-40 years-old (47.74%) and majority were female (77.35%). In terms of years of experience at the institution, 37.98% had 1-5 years of experience. Physicians, including residents, fellows, and consultants, constituted the largest professional group at 57.14%, followed by nurses at 31.01%.

Table 1. Demographic Characteristics of Respondents (N=287)

	N	%
Age		
21-30	69	24.04
31-40	137	47.74
41-50	35	12.20
51-60	30	10.45
Older than 60	16	5.56
Sex		
Female	222	77.35
Male	65	22.65
Profession		
Medical Technologist	4	1.39
Nurse	89	31.01
Pharmacist	30	10.45
Physician	164	57.14
Resident	46	16.03
Fellow	55	19.16
Consultant	63	21.95
Years of experience in the institution		
Less than 1 year	52	18.12
1-5 years	109	37.98
> 5-10 years	41	14.29
> 10-15 years	33	11.50
More than 15 years	52	18.12

Attitudes of healthcare workers toward AMS in this hospital

We utilized a 4-point Likert scale with response options ranging from 1 to 4 (1= Strongly disagree, 2= Disagree, 3= Agree, 4= Strongly agree) and a midpoint set at 2.5. Responses above this midpoint were classified as 'Positive Attitude,' indicating agreement, while those at or below were deemed 'Negative Attitude,' signifying disagreement.

Over-all attitudes toward AMS were generally positive across all professional groups, with scores ranging from 3.40 to 3.80 out of 4. Notably, 283 out of 288 respondents (98.26%) exhibited positive attitudes. The nurses had lower attitude scores than other professional groups, with the Kruskal-Wallis test, $H(5) = 20.827$, $p < 0.001$, confirming significant differences in attitudes only between nurses and pharmacists ($p < 0.001$). The items on familiarity with the goals of ASP and the provision of adequate training on AMS practices consistently received lower ratings across all groups.

Table 2. Attitudes of Healthcare Workers Toward AMS in this Hospital

	Medical Technologist	Nurse	Pharmacist	Physician (Consultant)	Physician (Fellow)	Physician (Resident)
I understand what antimicrobial stewardship (AMS) is.	3.75	3.33	3.83	3.56	3.47	3.45
I am familiar with the goals of the AMS program in this hospital.	3.50	3.27	3.77	3.43	3.33	3.46
Implementation of AMS programs is essential.	3.75	3.42	3.87	3.81	3.70	3.74
Antimicrobial stewardship (AMS) involves the appropriate and optimal selection and administration of antimicrobials in appropriate dose, route, intervals and duration.	3.75	3.50	3.90	3.68	3.70	3.78
Antimicrobial stewardship (AMS) interventions can improve patient outcomes if the selection of antimicrobial dose, formulation, frequency and duration of administration are all well optimized.	3.50	3.52	3.90	3.71	3.71	3.74
Implementing effective AMS strategies or interventions in the hospital can significantly reduce the development and spread of antimicrobial resistance.	3.75	3.47	3.87	3.73	3.80	3.78
Implementing AMS practices can lead to a decrease in the length of hospital stay for patients.	3.75	3.45	3.83	3.60	3.64	3.67
The implementation of effective and diligent AMS practices can significantly reduce inappropriate antimicrobial use within this hospital.	4.00	3.52	3.87	3.81	3.73	3.72
This hospital provides adequate training on AMS practices.	2.75	3.11	3.27	2.98	3.16	3.22
OVERALL	3.611	3.40	3.80	3.60	3.58	3.62

Attitudes of healthcare workers in relation to their years of experience in this hospital

We investigated the relationship between HCWs' years of work experience at this hospital and their attitudes toward AMS. The analysis showed a negative association with Spearman's correlation coefficient of -0.142 ($p < 0.05$, $N = 288$). This correlation is statistically significant at the 0.05 level. However, in line with Cohen's conventions, the effect size associated with this correlation was considered small.

Perception of healthcare workers on the level of AMR in different contexts

The respondents rated their perceived levels of AMR from "Very low" to "Very high" in various contexts, including the country, our hospital, their specific ward or unit, and first-line antibiotics for common bacterial infections in children under five.

The perceived levels of AMR in the country, hospital, ward or unit, and common bacterial infections in children under five years old were consistently rated as moderate to high (1-1.8: Very low; 1.81-2.6: Low; **2.61-3.4: Moderate; 3.41-4.2: High;** 4.21-5: Very high) across all professional groups. In the context of AMR, all professions believed the hospital had lower AMR levels than the rest of the country. Statistical analysis utilizing the Friedman test ($\chi2(3) = 152.018$, $p < 0.001$) followed by Conover's Post Hoc comparisons revealed significant differences in perceptions of country-level AMR levels in comparison to other contexts ($p_{bonf} < 0.001$).

Table 3. Perception of Healthcare Workers on the Level Of AMR in the Country, Hospital, their Ward or Unit and to First-Line Antibiotics for Common Bacterial Infections in Children in this Hospital who are less than 5 Years Old

	Medical Technologist	Nurse	Pharmacist	Physician (Consultant)	Physician (Fellow)	Physician (Resident)
In the country	3.75	3.32	4.00	3.36	3.46	3.48
In the hospital	3.00	2.93	3.17	3.24	3.36	3.24
In their ward or unit	3.00	2.73	2.61	2.92	3.04	3.02
To first-line antibiotics for common bacterial infections in children in this hospital who are less than 5 years old	3.00	2.88	3.13	2.91	2.98	2.98

Perceptions of healthcare workers on the impact of AMR

We used 4- and 5-point Likert scales to assess HCWs' perceptions of the impact of AMR on antimicrobial choices and patient outcomes and safety. Overall, respondents agreed that AMR affects antimicrobial choices. Additionally, the impact of AMR on patient outcomes and safety was rated as moderate to high. Nurses perceived AMR to have a lower impact on prescription choices and patient outcomes than other groups.

Specifically, nurses' perceptions of the impact of prescription choices differed significantly from most other groups, as did their views on patient outcomes compared to consultants and fellows. These differences were statistically significant H (5) = 22.146, $p < 0.001$, with Bonferroni-adjusted p-values indicating significant distinctions when comparing nurses to other groups, such as pharmacists ($p < 0.009$), consultants ($p < 0.007$), fellows ($p < 0.008$), and residents ($p < 0.003$).

Table 4. Healthcare workers' perception on the impact of antimicrobial resistance on the choice of antimicrobial prescriptions and patient outcomes and safety

	Medical Technologist	Nurse	Pharmacist	Physician (Consultant)	Physician (Fellow)	Physician (Resident)
On choices of anti-microbial prescrip-tions *(ratings from 1 to 4)**	3.50	3.25	3.63	3.60	3.53	3.57
On patient outcomes and safety *(ratings from 1 to 5)* **	3.75	3.71	3.93	4.19	4.18	4.17

1-1.9: Strongly disagree; 2-2.9: Disagree;* ***3-3.9: Agree**; 4- Strongly agree*
1-1.8: Very low; 1.81-2.6: Low; 2.61-3.4: Moderate;* ***3.41-4.2: High*; 4.21-5: Very High*

Perception of healthcare workers on the factors contributing to AMR in the hospital

The respondents rated all the factors listed in Table 5 as "Very important" to "Extremely important" contributors to AMR in this hospital. The top four factors across multiple groups include prescribing inappropriate antimicrobials, prescribing antimicrobials when not needed, poor adherence of patients to prescribed antimicrobial regimens in outpatient settings, and inadequate infection prevention and control measures. Nurses consistently rated the importance of all the factors lower than other professional groups.

Table 5. Perception of healthcare workers on the factors contributing to AMR in the hospital

	Medical Technologist	Nurse	Pharmacist	Physician (Consultant)	Physician (Fellow)	Physician (Resident)
1. Prescribing the inappropriate antimicrobials	4.25	3.92	4.53	4.52	4.49	4.37
2. Prescribing Antimicrobials when not needed	3.75	3.75	4.43	4.65	4.49	4.41
3. Poor adherence of patients to prescribed antimicrobial regimen (outpatient)	4.25	4.07	4.43	4.48	4.53	4.46
4. Poor access to treatment guidelines within the hospital	4.00	3.97	4.30	4.19	4.24	4.24

5.	Lack of continuing education and updated information on antimicrobial susceptibility patterns	4.00	3.97	4.47	4.38	4.35	4.41
6.	Empiric antimicrobial prescribing without laboratory investigation	4.00	3.82	4.43	4.08	4.04	3.83
7.	Poor access to antibiograms to guide prescription	4.00	3.83	4.37	4.35	4.26	4.11
8.	Use of antimicrobials for longer than the prescribed standard duration	4.00	3.79	4.43	4.33	4.22	4.22
9.	Lack diagnostic (laboratory or ancillary) tests	4.00	3.92	4.40	4.10	4.00	3.83
10.	Lack of/inadequate infection prevention and control measures	4.25	3.98	4.43	4.51	4.29	4.24
11.	Lack of control in the access and prescription of antimicrobials	4.00	3.91	4.30	4.29	4.16	4.15
12.	Lack of antimicrobials in the pharmacy's inventory	4.25	3.92	4.17	3.98	4.04	3.98
13.	Substandard antimicrobials in the pharmacy's inventory	3.75	3.91	3.97	4.24	4.00	3.89
14.	Influence of pharmaceutical companies on the hospital	4.00	3.79	3.90	3.68	3.53	3.39

*1-1.8: Not important; 1.81-2.6: Important; 2.61-3.4: Moderately important****; 3.41-4.2: Very important; 4.21-5: Extremely important***
Reliability: α = 0.971

Awareness of healthcare workers on hospital policies to combat AMR and on Antimicrobial Stewardship Program (ASP) and ASP interventions

We assessed the respondents' knowledge of the hospital policies to combat AMR and ASP and its policies and interventions by comparing their answers to correct responses, as illustrated in Table 6. The passing score was set at 75% correctness.

Table 6. Awareness of healthcare workers on hospital policies to combat AMR, and on Antimicrobial Stewardship Program (ASP) and ASP interventions

Question	Correct Answer
Hospital policies to combat AMR	
1. Has the hospital implemented national policies and guidelines for the appropriate use, availability, and distribution of high-quality antimicrobials in its pharmacy?	Yes
2. Has the hospital instituted protocols for antimicrobial treatment and prophylaxis?	Yes
3. Does the hospital participate in a national or local antimicrobial awareness campaigns?	Yes
4. Has the hospital instituted guidelines or regulations requiring antimicrobials to be dispensed only on prescription by a qualified healthcare worker?	Yes
5. Does the hospital monitor antimicrobial consumption to estimate usage?	Yes
6. Does the hospital have action plans in place to identify and report trends in antimicrobial resistance (AMR)?	Yes
7. Has the hospital reviewed and adopted the antimicrobials listed in the Philippine National Formulary?	Yes
8. Does the hospital have a surveillance system for antimicrobial use that includes national consumption data and current infection treatment guidelines?	Yes
9. Has the hospital used government generated and reported AMR reports / information?	Yes
10. Is this hospital part of a functioning national antimicrobial resistance surveillance system covering antimicrobials in hospitals and outpatient clinics?	No
11. Is a functional infection prevention and control (IPCC) committee with standard operating procedures (SOPs), guidelines and protocols available and accessible to all sectors in the hospital?	Yes

	Question	Correct Answer
Antimicrobial Stewardship Program (ASP) and ASP interventions		
1.	Is there any existing, formal, institution-wide antimicrobial stewardship program in this hospital?	Yes
2.	A policy that requires prescribers to document the dose, duration, route, frequency, and indications of all antimicrobial prescriptions in the medical chart	Yes
3.	A policy requiring antimicrobial pre-authorization by an AMS clinician/ID specialist for specific antimicrobials	Yes
4.	A policy governing treatment duration, such as Automatic Stop Order (ASOP) that requires prescriptions to be regularly reviewed	Yes
5.	Antimicrobial formulary, restriction, and approval systems	Yes
6.	Antimicrobial Order Forms (AOF), which require clinicians to justify their antimicrobial use	Yes
7.	Antimicrobial combination therapies (use of multiple antimicrobials) used as initial empiric treatment of severe infections	Yes
8.	Streamlining (switching to a more targeted narrow-spectrum antimicrobial once an organism is identified via culture)	Yes
9.	De-escalation (discontinuing the empirical antimicrobial if the culture is negative)	Yes
10.	Dose optimization (i.e., account for individual patient characteristics such as age, renal function, and weight; causative organism; site of infection; and pharmacodynamics of the drug) when prescribing antimicrobials	Yes
11.	A systematic plan for converting parenteral to oral (I.V. to P.O.) administration of antimicrobial once a patient meets defined clinical criteria	Yes
12.	Are there diagnostic pathways for patients with reported bacterial infections?	Yes
13.	Are there guidelines for reporting for adverse reactions to antimicrobials?	Yes
14.	Are antibiograms developed and distributed at least quarterly?	Yes
15.	Are antibiograms utilized to assess antimicrobial resistance trends within the hospital?	Yes
16.	Do physicians use rapid diagnostic tests without stewardship advice?	Yes
17.	Does the hospital monitor hospital-specific antimicrobial resistance?	Yes
18.	Does the microbiology laboratory practice selective reporting of susceptibility testing (reporting only relevant antibiotics' results)?	Yes

As seen in Table 7, only nurses and pharmacists met the passing threshold for knowing the hospital policies to combat AMR. Generally, understanding of ASP and its interventions was satisfactory (>75%) across the various professions except for medical technologists.

Table 7. Healthcare workers' knowledge of hospital policies to combat AMR, Antimicrobial Stewardship Program (ASP) and ASP interventions

	Medical Technologist	Nurse	Pharmacist	Physician (Consultant)	Physician (Fellow)	Physician (Resident)
Hospital policies to combat AMR	58.3	75.1	80.8	62.3	72.7	73.2
ASP, and ASP Interventions	66.7	84.0	85.4	75.3	82.8	88.3

Note: Scores are in percentage of total possible correct answers.

Perception of healthcare workers on barriers to antimicrobial stewardship (AMS) in the hospital

We assessed the perception of HCWs on barriers to AMS in this hospital using a multiple-choice question. The top three most commonly identified barriers to AMS across all groups were 1. lack of HCWs' training and education in antimicrobial use; lack of infectious disease/microbiology services; 2. lack of electronic medication management services, and

3. personnel shortages (specifically, a shortage of AMS full-time staff). Table 8 shows the frequencies and percentages of respondents who identified each item as a barrier to AMS.

Table 8. Perception of healthcare workers on barriers to Antimicrobial Stewardship (AMS) in the hospital

	Medical Technologist n (%)	Nurse n(%)	Pharmacist n (%)	Consultant n (%)	Fellow n (%)	Resident n (%)	Total n(%)
1. Healthcare workers' lack of training and education in antimicrobial use	2 (50)	60 (67.42)	25 (83.33)	49 (77.78)	40 (72.73)	37 (80.44)	213 (73.96)
2. Lack of time among the antimicrobial stewardship team	2 (50)	40 (44.94)	24 (80)	26 (41.27)	17 (30.91)	14 (30.44)	123 (42.71)
3. Lack of leadership to promote antimicrobial stewardship at the facility	1 (25)	35 (39.33)	8 (26.67)	18 (28.57)	13 (23.64)	15 (32.61)	90 (31.25)
4. Lack of support and cooperation from senior clinicians in this hospital	1 (25)	38 (42.70)	18 (60)	17 (28.98)	16 (29.10)	13 (28.26)	68 (23.61)
5. Lack of infectious disease or microbiology services	3 (75)	55 (61.80)	18 (60)	56 (88.89)	48 (97.23)	33 (71.74)	213 (73.96)
6. Lack of pharmacy resources	2 (50)	40 (44.94)	18 (60)	17 (28.98)	15 (27.27)	22 (47.83)	114 (39.58)
7. Unwillingness of healthcare providers to change their prescribing practices	1 (25)	32 (3.96)	20 (66.67)	35 (55.56)	20 (36.36)	19 (41.30)	95 (32.99)
8. Lack of enforcement by hospital management/executive	1 (25)	30 (33.71)	9 (30)	21 (33.33)	15 (27.27)	15 (32.61)	91 (31.60)
9. Lack of an electronic medication management system	2 (50)	53 (59.55)	22 (73.33)	43 (68.25)	37 (67.27)	28 (60.87)	185 (64.24)
10. Inadequate time for AMS activities among healthcare providers	2 (50)	47 (52.81)	17 (56.67)	32 (50.79)	19 (34.55)	21 (45.65)	138 (47.92)
11. Personnel shortages/ lack of manpower (e.g., full-time AMS staff)	1 (25)	58 (65.17)	27 (90)	40 (63.49)	28 (50.91)	22 (47.83)	176 (61.11)
12. Inadequate funding for antimicrobial stewardship strategies, activities, or personnel	2 (50)	39 (43.82)	17 (56.67)	29 (46.03)	17 (30.91)	15 (32.61)	119 (41.32)
13. Opposition to antimicrobial stewardship from healthcare workers (HCWs)	1 (25)	31 (34.83)	12 (40)	18 (28.57)	10 (18.18)	9 (19.57)	81 (28.13)
14. Paucity of data on improved outcomes with AMS programs in the health facility	2 (50)	31 (34.81)	8 (26.67)	27 (42.86)	20 (36.36)	19 (41.30)	107 (37.15)
15. None of the above	0 (0)	1(1.12)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.35)

Practices of healthcare workers towards AMS: Comparison of self-reported and observed practices

Table 9 provides information on the practices of different professional groups toward AMS. Each row represents specific practices related to a profession, while each column represents a professional group reporting those practices. For instance, a physician-specific practice (row) intersection with their own group's report (column) indicates their self-reported practices. The intersections of physician-specific practices (row) with columns representing other professional groups show how often these other groups perceive physicians to engage in AMS practices. This allows for comparing the group's self-reported practices with those observed by professional groups other than themselves.

The questions required "yes" (coded as 1), "no," or "I don't know" (both coded as 0) responses. The answers were added to give practice scores and were interpreted as "high," "fair," and "poor" if they ranged between 80-100%, 50-79%, and <50% of the maximum possible score.

Regarding physicians' self-reported and observed practices, they had high self-reported practice scores in most areas except for avoiding unnecessary use of broad-spectrum antimicrobials, using a single dose of an IV antibiotic for surgical procedures, reviewing antimicrobial prescriptions for inpatients in all ward rounds, and regularly communicating team-based assessment of antimicrobial use to prescribers and the Infection Prevention and Control Committee (IPCC). The lowest self-reported practice concerned the use rate of a single IV antibiotic dose for surgical prophylaxis, with only 50.6% adherence reported. Nurses and pharmacists also observed low adherence to this protocol among physicians (52.8% and 43.3%, respectively).

Pharmacists had a high self-reported practice of reviewing antimicrobial prescriptions during all ward rounds. However, all pharmacists (100%) believed that their group reviews prescriptions in all ward rounds, while only 72% of physicians reported the same practice, $H(3)=36.463$, $p<0.001$, $z=3.511$, $p_{bonf}=0.001$.

Nurses had a high self-reported practice of reviewing antimicrobial prescriptions during all ward rounds. However, more nurses (85.4%) believed their group reviews prescriptions in all ward rounds compared to physicians (58.5%), $H(3)=34.340$, $p<0.001$, $z=4.245$, $p_{bonf}=<0.001$. Additionally, more nurses (88.8%) reported communicating with the Infection Prevention and Control Committee compared to physicians (66.5%), $H(3)=17.718$, $p<0.001$, $z=3.937$, $p_{bonf}=<0.001$.

Table 9. Practices of healthcare workers towards AMS: frequencies of self-reported and observed practices

	Medical Tech-nologists	Nurses	Pharmacists	Physicians
Physicians				
Physicians use local guidelines to initiate prompt, effective antimicrobial treatment within one hour of presentation or as soon as possible in patients with life-threatening infections.	0	85.4	96.7	89.6
Physicians avoid the unnecessary use of broad-spectrum antimicrobials.	**0**	**71.9**	**53.3**	**79.3**
Physicians document the clinical indications, formulation, dose, route, frequency, duration, and review dates of antimicrobial use.	0	89.9	83.3	89.0
Physicians only use a single dose of an IV antimicrobials for surgical procedures.	**0**	**52.8**	**43.3**	**50.6**
Physicians switch to the appropriate, narrower-spectrum antimicrobials when susceptibility testing indicates resistance.	0	85.4	90.0	89.0
Physicians review antimicrobial prescriptions for hospital inpatients in all ward rounds.	0	85.4	73.3	73.2
Physicians review antimicrobial treatments within 48 hours of initiation and discontinue their use if no evidence of infection is found.	0	77.5	73.3	72.0
Physicians review antimicrobial treatments within 48 hours of initiation and appropriately switch from intravenous to oral administration when indicated.	0	80.9	76.7	81.1
Physicians modify their antimicrobial prescribing practices based on the results of adverse event monitoring.	0	94.4	86.7	90.9
Physicians modify their antimicrobial prescribing practices based on the results of antimicrobial susceptibility reports.	0	93.3	93.3	95.7
Physicians modify their antimicrobial prescribing practices based on the results of antimicrobial prescribing and medication error audits.	0	82.0	76.7	82.3
Physicians modify their antimicrobial prescribing practices based on the results of antimicrobial usage data.	0	89.9	83.3	83.5
Pharmacists				
Pharmacists review antimicrobial prescriptions for hospital inpatients in all ward rounds.	**0**	**91.0**	**100**	**72.0**
Nurses				
Nurses review antimicrobial prescriptions for hospital patients in all ward rounds.	**0**	**85.4**	**40.0**	**58.5**
Healthcare workers				
HCWs instruct patients and caretakers about the use of prescribed antimicrobial medications.	25.0	89.9	100	90.2
In antimicrobial treatment policy decisions, HCWs actively seek the input and perspectives of other stakeholders while promoting the adoption of best practices.	0	87.6	86.7	78.7
HCWs regularly take part in a team-based evaluation of antimicrobial usage, considering both the quality and the quantity.	50.0	82.0	83.3	68.9
HCWs regularly communicate the results of their team-based assessments of antimicrobial use to prescribers and the Infection Prevention and Control Committee.	**75.0**	**88.8**	**86.7**	**66.5**

Note: Values are the percentage of that respondent category that perceives the practice as being done. Highlighted cells are the groups for which significant differences in perception were observed.

Discussion

Attitudes

Our study showed a positive attitude towards AMS among all professional groups. Pharmacists had the highest attitude scores towards AMS, while nurses had the lowest. It is important to note that despite nurses having the lowest scores, their overall attitude towards AMS remained positive. These findings align with a study by Kimbowa *et al*. (12), which also reported positive AMS attitudes across professional groups, with pharmacists scoring the highest and nurses scoring the lowest.

Our HCWs agreed with AMS' crucial role in combating AMR, curbing its spread, and reducing hospital stays. This aligns with the findings of Kimbowa *et al.* (12). and Pagcatipunan *et al.* (10), where HCWs also recognized that implementing AMS strategies can minimize the risk of AMR development, reduce patient's length of stay, and improve patient outcomes.

Our study, however, identified a need for greater familiarity with AMS goals and a demand for more comprehensive AMS-related training within our hospital. This need for education and training is consistent with existing literature, which suggests that while HCWs generally appreciate the importance of AMS, they often need a deeper understanding of what an AMS program entails (13). This highlights the importance of educational initiatives to introduce AMS goals and provide insights into the corresponding interventions and their practical implementation for HCWs. Recognizing that a positive attitude is a critical facilitator for successful AMS and ASP (13), the implementation of targeted AMS-related training programs to leverage this positive outlook could significantly enhance knowledge, improve our HCW's attitudes, and positively impact their practices, as evidenced by several studies (14-16).

Our study identified a weak, negative correlation between HCWs' years of experience and their attitudes toward AMS, suggesting a slight decline in attitude scores as the years of work experience in the hospital increased. Interestingly, this finding challenges the conventional notion that more time spent in a healthcare setting naturally leads to stronger support for AMS initiatives. A study by Charani *et al*. (17) on antimicrobial prescribing practices, while not directly addressing attitudes, revealed that senior physicians often consider themselves exempt from following established policies and practice guidelines, as they operate within a culture of perceived autonomous decision-making, relying more on personal knowledge and experience than formal policy. In the context of AMS attitudes, such perception could contribute to less positive AMS attitudes in more senior HCWs, emphasizing the significance of continuous education and reinforcement of stewardship principles, even among experienced HCWs.

However, it is important to interpret this result cautiously, given the relatively weak correlation observed.

Perceptions

HCWs perceived moderate to high levels of AMR in various contexts, including the country, our hospital, their wards or units, and first-line antibiotics for common bacterial infections in children under five. Notably, within the hospital, HCWs perceived AMR as less severe than the national level, aligning with findings from other surveys (18,19). Nurses consistently rated the impact lower than other groups, a pattern inherent to the nursing group rather than the questionnaire's content. While not directly applicable to our study, other studies (20,21) reveal a similar limited interest in AMS-related concepts among nurses despite intersecting with their work. Their hesitancy to engage fully in AMS arises from perceiving it as the domain of physicians and pharmacists, the absence of formal policies outlining their roles, a culture favoring physician prescriber authority, and a belief that AMS tasks extend beyond traditional nursing roles, posing an additional burden (20,21). An additional study to further explore these themes may offer valuable insights and enhance nurses' engagement in our hospital's AMS initiatives.HCWs agreed that AMR impacts antimicrobial choices, patient outcomes, and patient safety. Over the years, the emergence of AMR has led to notable shifts in prescribing practices, such as changes in empiric therapy choices, with a tendency to use broader-spectrum antimicrobials and other agents with reduced efficacy and increased toxicity (22). In our hospital, empiric antimicrobial therapies are tailored to the resistance pattern of the organisms, ideally guided by the hospital-wide and unit-specific antibiograms and the data from the Antimicrobial Resistance Surveillance Program (ARSP) results. The impact of AMR on patient safety and outcomes, including all-cause and infection-related morbidity and mortality rates, is a well-recognized consequence of AMR (22).

HCWs identified our hospital's most critical contributors to AMR: inappropriate prescription of antimicrobials, unnecessary prescription of antimicrobials, patient non-adherence to outpatient therapy, and inadequate infection control measures. These findings are congruent with those of Balliram *et al.,* Burger *et al.,* and Abera *et al.,* where inappropriate and over-prescription of antimicrobials and patient non-adherence to antimicrobial therapy in the outpatient department were also identified as primary drivers of AMR (23-26). Considering these findings and drawing upon prior research, it may be advisable to consider initiatives such as educating physician prescribers about the selection of appropriate antimicrobials, making local antimicrobial guidelines like the National Antibiotic Guidelines (NAG)

available, and promoting active consultations with infectious disease experts to facilitate the successful implementation of AMS (26).

Only nurses and pharmacists met the threshold for awareness of hospital policies against AMR, which, especially for pharmacists, is not surprising. As critical stakeholders in antimicrobial management, pharmacists are involved in procuring, dispensing, monitoring, and enforcing policies related to judicious antimicrobial use in this hospital (4). Clinical pharmacists, integral members of the AMS team, often engage with IPCC policies and AMR awareness campaigns. On the other hand, the limited exposure may account for the need for more policy awareness among trainees with shorter years of experience (2-3 years), such as fellows and residents, who primarily focus on their clinical duties during onboarding. Similarly, some consultants, despite potentially having longer years of experience, may not be full-time hospital employees, leading to limited physical presence and involvement in hospital activities, including policy awareness.

Most HCWs, except for medical technologists, demonstrated awareness of the hospital's ASP and associated interventions, including pre-authorization, formulary restrictions, streamlining, de-escalation, dose optimization, and intravenous to oral (IV to PO) antimicrobial switch. This observation is unsurprising as these aspects of AMS are typically within the purview of prescriber physicians, pharmacists, and nurses. However, recognizing the crucial role of medical technologists in diagnostic stewardship and the creation of hospital-wide antibiograms (7), it is imperative to extend efforts to educate them about AMS policies and practices.

In our study, the following were identified as top barriers to AMS: inadequate training and microbiology services, absence of electronic medication management, and personnel shortages. These findings are similar to the results of local studies by Pagcatipunan *et al.* and Diño *et al.* (10,11).

The lack of adequate training in AMS consistently emerges in our survey and can be considered an actionable target. Although our hospital has Gram staining, cultures, and automated susceptibility testing capacities, the absence of other microbiology services was identified as a prominent AMS barrier. However, the limited diagnostic capacity for molecular identification or rapid testing for a wide range of microorganisms is likely the barrier the HCWs intended to highlight. Some studies suggest interventions like enhancing diagnostic capacity through collaboration with larger institutions with advanced microbiology laboratory capabilities or expanding our hospital's microbiology laboratory facilities through a dedicated national action plan with allocated funding (27).

communication of guidelines to prescribers (31).

Discrepancies were observed between HCWs' self-reported and observed AMS-related practices, particularly in avoiding broad-spectrum antimicrobials, conducting consistent antimicrobial prescription ward rounds, and communicating with the IPCC. This presents an opportunity to identify practice gaps and provide targeted feedback to specific professional groups.

Establishing a shared understanding of what constitutes an antimicrobial prescription ward rounds can be beneficial to addressing the gap in practices related to antimicrobial prescription ward rounds. Implementing standardized documentation policies (31) and more comprehensive prescription charts (32) can help achieve this goal. Studies have shown that these measures can help prevent unnecessary or prolonged use of antimicrobials and reduce overall antimicrobial consumption without impacting patient outcomes (32).

Another effective strategy is routinely monitoring antimicrobial usage, especially broad-spectrum agents, and providing feedback to HCWs about institutional antimicrobial utilization and global Point Prevalence Survey (PPS) results (31). Such measures can effectively guide physicians' prescribing practices and promote adherence to AMS strategies, as demonstrated in a local study (31) where repeated surveillance and hospital-wide PPS identified targets for quality improvement of antimicrobial prescribing and raised awareness among HCWs.

Involving other HCWs, such as nurses and pharmacists, in AMS programs at the ward level can also enhance collaboration and improve communication among team members. Since AMS is a collaborative, multidisciplinary effort, integrating nurses and pharmacists can facilitate better coordination among HCWs (31).

Recommendations

Our study relied on self-administered survey questionnaires, which introduces the potential for self-reporting and social desirability biases, as participants may provide answers they perceive as socially desirable rather than reflecting their attitudes and perceptions towards AMS. Additionally, relying solely on self-reports may not capture the full complexity of healthcare workers' attitudes and perceptions towards AMS. Therefore, future research should consider incorporating other qualitative methods, such as interviews or focus group discussions, to gain a deeper and more nuanced understanding of HCWs' attitudes and perceptions.

This is a single-center study, which limits the generalizability of the results to other healthcare settings. To improve the generalizability, future researchers can extend

scope of their studies to include multiple healthcare facilities.

Moreover, this study serves as a baseline exploration of the attitudes, perceptions, and practices of HCWs towards AMS. It is intended to generate research questions and provide a foundation for further investigations. Future research can build upon this baseline study by exploring specific emerging themes, such as the impact of AMR on antimicrobial prescription practices and patient outcomes. Researchers may also focus on specific professional groups to conduct more in-depth studies that account for different HCWs' unique perspectives and practices.

Conclusion

Our study at the Philippine Children's Medical Center revealed generally positive attitudes and high self-reported practices of AMS among HCWs. A need for enhanced education and training on AMS goals and practices was identified. HCWs perceived moderate to high AMR levels in different contexts but believed the hospital had lower AMR levels than the country. HCWs agreed that AMR impacts antimicrobial prescription choices, patient outcomes, and safety. The top contributors to AMR in this hospital were inappropriate prescription of antimicrobials, unnecessary prescription of antimicrobials, patient non-adherence to outpatient therapy, and inadequate infection control measures. HCWs, except medical technologists, were aware of the ASP and its interventions, while only nurses and pharmacists were aware of the hospital policies against AMR. Barriers to effective AMS implementation included insufficient AMS training, limited access to microbiology services, and electronic medication management and staffing challenges. Practice gaps, particularly in single-dose surgical antibiotic prophylaxis, were identified. The findings from this study offer valuable, actionable insights and recommendations for enhancing the hospital's Antimicrobial Stewardship Program as it aims to strengthen its AMS interventions.

Acknowledgement

This study was supported by a research grant from the Pediatric Infectious Disease Society of the Philippines (PIDSP), Inc.

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