Determination of the Enablers and Challenges in the Implementation of Pharmacy-based Antimicrobial Stewardship (AMS) Program in a Level 3 Hospital in Manila

Patti Euenyce T. Diño, RPh, Samuel S. Aquino, RPh, Danica Dixie M. Depante, RPh and Imelda G. Peña, RPh, MS, DrPH

College of Pharmacy, University of the Philippines Manila

ABSTRACT

Background and Objectives. Antimicrobial resistance (AMR) is a global public health threat that results from misuse and overuse of antimicrobials. The Department of Health (DOH) institutionalized the Antimicrobial Stewardship (AMS) Program in hospitals, based on the core elements *(1) Leadership, (2) Policies, Guidelines, and Pathways, (3) Surveillance Antimicrobial Use (AMU) & AMR, (4) Action, (5) Education, and (6) Performance Evaluation* to ensure rational use of antimicrobials and improve patient outcomes. The program implementation will require the involvement of the AMS clinical pharmacist to positively influence the success of the program's implementation. This study aims to identify the enablers and challenges as perceived by AMS clinical pharmacists in the implementation of an AMS program in a level 3 hospital in Manila.

Methods. A quantitative descriptive study design was employed by administering an online 50-item survey questionnaire to AMS pharmacists, who have at least six (6) months of experience as an AMS pharmacist in the hospital. The survey questionnaire was validated by an expert consultant and underwent pre-testing (Cronbach α = 0.983) for acceptable internal consistency. Responses were collated, coded, and analyzed using median values and frequency distributions for each questionnaire item per Department of Health (DOH) Core Element. Items garnering a median of >3.50 up to 5 were considered as perceived enablers, while those ≤3.50 were identified as perceived challenges.

Results. Some perceived enablers by the AMS pharmacists include presence of a leader and/or clinician in the AMS team, Information Technology (IT) resource availability, clear roles of AMS pharmacists, readily available hospital AMS guidelines, engagement in AMR and AMU surveillance activities, regular performance of AMS interventions (e.g., IV-to-PO conversion, dose optimization, de-escalation of broad spectrum), regular monitoring and evaluating of prescriptions and prescribing behavior, and continuous education on infection, prevention, and control (IPC) and hygiene. On the other hand, some perceived challenges include insufficient funding, inadequate knowledge in interpreting antibiograms, lack of adequate and specialized training sessions, lack of coordination with medical and nursing staff to ensure timely drug administration and automatic stop order, prescribing of non-Philippine National Formulary (PNF) antimicrobials, lack of time to perform AMS activities, lack of qualified personnel, and lack of hospital management and information technology (IT) support.

Conclusion. Empowering AMS clinical pharmacists is vital to addressing the perceived challenges and maximizing the perceived enablers to ensure the successful implementation of the AMS program in the hospital.

Keywords: antimicrobial stewardship, DOH Core Elements, perceived enablers and challenges

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Corresponding author: Imelda G. Peña, RPh, MS, DrPH
College of Pharmacy
University of the Philippines Manila
Taft Avenue, Ermita, Manila 1000, Philippines
Email: idpena@up.edu.ph
ORCiD: https://orcid.org/0009-0000-6116-7064

INTRODUCTION

Antimicrobial resistance (AMR) is a global public health threat that occurs when microbes mutate and become unresponsive towards antimicrobials, making them ineffective.[1,2] AMR is caused by the misuse and overuse of antimicrobials in humans and animals, poor sanitation and hygiene, poor infection prevention and control in hospitals, inaccessibility to quality and affordable antimicrobials, lack of awareness of AMR, and poor enforcement of regulations. The worsening problem of AMR will make infections more difficult to treat in the future, reducing antimicrobials available for patients and adding to the cost of national economies and healthcare systems.[2]

In light of this growing concern, the World Health Assembly endorsed the "Global Action Plan on Antimicrobial Resistance" in 2015 to serve as a guide for countries in developing their own national action plans on AMR.[3] While in the Philippines, the Department of Health (DOH) established the National Antimicrobial Stewardship (AMS) Program in public and private hospitals aiming to address AMR and promote the rational use of antimicrobials.[4] This is built on six (6) core elements, serving as the foundation for its implementation: (1) Leadership; (2) Policies, Guidelines, and Pathways; (3) Surveillance of Antimicrobial Use (AMU) & AMR; (4) Action; (5) Education; and (6) Performance Evaluation.[4]

The AMS program of a hospital is led by the AMS committee, in partnership with the Pharmacy and Therapeutics Committee (PTC) and Infection Prevention and Control Committee (IPCC).[4] Under the AMS committee, AMS team/s, composed of an AMS clinician, an AMS clinical pharmacist, and an executive, are created to implement and monitor AMS strategies. Some of the key roles and responsibilities of AMS clinical pharmacists include implementing AMS policies, guidelines and procedures, performing point of care interventions, coordinating with other healthcare professionals to ensure timely administration of appropriate antimicrobials, identifying cases that require review by Infectious Disease (ID) Specialists, and evaluating antimicrobial prescribing behavior and providing feedback or recommendations to the prescribers.[4]

AMS clinical pharmacists play a crucial role, affecting the success or failure of the hospital's AMS program. Hence, identifying the enablers and challenges encountered by AMS clinical pharmacists in implementing AMS activities is helpful in identifying ways to improve the implementation of the AMS program.

The general objective of this research is to determine the current status of the implementation of the AMS program in the University of the Philippines - Philippine General Hospital (UP-PGH). In line with this, the study aims to:

1. Identify the enablers encountered by AMS clinical pharmacists in the implementation of the AMS program in the UP-PGH.
2. Describe the challenges encountered by AMS clinical pharmacists in the implementation of the AMS program in the UP-PGH.

This study can contribute to the enhancement of current practices of AMS clinical pharmacists in UP-PGH and to the overall improvement of the hospital's AMS program. The results of this study can also be used as a reference to make necessary adjustments to the implementation of the AMS program in other hospitals in the country.

MATERIALS AND METHODS

This quantitative descriptive study was conducted in PGH, a 1,500-bed, tertiary government hospital in Manila City, the Philippines. All AMS clinical pharmacists who have at least six (6) months of experience working as an AMS clinical pharmacist in PGH were included in the study. The research proposal was registered under the UP Manila Research Grants Administration Office. Approval from the UP Manila Research and Ethics Board was obtained prior to the conduct of this study. Informed consent forms, disclosing the nature of the study, including its risks and benefits, were provided to the participants. Participants could voluntarily participate in and withdraw from the study without risks of incurring any penalties. No signatures or any other identifying information were asked and collected to ensure participant confidentiality. Only the researchers were given access to the data and all study-related documents.

The quantitative data was collected using an online questionnaire, which was validated by an expert consultant, and pre-tested using Cronbach's alpha, which showed a reliability of 0.983. The questionnaire consists of 50 items, containing both closed-ended and open-ended questions, including 5-Point Likert scales, multi-select matrix questions, and short essays. Two (2) types of 5-point Likert scales were used: the Agreement 5-Point Likert scale (i.e., Strongly Disagree to Strongly Agree) and the Frequency 5-Point Likert scale (i.e., Never to Always). The questionnaire could be answered in Google Forms for 20 to 30 minutes. The survey was opened to the participants for two weeks. Direct communication was limited only to the PGH Pharmacy Department's Chief Pharmacist, who served as the point person to recruit the participants and disseminate the online questionnaire. This is to ensure the anonymity of the respondents.

The questionnaire consists of items that asked the respondents' perception, actual institutional and individual healthcare professional practices, and personal attitudes and behavior. Where these practices and behaviors align with the standards set in the DOH Manual of Procedures (MOP), they were regarded as enablers; otherwise, these were regarded as challenges. In the context of this study, enablers refer to the factors, perceived by AMS clinical pharmacists, that align the current pharmacy AMS practices of the hospital to the DOH Core Elements standards, as stated in the AMS Program

in Hospitals Manual of Procedures, while challenges refer to the factors, perceived by AMS clinical pharmacists, that hinder the current pharmacy AMS practice of the hospital to the DOH Core Elements standards, as stated in the AMS Program in Hospitals Manual of Procedures.

For data analysis, each questionnaire item was first given a numerical score using the 5-Point Likert Rating and interpretation values to interpret the overall response per item[5] (Table 1). The median and frequency distributions per item were computed using Google Spreadsheets. Questionnaire items are perceived as enablers when both medians of clinical and dispensing pharmacists are above 3.50, and challenges when both medians are 3.50 and below. If there are differences in the medians, identification of enablers and challenges will depend on the relevance of the item to the activities primarily covered by AMS clinical pharmacists.

RESULTS

Demographic Data

From the initial 37 respondents, five (5) respondents were excluded as they did not fit the inclusion criteria. The final number of respondents was narrowed down to 32 AMS clinical pharmacists, among which eight (8) were clinical pharmacists and 24 were dispensing pharmacists. In this study, "AMS clinical pharmacists" refer to pharmacists who provide AMS services in the in-patient clinical pharmacy or dispensing area of UP-PGH. Clinical pharmacists conduct point-of-care interventions, including antimicrobial choice and appropriateness review, directed therapy based on microscopy and other rapid tests or culture and susceptibility tests, dose optimization, IV to PO conversion, and therapeutic drug monitoring. On the other hand, dispensing pharmacists are responsible for implementing the 7th day automatic stop order and handling of restricted antimicrobials, as regulated by the Antibiotic Policy set by the Hospital Infection Control Unit.[4,6] Additionally, the years of practice of the pharmacists were also collated (Table 2).

DOH Core Elements of the National AMS Program

The questionnaire consists of six parts patterned after the six DOH Core Elements.

Core Element 1: Leadership

The first part of the questionnaire consists of items relevant to the first Core Element, which tackled topics such as program funding, information technology (IT) support, collaboration, and roles and responsibilities (Tables 3 and 4).

Half of clinical pharmacists gave a neutral response for item QA1, implying that the financial compensation provided to them for dedicated time for AMS activities is insufficient. This is opposed to the 58.4% of dispensing pharmacists who agreed to the same item. A possible reason for this discrepancy is that clinical pharmacists perform more roles specific to the AMS program, thus needing more funding to perform AMS activities and financial compensation for performing them. This is supported by the respondents' choices in QF11, where 25% of the respondents identified "lack of funding" as one of the top five challenges faced by the hospital in implementing the AMS program.

Table 1. Five-Point Likert Rating and Interpretation Adapted from Pimentel (2010)

Scale	Rating	Interpretation
5	4.51 - 5.00	Strongly Agree / Always
4	3.51 - 4.50	Agree / Often
3	2.51 - 3.50	Neutral / Sometimes
2	1.51 - 2.50	Disagree / Rarely
1	1.00 - 1.50	Strongly Disagree / Never

Table 2. Relationship of Characteristics to Suitability of Work Capacity

Demographic Variables (N = 32)	Clinical Pharmacists		Dispensing Pharmacists	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Current role as an AMS clinical pharmacist	8	25	24	75
Years of Practice				
Less than 1 year	1	12	2	8
1 to 5 years	5	63	18	75
More than 5 years	2	25	4	17

Table 3. Responses of Clinical and Dispensing Pharmacists for DOH Core Element 1

Questionnaire Items	Clinical Pharmacist (N=8)						Dispensing Pharmacist (N=24)					
	Median	Frequency, Percentage (%)					Median	Frequency, Percentage (%)				
		1	2	3	4	5		1	2	3	4	5
Q A1: The hospital provides funding and financial benefits or compensation for dedicated time for AMS activities.	3	12.5	0	50	0	37.5	4	4.2	12.5	25.0	41.7	16.7
QA2: The hospital has IT capability to support the needs of AMS activities.	4	0	12.5	0	50	37.5	4	4.2	12.5	29.2	37.5	16.7
QA3: I collaborate with a leader and/or clinician involved in AMS activities in my hospital.	5	0	0	0	25	75	4	0	0	25.0	54.2	20.8
QA4: My roles and responsibilities as an AMS clinical pharmacist are clear and explicit.	5	0	0	0	12.5	87.5	4	4.2	12.5	25.0	45.8	12.5

Note: 1 - Strongly Disagree, 2 - Disagree, 3 - Neutral, 4 - Agree, 5 - Strongly Agree

Table 4. AMS Activities

QA5: I am involved in the following activities that contribute to an effective antimicrobial stewardship program in the hospital.	Clinical RPh, N=8 n (%)	Dispensing RPh, N=24 n (%)	Total
Development or review of local, evidence-based guidelines for antimicrobial drugs	3 (37.5)	3 (12.5)	6 (18.8)
Implementation of an antimicrobial formulary (i.e., a list of restricted/approved antimicrobials)	4 (50.0)	15 (62.5)	19 (59.4)
An active antimicrobial stewardship committee (i.e., an organizational structure – standalone or embedded in another structure – responsible for defining the antimicrobial stewardship strategy)	2 (25.0)	2 (8.3)	4 (12.5)
An active antimicrobial stewardship team (i.e., core operational team, responsible for the implementation of the antimicrobial stewardship activities in daily practice)	7 (87.5)	6 (25.0)	13 (40.6)
Design of interventions, specifically targeted at the antimicrobial prescription (e.g., intravenous-to-oral switch, PKPD dose optimization, automatic stop/review policy, audit and feedback)	6 (75.0)	1 (4.2)	7 (21.9)
Dedicated education and communication to guide antimicrobial prescribing	7 (87.5)	8 (33.3)	15 (46.9)
Use of information technology to support antimicrobialprescribing (e.g., electronic decision support, mobile phone application)	4 (50.0)	6 (25.0)	10 (31.3)
Others	0 (0)	1 (4.2)	1 (3.1)

Note: Respondents were asked to choose all options that apply.

Table 5. Responses of Clinical and Dispensing Pharmacists for DOH Core Element 2

Questionnaire Items	Clinical Pharmacist (N=8)						Dispensing Pharmacist (N=24)					
	Median	Frequency, Percentage (%)					Median	Frequency, Percentage (%)				
		1	2	3	4	5		1	2	3	4	5
QB1: I routinely identify cases that require reviewing and approval by infectious disease specialists.	4.5	0	12.5	0	37.5	50	4	0	16.7	25.0	33.3	25.0
QB2: There is a formal procedure for a pharmacist to review the appropriateness of an antimicrobial within or after 48 hours from the initial order (ex. post-prescription review).	4.5	0	12.5	12.5	25	50	3.5	4.2	29.2	16.7	37.5	12.5
****QB3: I use the hospital's antimicrobial treatment guidelines and clinical pathways to evaluate the patients' charts.***	5	0	0	12.5	0	87.5	3	25.0	12.5	25.0	12.5	25.0
QB4: The hospital guidelines are clear and readily available at the point of care.	5	0	0	12.5	25	62.5	4	4.2	8.3	12.5	54.2	20.8
QB5: I assist in the development and dissemination of hospital antimicrobial policies and guidelines.	4.5	0	0	0	50	50	4	4.2	12.5	29.2	37.5	16.7

*Note: 1 - Strongly Disagree, 2 - Disagree, 3 - Neutral, 4 - Agree, 5 - Strongly Agree; *1 - Never, 2 - Rarely, 3 - Sometimes, 4 - Often, 5 - Always*

Both clinical and dispensing pharmacists generally agree that the hospital has the IT capability to support its AMS activities. They also affirmed that they collaborate with a clinician in performing AMS activities. All clinical pharmacists and 58.3% of dispensing pharmacists agreed that their AMS roles and responsibilities are clear and explicitly communicated. A possible reason why some dispensing pharmacists disagreed in item QA4 may be due to the overlapping of their roles with clinical pharmacists in terms of AMS activities (Table 4).

According to the responses to item QA5, most clinical pharmacists are members of an active AMS team, responsible for the design of AMS interventions (e.g., intravenous-to-oral switch, PK-PD dose optimization, automatic stop/review policy, audit and feedback), and the dedicated education and communication to guide antimicrobial prescribing. On the other hand, most dispensing pharmacists are involved in implementing the antimicrobial formulary (i.e., a list of restricted/approved antimicrobials) through their dispensing functions. However, many dispensing pharmacists also share the same responsibilities and activities with the clinical pharmacists. This may result in the possible confusion in roles and responsibilities, affecting the quality of service being delivered as well as the welfare of the pharmacists.

Core Element 2: Policies, Guidelines, and Pathways

Items under Core Element 2 covered the involvement of AMS pharmacists in terms of the AMS procedures and processes in the hospital (Table 5).

The AMS pharmacists responded that they routinely identify cases that require reviewing and approval by the IDS. As for QB2, the clinical pharmacists agreed that there is a formal procedure for a pharmacist to review the appropriateness of an antimicrobial within or after 48 hours from the initial order, but the responses of dispensing pharmacists only generated a median of 3.5. It may be that some dispensing

pharmacists are not aware of this procedure because performing audit and feedback is not formally part of their responsibilities. In performing prescription review, the clinical pharmacists answered in item QB3 that they always use the hospital's antimicrobial treatment guidelines and clinical pathways to evaluate the patients' charts, yielding a median of 5. In item QB4, the clinical pharmacists strongly agreed and dispensing pharmacists agreed that the guidelines in their hospital are clear and readily available at the point-of-care. The clinical (median of 4.5) and dispensing pharmacists (median of 4) agreed that they assist in the development and dissemination of hospital antimicrobial policies and guidelines.

Core Element 3: Surveillance of AMU and AMR

The third part of the survey is concerned with AMU and AMR surveillance, and antibiogram-related questions (Table 6).

Most of the clinical and dispensing pharmacists responded positively to all five questions as seen from the medians, though the frequency distribution for dispensing pharmacists is more scattered. A number of clinical and dispensing pharmacists perceive the hospital's utilization of the antibiogram to be lacking, while only a number of clinical pharmacists are mostly not satisfied with the current systems on surveillance-related activities, such as monitoring of resistance rates of pathogens, tracking of susceptibility patterns, and usage of facility-specific antibiograms.[7] Respondents generally have a good perception towards implementation of AMS to target resistance rates and utilization of antibiograms.

Core Element 4: Action

Questionnaire items under Core Element 4 takes into account the AMS activities in which the AMS pharmacists are involved in (Table 7).

Clinical pharmacists comply with, ensure, and perform the AMS activities as indicated in the medians and frequency distribution, since they are actively involved in and conduct AMS activities that contribute to the successful delivery and implementation of AMS in the institution. The low responses of clinical pharmacists in some items may be due to the amount of cases/patients needed to be handled, heavy workload, insufficient skills and training, lack of collaboration with other healthcare providers, and lack of diagnostic measures.[8] Dispensing pharmacists, however, presented lower medians towards effective and efficient performance of AMS activities. This indicates that dispensing pharmacists are not habitually performing and fulfilling AMS activities, aside from alerting physicians in situations where therapy might be unnecessarily duplicative; subjecting themselves to antibiotic audit when handling prescribed restricted antibiotics; and monitoring adherence to a documentation policy in terms of antimicrobial dose, duration, and indication.

Core Element 5: Education

The items under Core Element 5: Education involve educational activities and training currently done in the hospital, as well as future activities which can be possibly done to enhance the skills and competencies of pharmacists and to increase the knowledge of both the pharmacists and the public (Table 8).

In terms of education, both clinical and dispensing pharmacists responded with considerably high medians of 4-5, indicating agreement and strong agreement to education components present in the institution, as these will influence the effective implementation of the AMS program by teaching healthcare professionals the necessary principles of judicious prescribing and use of antimicrobials.[4] For QE1, in terms of the provision of training programs, 87.5% of clinical pharmacists and 37.5% of dispensing pharmacists reported the presence of training programs on antimicrobial prescribing and use including antimicrobial treatment guidelines, clinical pathways, guidelines for IV to PO conversion, and de-escalation of antimicrobials, aligned with the requirements for continuous education for healthcare staff as identified in the DOH MOP. Based on the responses to QE1, more clinical pharmacists recognized the presence of AMS training programs conducted by the hospital probably due to educational topics primarily designed to target point-of-care AMS activities, as compared to the general dispensing of antimicrobials. There is also a

Table 6. Responses of Clinical and Dispensing Pharmacists for DOH Core Element 3

Questionnaire Items	Clinical Pharmacist (N=8)						Dispensing Pharmacist (N=24)					
	Median	Frequency, Percentage (%)					Median	Frequency, Percentage (%)				
		1	2	3	4	5		1	2	3	4	5
QC1: The hospital effectively addresses antimicrobial resistance.	4	0	12.5	0	50	37.5	4	8.3	4.2	29.2	33.3	25
QC2: The hospital engages in antimicrobial resistance and antimicrobial surveillance activities.	5	0	0	0	37.5	62.5	4	4.2	8.3	20.8	45.8	20.8
QC3: The hospital's antibiogram is regularly updated.	4	0	0	25	37.5	37.5	3	4.2	12.5	54.2	16.7	12.5
QC4: The hospital's antibiogram is easily accessible.	4	0	12.5	12.5	50	25	3	4.2	8.3	45.8	29.2	12.5
QC5: I am able to interpret and apply the hospital's antibiograms for patient care.	4	0	0	12.5	50	37.5	3	4.2	16.7	37.5	29.2	12.5

Note: 1 - Strongly Disagree, 2 - Disagree, 3 - Neutral, 4 - Agree, 5 - Strongly Agree

Table 7. Responses of Clinical and Dispensing Pharmacists for DOH Core Element 4

Questionnaire Items	Clinical Pharmacist (N=8)						Dispensing Pharmacist (N=24)					
	Median	Frequency, Percentage (%)					Median	Frequency, Percentage (%)				
		1	2	3	4	5		1	2	3	4	5
QD1: I ensure automatic changes from IV-to-PO antibiotic therapy in appropriate situations.	5	0	0	25	12.5	62.5	3	25	20.8	20.8	33.3	0
QD2: I ensure time-sensitive automatic stop orders for specified antibiotic prescriptions.	5	0	0	0	12.5	87.5	3	12.5	29.2	16.7	29.2	12.5
QD3: I perform dose adjustments in cases of organ dysfunction (e.g., kidney or liver impairment).	5	0	12.5	12.5	0	75	2	37.5	29.2	4.2	12.5	16.7
QD4: I ensure dose optimization in the treatment of patients infected with resistant pathogens.	5	0	12.5	0	12.5	75	2	33.3	20.8	16.7	20.8	8.3
QD5: I alert physicians in situations where therapy might be unnecessarily duplicative.	5	0	0	12.5	0	87.5	3.5	16.7	16.7	16.7	37.5	12.5
QD6: I ensure that the clinical guideline for the de-escalation of broad-spectrum antibiotics is followed in appropriate situations.	5	0	0	12.5	0	87.5	2.5	16.7	33.3	8.3	33.3	8.3
QD7: I efficiently communicate microbiology laboratory / culture results to the attending physician.	4.5	12.5	25	0	12.5	50	1	70.8	16.7	0	12.5	0
QD8: I efficiently coordinate with medical and nursing staff to ensure timely administration of appropriate antimicrobials.	5	0	0	0	0	100	3	12.5	29.2	16.7	25	16.7
QD9: I provide drug information and advice on dosing, drug interactions, and adverse drug reactions.	5	0	0	12.5	12.5	75	3	8.3	29.2	25	33.3	4.2
*****QD10: I am willing to be subjected to antibiotic audit when handling prescribed restricted antibiotics.***	5	0	0	12.5	25	62.5	4	4.2	0	41.7	33.3	20.8
QD11: I evaluate antimicrobial prescribing behavior and provide feedback to prescribers.	4.5	12.5	12.5	0	25	50	3	29.2	16.7	25	20.8	8.3
QD12: I monitor antibiotic use (consumption) at the unit and/or hospital-wide level.	5	25	12.5	0	0	62.5	2	29.2	29.2	12.5	16.7	12.5
QD13: I monitor adherence to a documentation policy in terms of antimicrobial dose, duration, and indication.	5	0	12.5	0	0	87.5	4	12.5	20.8	8.3	25	33.3

*Note: 1 - Strongly Disagree, 2 - Disagree, 3 - Neutral, 4 - Agree, 5 - Strongly Agree; **1 - Strongly Disagree, 2 - Disagree, 3 - Neutral, 4 - Agree, 5 - Strongly Agree*

Table 8. Responses of Clinical and Dispensing Pharmacists for DOH Core Element 5

Questionnaire Items	Clinical Pharmacist (N=8)						Dispensing Pharmacist (N=24)					
	Median	Frequency, Percentage (%)					Median	Frequency, Percentage (%)				
		1	2	3	4	5		1	2	3	4	5
QE1: The hospital provides adequate training on antimicrobial prescribing and use (e.g., antimicrobial treatment guidelines, clinical pathways, guidelines for IV to PO conversion, and de-escalation of antimicrobials, etc.)	4	0	0	12.5	50	37.5	3	8.3	12.5	41.7	25	12.5
QE2: I am willing to attend the educational sessions and trainings conducted by the AMS Committee and/or sponsored by DOH and other organizations offering training programs or workshops on AMS.	5	0	0	0	12.5	87.5	5	0	0	8.3	29.2	62.5
QE5: The hospital develops training modules with clear learning outcomes and competencies on AMS.	4	0	0	12.5	62.5	25	3	8.3	16.7	45.8	25	4.2
QE8: I continually update myself on the newest developments in the area of disease management and microbiology, infectious prevention, pharmacotherapy, and AMS practice.	4.5	0	0	12.5	37.5	50	4	0	12.5	25	37.5	25
QE9: I continually educate pharmacy-staff and the public on basic principles of infection prevention and control, personal hygiene, and hand washing.	4.5	0	0	0	50	50	4	4.2	0	25	54.2	16.7

Note: 1 - Strongly Disagree, 2 - Disagree, 3 - Neutral, 4 - Agree, 5 - Strongly Agree

possibility that dispensing pharmacists prioritize other training programs outside the scope of AMS, as compared to clinical pharmacists, due to their more general dispensary roles in the hospital pharmacy. As the hospital is also considered to be a teaching and training institution, training modules on AMS were identified to be available and directed towards clinical pharmacists (87.5%) more, as compared to dispensing pharmacists (29.2%).

The AMS Committee of the institution must ensure that healthcare providers involved in the implementation of AMS program in the hospital, including clinical pharmacists, must attend the Standard Training Course on AMS through the education program certified and recognized by DOH.[4] Both clinical (100%) and dispensing (91.7%) pharmacists expressed strong willingness to attend educational sessions and training conducted by the AMS Committee and/or sponsored by DOH and other organizations that may offer corresponding training programs and workshops on AMS.

Similarly, the majority of clinical (87.5%) and dispensing (62.5%) pharmacists also continually update themselves on the newest developments in the area of microbiology, infectious disease management and prevention, pharmacotherapy, and AMS practice for their continuing professional development aligned in the DOH MOP. Not limited to educating oneself, but both clinical (100%) and dispensing (70.9%) AMS clinical pharmacists also educate other pharmacy-staff and the public, possibly via patient interaction, communication in the workspace, or through social media, on basic principles of infection prevention and control, personal hygiene, and handwashing to prevent the spread of AMR in the community.

According to their responses in QE3 *("Has your hospital organized educational activities on the topic of antimicrobial stewardship?")*, majority of both clinical and dispensing pharmacists utilize e-learning or relevant webinars, and written information including leaflets, guideline booklets, newsflashes as educational activities organized by the hospital for antimicrobial stewardship. In terms of educational courses taken in the hospital, dispensing pharmacists reported to have attended more regular courses (>1 day), practicals, and on the job training (ex. during ward rounds) in the hospital.

Additionally, in QE4 *("Which of the following educational activities on antimicrobial stewardship do you think would support the hospital in continuing its stewardship efforts?")*, both clinical and dispensing pharmacists report face-to face training sessions and case-based learnings as educational activities that can support the hospital in continuing its stewardship efforts. In QE6 *("Which of the following core areas are you knowledgeable about as an AMS clinical pharmacist?")*, majority of the pharmacists were already confident in their knowledge of basic clinical skills and pharmacology of anti-infective drugs. Lastly, for QE7 *("Which of the following educational topics do you think would support the hospital in continuing its antimicrobial stewardship efforts?")*, educational topics on the management of infections caused by multidrug-resistant organisms, effective AMS interventions, and interpretation of antibiograms were identified to be the most essential to support the hospital's efforts on antimicrobial stewardship.

Core Element 6: Performance Evaluation

The questions for Core Element 6: Performance Evaluation involve topics evaluating the effectiveness of the current AMS program implementation in the hospital (Table 9). Both dispensing and clinical pharmacists agree that the hospital has a functional AMS program that improves patient care, reduces the problem of antimicrobial resistance, decreases the duration of prophylaxis (surgical or medical) or empiric use of antimicrobials, decreases the amount of intravenous antibiotic prescriptions, and increases the amount of targeted prescriptions based on microbiology results. Proper documentation of stop or review dates and indications of antimicrobial prescriptions were executed accordingly, and both dispensing and pharmacists contribute to support the antimicrobial stewardship program in the hospital by providing timely data, reporting accurately, monitoring AMS strategies and interventions as measures of effectiveness, and identifying areas for improvement to achieve and excel in the target performance indicators set by DOH.

The last two questions asked for respondents' insights and opinions on the enablers (Table 10) and challenges (Table 11) in the hospital's AMS program implementation.

A respondent has enumerated that "dedicated pharmacists who do AMS even if there are so many patients" can be an enabler to the hospital's implementation of the AMS program. On the other hand, respondents have noted that physicians who are not well-versed with the DOH AMS training and operate using different guidelines are challenges to its implementation. The lack of initiative and action from the pharmacy department as well as from the dispensing pharmacists specifically also were challenges identified that make pharmacist-based AMS performance difficult. Additionally, the current system for procurement of medicines and medical supplies was also mentioned to hinder roles of AMS clinical pharmacists as this consumes too much time, resources and energy of the pharmacy department.

To address these challenges, a number of the respondents have recommended focusing on the continuous education and training of the staff on performing AMS to gain more competency and qualification. Increasing funding and manpower to perform AMS activities were also recommended so that AMS clinical pharmacists can better perform their AMS roles, noting especially that AMS is a department-wide effort. Interprofessional collaboration between the pharmacists and other healthcare professionals and staff was also encouraged, with the aim of ensuring that standardized guidelines, procedures, and policies are in place. Having routine meetings or discussions on AMS with other departments was also recommended to allow exchange of information and data monitoring (i.e., antibiogram, antibiotic use and consumption, antibiotic resistance rates, availability of antibiotics, etc.). In line with this, transparency

Table 9. Responses of Clinical and Dispensing Pharmacists for DOH Core Element 6

Questionnaire Items	Clinical Pharmacist (N=8)						Dispensing Pharmacist (N=24)					
	Median	Frequency, Percentage (%)					Median	Frequency, Percentage (%)				
		1	2	3	4	5		1	2	3	4	5
QF1: This institution has a functional AMS program as it improves patient care and reduces the problem of antimicrobial resistance.	5	0	0	0	37.5	62.5	4	4.2	0	41.7	37.5	16.7
QF2: The hospital's AMS program decreases the duration of prophylaxis (surgical or medical) or empiric use of antimicrobials.	4	0	0	12.5	50	37.5	3.5	4.2	4.2	41.7	37.5	16.7
QF3: The hospital's AMS program decreases the amount of intravenous antibiotic prescriptions.	3.5	0	0	50	37.5	12.5	3	4.2	20.8	45.8	20.8	8.3
QF4: The hospital's AMS program increases the amount of targeted prescriptions based on microbiology results.	4	0	0	12.5	62.5	25	4	4.2	4.2	33.3	45.8	12.5
QF5: Stop or review date of antimicrobial prescriptions in the hospital is always properly documented.	4	0	0	25	37.5	37.5	3.5	4.2	8.3	37.5	37.5	12.5
QF6: Indication for antimicrobial prescription in the hospital is always properly documented.	4	0	0	0	62.5	37.5	4	4.2	8.3	25	41.7	20.8
QF7: I contribute to the provision of data as required for timely and accurate reporting of the AMS program implementation in my hospital.	5	0	0	25	12.5	62.5	3.5	4.2	4.2	41.7	33.3	16.7
QF8: I monitor all AMS strategies and interventions as a whole to measure their effectiveness and identify areas for further improvement.	4	0	0	12.5	50	37.5	3	4.2	16.7	45.8	20.8	12.5
QF9: I ensure all efforts are made to achieve and excel in the target performance indicators set by the DOH.	4	0	0	12.5	50	37.5	4	4.2	4.2	33.3	45.8	12.5

Note: 1 - Strongly Disagree, 2 - Disagree, 3 - Neutral, 4 - Agree, 5 - Strongly Agree

Table 10. Enablers Supporting the AMS Program Implementation

QF10: These are the enablers I have identified in my hospital which contribute or support the implementation of an effective AMS program	Clinical RPh, N=8 n (%)	Dispensing RPh, N=24 n (%)	Total
Education and training of prescribers	5 (62.5)	15 (62.5)	20 (62.5)
Access and adherence to national antibiotic prescribing guidelines	5 (62.5)	13 (54.2)	18 (56.3)
Multidisciplinary AMS approach	3 (37.5)	13 (54.2)	16 (50.0)
Pharmacy-representative in the AMS Team	3 (37.5)	13 (54.2)	16 (50.0)
Cooperation, mutual respect, and collaboration of key healthcare professionals	4 (50.0)	11 (45.8)	15 (46.9)
Good telehealth, internet access and IT systems (e.g., electronic health records)	6 (75.0)	7 (29.2)	13 (40.6)
Creation and utilization of a restricted antimicrobial formulary	2 (25.0)	9 (37.5)	11 (34.4)
Regular antibiogram review	2 (25.0)	8 (33.3)	10 (31.3)
Leadership commitment	2 (25.0)	7 (29.2)	9 (28.1)
Active involvement of the drug and therapeutic committee	2 (25.0)	7 (29.2)	9 (28.1)
Rapid diagnostic testing	1 (12.5)	4 (16.7)	5 (15.6)
Reviewing of antimicrobial prescribing with feedback aided by computer systems	1 (12.5)	3 (12.5)	4 (12.5)
Pride in local healthcare facilities	0 (0)	3 (12.5)	3 (9.4)
Flat hierarchical structure of governance	1 (12.5)	1 (4.2)	2 (6.3)
Pilot AMS with initial evaluation	0 (0)	2 (8.3)	2 (6.3)
None	0 (0)	0 (0)	0 (0)

Note: Respondents were asked to choose all options that apply.

Table 11. Challenges Hindering the AMS Program Implementation

QF11: These are the challenges I have identified in my hospital which hinder the implementation of an effective AMS program	Clinical RPh, N=8 n (%)	Dispensing RPh, N=24 n (%)	Total
Prescribing of non-PNF antimicrobial drugs	7 (87.5)	17 (70.8)	24 (75.0)
Lack of time to perform stewardship	7 (87.5)	13 (54.2)	20 (62.5)
Lack of qualified personnel	2 (25.0)	12 (50.0)	14 (43.8)
Lack of hospital management support and information technology support	1 (12.5)	12 (50.0)	13 (40.6)
Lack of expertise and training in antimicrobial stewardship within the antimicrobial stewardship team	4 (50.0)	9 (37.5)	13 (40.6)
Regular shortages or stock outs of essential antibiotics	6 (75.0)	6 (25.0)	12 (37.5)
Lack of funding	1 (12.5)	7 (29.2)	8 (25.0)
Inadequate monitoring of antimicrobials, especially on restricted antimicrobials	2 (25.0)	6 (25.0)	8 (25.0)
Lack or unavailability of practical, evidence-based, local guidelines	4 (50.0)	3 (12.5)	7 (21.9)
High cost of antibiotics	1 (12.5)	5 (20.8)	6 (18.8)
Lack of cooperation from prescribers	2 (25.0)	3 (12.5)	5 (15.6)
Inadequate use of the microbiology laboratory	0 (0)	3 (12.5)	3 (9.4)
Poor communication of antimicrobial results and infection control	1 (12.5)	2 (8.3)	3 (9.4)
Existence of hospital hierarchies	0 (0)	3 (12.5)	3 (9.4)
Patient demands or beliefs	0 (0)	3 (12.5)	3 (9.4)
Insufficient microbiology laboratory capacity	0 (0)	2 (8.3)	2 (6.3)
Poor quality of antibiotics	0 (0)	2 (8.3)	2 (6.3)
Lack of AMR awareness	0 (0)	1 (4.2)	1 (3.1)
Lack of trust in local guidelines	0 (0)	0 (0)	0 (0)
Lack of confidence in the hospital infection prevention and control (IPC) processes	0 (0)	0 (0)	0 (0)
None	0 (0)	0 (0)	0 (0)

Note: Respondents were asked to choose all options that apply.

of the pharmacy department to procurement, administrative and medical-related matters, as well as transparency of other departments, can allow better AMS implementation as each department knows which areas are they accountable for. Recognizing pharmacy contribution to AMS can also empower pharmacists in their AMS activities and performance.

DISCUSSION

For *Core Element 1 Leadership*, presence of a leader and/or clinician as part of the AMS activities, IT capability to support the needs of the AMS activities, and established clear and explicit roles have been identified as enablers present in the hospital. The ASHP states that pharmacists may enhance antimicrobial stewardship by using IT in antimicrobial use surveillance and reporting, and in developing clinical decision support tools. Good telehealth and internet access, the use of IT to implement strategies, the use of expert systems to provide patient-specific recommendations at the point of care, and IT support for antibiotic prescribing were identified as enablers for implementing AMS programs in hospitals, while the lack of IT resources (IT-based monitoring scheme for antibiotic use, and inaccurate or incomplete data access and data extraction) were the barriers identified in several studies.[9-12] It is then crucial to enhance the hospital's IT system to create and establish a more systematic and efficient process in providing interventions to patients, such as through the use of automation and artificial intelligence, and to facilitate the monitoring and reporting of performance indicators and outcomes.[13,14] These IT tools can be used to collate important patient information, including admission notes and nursing notes, previous hospital admission, vital signs, medication administration charts, laboratory and culture results and reports, clinical decision support system (CDSS) entries, clinical progress notes, referral letters, discharge dates, outpatient prescriptions, and outpatient visit notes, which can then allow prescribers to make more informed decisions on appropriate antimicrobial prescribing; hence, reducing the misuse and overuse of antimicrobials. Additionally, these IT models can also be sources of information that are used by healthcare professionals, such as clinical treatment guidelines, the hospital's antibiogram, and the hospital formulary, providing ease in availability and accessibility which can further promote the effective implementation of the AMS program.[13]

Though improving IT systems may be beneficial to the AMS program implementation, some precautions and limitations should be recognized. The overuse of alert systems have resulted in alert fatigue, which desensitized the

prescribers to the importance of the alerts and thus led to increased formulary noncompliance.[15] Systems that give too many options for selection may also lead to choice overload and impede decision making.[16] Hence, IT systems should also be user-friendly and well aligned with the prescribers' workflow to increase its acceptability among healthcare providers.[16] Even with an IT system, prescribers may still work around the system; therefore, manual monitoring and follow-up of documented indications may still be required.[17]

As for *Core Element 2 Policies, Guidelines and Pathways*, availability of clear hospital guidelines at the point of care, presence of a formal procedure for post-prescription review, routine identification of cases requiring the review and approval of infectious disease specialists, utilization of the hospital's antimicrobial treatment guidelines and clinical pathways for patient evaluation, and assistance of AMS clinical pharmacists in the development and dissemination of hospital antimicrobial policies and guidelines are perceived enablers.

According to the AMS Program in Hospitals MOP, the use of oral and intravenous restricted antimicrobials should be authorized by the IDS or AMS clinician before prescribing. This is to preserve the use of these antimicrobials to diseases where they are really needed, and to minimize the adverse effects and costs associated with inappropriate therapy.[4] It is commendable that both clinical and dispensing pharmacists generally observe such practice to ensure that only the right drug is given to the right patient.

The MOP recommends AMS clinical pharmacists to review and evaluate the appropriateness of monitored antimicrobials at the point of prescribing, at the point when findings from initial investigations including microbiological results become available, and at the point of expected discontinuation.[4] When the AMS clinical pharmacists deem the prescribed antimicrobial/s as inappropriate, this should be discussed at an AMS Team meeting and a decision should be reached by consensus. A formal standardized procedure for audit and feedback is necessary to ensure the rational and optimal use of antimicrobials in the hospital. Some respondents also identified "lack of compliance of prescribers to standard treatment guidelines" as a challenge in program implementation. The role of pharmacists in audit and feedback can serve as a persuasive intervention strategy to encourage physicians to prescribe antimicrobials appropriately.[4]

Ensuring the adherence to the hospital's antimicrobial treatment guidelines and clinical pathways is crucial in guiding the selection of appropriate antimicrobials, standardizing the quality of treatment given, preventing the misuse of antimicrobials, and improving patient care.[4] Although a problem noted by some respondents is the lack of standardization of AMS policies and guidelines in the hospital. The hospital's AMS committee should incorporate the DOH AMS policy into the hospital's own AMS policy and standardize the treatment guidelines and clinical pathways used by all healthcare professionals to strengthen interprofessional collaboration. These evidence-based treatment guidelines and clinical pathways should also be simple, clear, localized, and readily available. The MOP cites assistance in the development and dissemination of AMS policies and guidelines as one of the responsibilities of AMS clinical pharmacists.[4] By fulfilling this role, pharmacists can contribute to the improvement of hospital guidelines and their stricter implementation.

For *Core Element 3 Surveillance of AMU and AMR*, having the hospital effectively address AMR and engage in AMR and AMU surveillance activities have enabled AMS clinical pharmacists to carry out efficient AMS activities, as seen with most of the responses of both clinical and dispensing pharmacists. This establishes the important contribution of clinical and dispensing pharmacists in reducing irrational AMU and AMR rates.[8] Most dispensing pharmacists perceive the institution's antibiograms as lacking accessibility and regular updating, which then leads to difficulty in interpreting antibiograms for patient-centered care.

More discussions towards improvement may be implemented in the institution concerning antibiogram interpretation and accessibility to strengthen the knowledge and capability of both clinical and dispensing pharmacists. Hospital antibiograms (as well as the DOH reports) can be made more accessible to support decision-making processes of both clinical and dispensing pharmacists. Pharmacists should be informed where and how to access antibiograms, and educated on how to interpret them. Working on improving AMU and AMR surveillance will generally play a crucial role in ensuring appropriate empirical antimicrobial prescribing and in implementing a successful AMS program.[7]

Under *Core Element 4 Action*, ensuring automatic changes from IV-to-PO antibiotic therapy, performing appropriate dose adjustments, ensuring dose optimization in the treatment of resistant pathogens, ensuring compliance to clinical guidelines for de-escalation of broad-spectrum antibiotics, communicating microbiology laboratory and/or culture results to the attending physician, submitting prescribed restricted antibiotics to antibiotic auditing, evaluating antimicrobial prescribing behavior and providing feedback to prescribers, and monitoring adherence to a documentation policy in terms of antimicrobial dose, duration, and indication are perceived enablers of an effective AMS program implementation.

It can be concluded that clinical pharmacists are actively involved and conduct such activities, which then contributes to the successful delivery and implementation of AMS activities in the institution, notably highlighting existing coordination and collaboration of clinical pharmacists with other healthcare professionals. Interprofessional collaboration allows efficient communication and reporting of important information, ensuring that appropriate antimicrobials and their doses can be administered to the patients. Questionnaire items with low median responses entail necessary actions attributed to the amount of cases/patients needed to be handled, heavy workload, insufficient skills and training, lack

of collaboration with other healthcare providers, and lack of diagnostic measures.[8] Other actions may also consist of providing more specialized AMS training for pharmacists to hone and develop their skills and competencies in terms of AMS interventions, adding more full-time AMS clinical pharmacists for better distribution of workload and less time constraints, and receiving administrative support and commitment in terms of AMS activities from the institution.

On the other hand, except for alerting physicians in situations where therapy might be unnecessarily duplicative, subjecting themselves to antibiotic audit when handling prescribed restricted antibiotics; and monitoring adherence to a documentation policy in terms of antimicrobial dose, duration, and indication, most activities desired from AMS pharmacists are not habitually conducted and fulfilled by dispensing pharmacists. It is alarming as 87.5% of the dispensing pharmacists do not communicate microbiology laboratory and/or culture results to the attending physician, creating a significant difference as compared to clinical pharmacists. This specifically should be addressed since delivering microbiology laboratory results is a critical function in diagnosing infections and can affect treatment options provided to patients.

More training and improvements in relation to educational activities (such as online learning and webinars, and face-to-face training sessions), support and funding from the hospital administration, and interprofessional collaboration may be done for dispensing pharmacists so that AMS activities can be delivered more effectively. Since dispensing pharmacists mainly focus on dispensing activities, the previously mentioned AMS activities may possibly not be prioritized by dispensing pharmacists and are rather additional roles and responsibilities.

In terms of *Education* as *Core Element 5*, willingness to attend educational sessions and training on antimicrobial prescribing and use, independent updating on the newest AMS practice developments and continuous education of pharmacy-staff and the public on infection prevention and control, personal hygiene, and handwashing serve as enablers to the successful implementation of the AMS program.

Highlighting educational activities specifically, this influences the effective implementation of the AMS program by teaching healthcare professionals the necessary principles of judicious prescribing and use of antimicrobials.[4] In addition, training programs on antimicrobial prescribing and use including antimicrobial treatment guidelines, clinical pathways, guidelines for IV to PO conversion, and de-escalation of antimicrobials are aligned with the requirements for continuous education for healthcare staff as identified in the DOH MOP. Perceived educational activities frequently implemented in the institution include provision of e-learning or relevant webinars, handing out written information, and having occasional training sessions and courses of at least once a day. It is necessary to provide training modules and curricula with clear learning outcomes and competencies needed for both clinical and dispensing pharmacists to be well-educated and competent to perform their unique roles and responsibilities in the AMS program successfully as positive contributors of the AMS team.[4] The AMS Committee of the institution must ensure that healthcare providers involved in the implementation of AMS program in the hospital, including clinical pharmacists, must attend the Standard Training Course on AMS through the education program certified and recognized by DOH.[4]

For *Core Element 6 Performance Evaluation*, the employment of a functional AMS program has been reported to improve patient care, reduce the problem of antimicrobial resistance, decrease the duration of surgical or medical prophylaxis or empiric use of antimicrobials, and increase the amount of targeted prescriptions based on microbiology results. The documentation of indications for antimicrobial prescriptions based on microbiology results and ensuring that all efforts by AMS clinical pharmacists are made to achieve and excel in the target performance indicators set by DOH are identified as enablers for the hospital's AMS program implementation.

Aside from those interpreted using the 5-point scale, the top five most perceived enablers and perceived challenges were identified. Additional five enablers (Table 10) reported are (1) Education and training of prescribers, (2) Access and adherence to national antibiotic prescribing guidelines, (3) Multidisciplinary AMS approach and Pharmacy-representative in the AMS team, (4) Cooperation, mutual respect, and collaboration of key healthcare professionals, and (5) Good telehealth, internet access, and IT systems (e.g., electronic health records). Education and training of prescribers, as enablers for AMS program implementation[18], have also been reported in Saudi Arabia[19], and in the Philippines[11]. Adequate prescriber training and education are key strategies to strengthen the judicious use of antimicrobials, resulting in the delivery of effective AMS services of pharmacists. In line with Core Element 5, healthcare providers can properly perform effective and safe AMS interventions with appropriate skills and competencies through comprehensive education and training.[4]

The remaining perceived enablers identified were found to be consistent with studies conducted in Saudi Arabia[19], Australia[10,20], Ethiopia[21], Scotland[22], and Henson & TMC AMS Team, and Pagcatipunan et al. in the Philippines[11,23]. Moreover, the listed remaining enablers have been found to be consistent with the DOH MOP. For instance, adequate access and adherence to the national antibiotic prescribing guidelines allow treatment and prophylaxis of infections to be evidence-based, resulting in guidance to clinicians and other healthcare professionals on properly managing infectious diseases and selecting the most appropriate antimicrobial agent for the patient. Establishing a multidisciplinary, multi-intervention, and coordinated AMS strategy and approach to optimize the use of antimicrobials can support the establishment of an effective and efficient AMS program. Ensuring a

pharmacy representative in the AMS team can assist in coordinating and implementing AMS activities, developing and disseminating AMU guidelines, enforcing compliance to AMS policies, performing point of care interventions for antimicrobial therapy optimization, educating pharmacy staff and students on AMS, coordinating with medical and nursing staff to ensure timely administration of appropriate antimicrobials, identifying cases that require IDS review and approval, providing drug information and advice, evaluating antimicrobial prescribing behavior, providing feedback to prescribers, and assessing the performance of the AMS program in the hospital.[4] AMS clinical pharmacists must enhance cooperation, mutual respect, and collaboration among key healthcare professionals, including the PTC and IPC committees to promote rational use of antimicrobials and provide a holistic approach in targeting AMR within the hospital. Good telehealth, internet access, and IT systems are essential to building an enabling environment to support AMS activities. Improvements and advancements in technology can significantly promote interprofessional and interdepartmental collaboration to achieve effective AMS interventions to successfully combat AMR.

On the other hand, perceived challenges must be addressed as these can be potential points of improvement for a more effective implementation of the AMS program. Insufficient funding and financial benefits or compensation for pharmacists' dedicated time for AMS activities, lack of proactiveness for pharmacists to expand their roles and responsibilities beyond the dispensing area, lack of prioritization of AMS programs and implementation over other pharmacy-related issues, and lack of initiative from the Pharmacy Department to implement AMS programs and activities as part of *Core Element 1 Leadership*. Funding is a crucial factor in the successful implementation of AMS programs, and this also includes financial compensation for additional time spent in AMS activities, and incentives to help support and retain staff.[9-11] The lack of funding will result in the lack of trained and dedicated pharmacists, which is also a problem reported by several respondents. Recommendations for increased funding and manpower may be dependent on the available budget and prioritization of the hospital administration. According to the MOP, the staffing requirement set by the DOH is one full time AMS clinical pharmacist per 100 beds in a Level III hospital.[4] However, the hospital study site, which has a 1,500 bed capacity, currently only has eight AMS clinical pharmacists. Because of this, AMS clinical pharmacists cannot be assigned in every hospital ward or unit, thereby limiting the scope of their area of activity. The researchers suggest that the hospital's Pharmacy Department conduct an on-site study to determine whether the involvement of AMS clinical pharmacists in a specific ward contributes to the lowering of inappropriate antimicrobial prescribing and AMR rates. This can be followed with a pharmacoeconomic study to further strengthen the evidence pointing to the clinical and economic advantages of assigning AMS clinical pharmacists in all hospital wards. The results of the study can be used as a credible business case to persuade the hospital administration to increase budget allocation to the AMS program.[24] With increased funding, the AMS committee and Pharmacy Department can build the capacity of the AMS program and gradually introduce AMS interventions to other hospital wards or units.

Lack of compliance of prescribers to standard treatment guidelines for *Core Element 2 Policies, Guidelines, and Clinical Pathways*. To promote compliance, drug utilization reviews (especially in areas with high volume of antimicrobial prescribing) may be conducted to determine and understand prescribing behavior and drug use patterns, and to serve as basis for the development of AMS guidelines in the hospital. The hospital formulary should be regularly reassessed by the PTC in light of frequently prescribed antimicrobials and new clinical evidence. The IT system could also be used to address this concern. For instance, IT system models and innovative technologies employed in Singapore, United States, and Thailand have reported to positively influence the conduct of AMS activities and interactions in hospitals. In Singapore, CDSS were proven to be effective in improving rational use of antimicrobials.[16] The system is equipped with analytical tools for the collection and analysis of microbiology results and antimicrobial utilization data, and the reporting of AMR and AMU trends.[25] It also recommends the appropriate antimicrobials based on the patient's condition and the hospital's guidelines, and tracks whether the prescriber accepted the recommendations. Singapore's CDSS comprises the Antimicrobial Advice (prompts the healthcare team on the recommendations of the IDS) and AMS Program List modules (used by the IDS to document and review recommendations for the healthcare team). Some other features integrated into the CDSS include microbiological culture results, antibiotic guidelines, prescription tools, allergy and therapeutic duplication checks, and renal dose adjustments.[16] Other innovative IT systems and technologies introduced in Singapore are the following: (1) eRx Medication Administration, which centralizes patients' medication history and has a CDSS to minimize the risk of medication errors; (2) Infection Control Management System, which assists in identifying and tracking potentially infectious pathogens, and facilitates outbreak monitoring; (3) Predictive Risk Stratification, which uses predictive modeling to allow for the early detection of MRSA infection; and (4) the use of machine learning models and artificial intelligence to assist in vancomycin (and other high risk medications) dose titration by making consistent and safe dosing recommendations.[26,27] In the United States, pop-up alert systems containing a list of formulary alternatives were used to limit noncompliance to the formulary and to assess the appropriateness of requesting non-formulary medications.[28] In Thailand, several hospitals with an established AMS program use computer systems, which incorporate antimicrobial guidelines, a stop order

system, and an ordering system that required the prescriber to provide the complete information.[29] Improving IT systems can result in a better delivery of the AMS program, as this tackles the challenges identified at a system-wide level.

Some respondents identified several barriers to their interprofessional collaboration such as physicians and pharmacists using different AMS guidelines, and the lack of recognition and empowerment of pharmacists to their contribution in the AMS program. It was also reported that there is poor collaboration between the Pharmacy Department and other hospital departments and committees (such as the Infection and Control Committee). As poor collaboration between stakeholders will hinder the success of the AMS program, pharmacists and all other stakeholders should actively promote and strengthen multidisciplinary collaboration within the hospital.[30] Some recommendations to address these barriers include harmonizing hospital policies and guidelines (DOH AMS Program and Hospital's Antibiotic Policy) used by all healthcare professionals, requiring representation of pharmacists in relevant hospital committees and teams, clarifying responsibilities and establishing clearer accountability of roles with other healthcare providers and departments, and holding training sessions/ monthly discussions aimed to promote and provide opportunities for interprofessional collaboration.

Lack of accessibility of the hospital's antibiogram and updating, which eventually leads to problems in interpreting and applying hospital's antibiograms for patient care as part of *Core Element 3 Surveillance of AMU and AMR*, have been identified as one of the challenges to AMS program implementation in the hospital. The involvement of AMS pharmacists, specifically the dispensing pharmacists[8], in reducing irrational AMU and AMR is crucial and should not be overlooked. Difficulty in antibiogram-related matters can hinder efficient interpretation and delay patient-centered care of clinical and dispensing pharmacists, and must then be addressed since dispensing pharmacists, though mainly focusing on dispensing, can still contribute to surveillance by providing evidence-based recommendations for the appropriateness of the antibiotics prescribed.[31] Discussions on AMS should be done routinely in the entire Pharmacy Department and all pharmacists should be trained to interpret and apply antibiograms for patient care.

Antibiogram-related matters were classified as a challenge as both clinical and dispensing pharmacists must be knowledgeable and capable of interpreting antibiograms to conduct AMS activities, especially since these activities are grounded on the information provided by the antibiograms. The institution can make the hospital antibiograms (and DOH reports) more accessible so that these can be used for decision-making by the AMS pharmacists, as well as inform pharmacists how these can be effectively and appropriately utilized. A way to make it accessible is by integrating the antibiogram into the hospital's IT system and making it accessible to all the healthcare professionals of the institution. Working on improving AMU and AMR surveillance will generally play a crucial role in ensuring appropriate empirical antimicrobial prescribing and in implementing a successful AMS program.[7]

Under *Core Element 4 Action*, AMS clinical pharmacists have identified ensuring time-sensitive automatic stop orders for specific antibiotic prescriptions, alerting physicians in situations where therapy might be unnecessarily duplicative, coordinating with medical and nursing staff to ensure timely administration of appropriate antimicrobials, providing drug information and advice on dosing, drug interactions, and adverse drug reactions, inefficient procurement of medicines and medical supplies in the hospital, inefficient management of logistics and implementation of dispensing activities, and monitoring antibiotic use (consumption) at the unit and/or hospital-wide level as barriers to the AMS implementation in the institution.

Notably all clinical pharmacists strongly agree on performing active and timely coordination with other medical and nursing staff regarding administration of appropriate antimicrobials. This implies that interprofessional collaboration is necessary and significant within the AMS team as this allows efficient communication and reporting of important information, ensuring that appropriate antimicrobials and their doses can be administered to the patients; hence, improving antibiotic prescriptions of physicians, promoting follow up of laboratory and/or culture results, and encouraging proper identification of inappropriate combinations or doses of medications by pharmacists.[21]

To promote interprofessional collaboration and ensure the quality performance of AMS activities, it is recommended to assign trained AMS clinical pharmacists in all hospital wards/units who would ensure that prescribed antimicrobials are properly administered to the patient within the duration approved by the infectious disease specialist. Routine evaluation and feedback of the pharmacists' performance in providing AMS activities must be conducted. Areas which clinical pharmacists perceive to be lacking must be addressed, and the institution should ensure that these activities are fulfilled by all clinical pharmacists so that AMS can be successfully implemented in the institution.

The lack of effective communication of microbiology laboratory and/or culture results to attending physicians by dispensing pharmacists must be addressed as delivering microbiology laboratory results is a critical function in diagnosis of infections, which in turn will impact how patient management and interventions are done.[32] As pharmacists aid in providing drug information and advice regarding antimicrobial selection, dosing, administration, adverse drug reactions and IV-to-PO switch[31], the lack of communication leads to inaccurate and inefficient diagnosis of both physicians and pharmacists, which can lead to misuse of antibiotics. Additionally, effectively communicating microbiology results can guide which antimicrobials are to be prescribed; thus, further highlighting the influence of diagnostics in AMS.[21]

More training and improvements towards educational activities (such as online learning and webinars, and face-to-face training sessions), support and funding from the hospital administration, and interprofessional collaboration may be done for dispensing pharmacists so that AMS activities can be delivered more effectively. These can be additional roles for dispensing pharmacists.

Similarly, lack of knowledge of prescribers about DOH AMS, lack of adequate and specialized training directed towards antimicrobial prescribing and use for AMS clinical pharmacists to employ persuasive and restrictive intervention strategies as part of the AMS program, together with inadequate training modules developed with clear learning outcomes and competencies on AMS practice are the challenges encountered by AMS clinical pharmacists in *Core Element 5 Education.*

AMS educational components influence the effective implementation of the AMS program by teaching healthcare professionals the necessary principles of judicious prescribing and use of antimicrobials.[4] More clinical pharmacists recognized the presence of AMS training programs conducted by the hospital possibly due to educational topics primarily designed to target point-of-care AMS activities. Although both clinical and dispensing pharmacists contribute to combating AMR as part of the AMS team, specific AMS training programs tailored to the positions of these pharmacists may be further developed and established to address their unique needs and competencies. Educational activities about AMS were most frequently given as e-learning or relevant webinars. E-learning or relevant webinars and written information through leaflets, guideline booklets, newsflashes, or "antibiotic of the month" posters were the most common forms of conducting educational activities since these were most accessible and convenient, compared to live training sessions and courses that require additional time for attendance and participation; hence, possibly involving schedule conflicts from the busy shift rotations and heavy demands of work of the AMS clinical pharmacists. The conduct of e-learning or relevant webinars, not limited to the hospital, has been employed most especially during the time of COVID-19 pandemic, due to the dearth need for healthcare workers to manage and treat confined patients infected with SARS-CoV-2, while ensuring the continuation of medical training.[33]

AMS training modules were identified to be available and directed towards clinical pharmacists more. The core area of basic clinical skills followed by pharmacology of anti-infective agents were the topics AMS clinical pharmacists were most knowledgeable about, while more training programs and educational initiatives on topics about interpretation of antibiograms and their utility may be recommended as part of the training modules. Even though AMS clinical pharmacists reported to have access to the hospital's anti-biogram as per request, difficulty in terms of interpreting antibiograms may hamper the potential contribution of such in tailoring AMS interventions to ensure dose optimization especially in treatment of patients infected with resistant pathogens, provision of drug information and advice on dosing, drug interactions, and adverse drug reactions, and evaluation of prescribing behavior while providing feedback to physicians. AMS clinical pharmacists must be trained on the interpretation and application of antibiograms to ensure optimal patient care.[4] Since both types of AMS clinical pharmacists have interrelated and interdependent functions in the AMS program implementation, it is necessary to provide training modules and curricula with clear learning outcomes and competencies for AMS pharmacists to be well-educated and competent in performing their roles and responsibilities in the AMS team.[4]

The institution's AMS Committee must ensure that healthcare providers involved in the AMS program, including clinical pharmacists, must attend the Standard Training Course on AMS through the education program certified and recognized by DOH.[4] Face-to-face training sessions from stewardship champions, case–based learning, and joint research activities on stewardship implementation research in collaboration with other institutions about educational topics on managing infections caused by difficult-to-treat MDRO (multi-resistant organisms), appropriate and effective AMS interventions in the hospital, and interpreting antibiotic susceptibility reports and antibiograms were identified to be the most significant to support the hospital in continuing its stewardship efforts. The majority of clinical and dispensing pharmacists continually update themselves on the newest developments in the area of microbiology, infectious disease management and prevention, pharmacotherapy, and AMS practice for their continuing professional development aligned in the DOH MOP. AMS clinical pharmacists also educate other pharmacy-staff and the public, possibly via patient interaction, communication in the workspace, or through social media, on basic principles of infection prevention and control, personal hygiene, and handwashing to prevent the spread of AMR in the community.

The need to decrease the amount of intravenous antibiotic prescriptions, document stop or review dates of antimicrobial prescriptions, contribute data as required for timely and accurate reporting of the AMS program, and monitor all AMS strategies and interventions as a whole to measure effectiveness and identify areas for further improvement have also been identified as challenges under *Core Element 6 Performance Evaluation*. Similarly, insufficient time and possibility of overworked schedules of AMS clinical pharmacists due to high volume of patients and limited pharmacy manpower have been perceived as barriers to implementing a successful AMS program in the hospital.

Prescribing antibiotics intravenously for patients confined in the hospital may have been a common practice; and this opens opportunities to respectfully collaborate with prescribers on the provision of the right drug and right route of medication to the right patient. Various instances

where infections that can be treated with equally efficacious oral antibiotics are instead treated with administration of antibiotics intravenously to better control patient response towards antibiotic therapy and achieve more optimal pharmacokinetic and pharmacodynamic responses. While antibiotic intravenous administration avoids variable gastrointestinal absorption times, addresses inability to tolerate oral administration, and bypasses first pass hepatic metabolism, equally efficacious oral antibiotics must be appropriately given to avoid adverse effects of intravenous administration and ensure cost-effectiveness among patients. AMS clinical pharmacists can serve their roles in promoting IV-to-PO switching after short course antibiotics therapy to mitigate the development of AMR and avoid loss of efficacy.[34] Additionally, proper inventory management of medications available in the hospital pharmacy and medicines included in the PNF must be employed to ensure effective practices of proper prescribing and use of intravenous antibiotics and assure proper switching of IV-to-PO antibiotic short course therapy for de-escalation. In line with the prescribed antibiotics to patients, the AMS clinical pharmacists identified the hospital's AMS program to increase the amount of targeted prescriptions based on microbiology results tailored to the medical needs of patients. This yields the provision of a more appropriate, effective, and evidence-based empirical antibiotic therapy, as the initial antibiotic treatment provided to the patient is targeted at the most probable causative microorganisms. In cases where evidence is lacking, local susceptibility data or available scientific evidence or expert options must be looked into.[3]

The stop or review dates for antimicrobial prescriptions in the hospital are not always properly documented, unlike the indications of antimicrobials prescribed. This practice may be due to innate familiarity of prescribers and pharmacists to frequently used antibiotics in the hospitals and their common duration, lack of time to list down specific review or stop dates of antibiotics prescribed given various medicines as part of antimicrobial therapy, and large number of patients being catered to by healthcare professionals per day, supported by lack of manpower. Despite these challenges, it is of utmost importance to employ documentation of stop or review dates of antimicrobial therapy and the corresponding indications of antimicrobials involved as these serve as indicators of antimicrobial prescribing quality.[35] For antibiotic prescribing, documenting indication and review date of therapy on hospital medication charts decreases unnecessary antibiotic use and reduces the incidence of *Clostridium difficile (C. difficile)*[36]; hence, AMS clinical pharmacists must document these information to enhance shared communication among healthcare team members and ensure shared understanding of the patient's clinical condition and rationale for therapy. Documenting indications for antimicrobial therapy and stop or review dates can allow AMS clinical pharmacists to optimize dosing for the clinical condition from dosing regimen guidelines to ensure that the prescribed dose is appropriate to the patient's individual characteristics.[37] Eventually, this will facilitate timely review of the patient's progress, response to therapy, further decision to undergo de-escalation or change therapy, switch from intravenous to oral therapy, and cease antimicrobial therapy accordingly.[38]

IT systems could be used to facilitate the timely and accurate documentation and reporting of AMS-related data and AMS interventions of pharmacists.

AMS clinical pharmacists contribute more to the provision of data as required for timely and accurate reporting of the AMS program implementation in the hospital, as compared to the dispensing pharmacists possibly due to the nature and coverage of their functions and responsibilities. It is essential that both AMS clinical pharmacists contribute to the provision of data and monitoring of activities for the timely and accurate reporting of AMS program implementation in the hospital because through monitoring and evaluation initiatives, the overall quality management improvement and effectiveness of AMS interventions in the hospital can be assessed to yield a successful implementation of an AMS program. AMS pharmacists continuously ensure that all AMS activities and efforts are made to achieve and excel in the target performance indicators set by the DOH; therefore, they can contribute to the progression of the implementation of the AMS program from the health facility and national level, to ultimately towards achieving the established goals of the national agenda to combat AMR.[4]

Aligned with the challenges identified from the responses of the AMS clinical pharmacists, both clinical and dispensing pharmacists have also identified the following top five (5) challenges encountered in the implementation of AMS program (Table 11): (1) Prescribing of non-PNF antimicrobial drugs, (2) Lack of time to perform stewardship, (3) Lack of qualified personnel, (4) Lack of hospital management support and information technology support, and (5) Lack of expertise and training in antimicrobial stewardship within the antimicrobial stewardship team. Physician attributes and their resistance to prescribing guidelines by using of non-formulary antimicrobial drugs has also been reported in studies conducted in Australia[10], Philippines[11], Hong Kong[39], and Ethiopia.[21] The other remaining challenges identified are consistent with studies conducted in Australia[10], private hospitals in the Philippines[11], Ethiopia[21], Scotland[22], and Hong Kong[39].

It is important to note that other hospitals in the country such as the Makati Medical Center and The Medical City have also already implemented their own AMS programs as guided by the DOH MOP. The Makati Medical Center, a 600-bed tertiary teaching hospital located in Makati City, has implemented a hospital-wide AMS program in 2017, delivered by a multidisciplinary AMS team on antimicrobial prescribing outcomes. Its program consists of a combination of persuasive, restrictive, and structural components adapted from the DOH MOP to measure the antimicrobial use prevalence and monitor the selected antibiotic prescribing

quality indicators. Its dedicated AMS team, composed of an infectious disease (ID) clinician, a clinical pharmacist, an infection prevention and control nurse (AMS officer), and an administrative staff member, is assigned to roll out AMS interventions and provide administrative and clinical support in the implementation and monitoring of its AMS program. Additionally, several stakeholders including the infectious disease department, microbiology laboratory, and nursing and pharmacy services have been in collaboration with the AMS team.[12] The Medical City, a tertiary private hospital in Pasig City, approved a policy in 2017 on antimicrobial use in the hospital patterned after the DOH MOP, with few revisions made to adapt to the institution's culture. Some of the components of the program include antimicrobial use guidelines on empiric recommendations and surgical prophylaxis, drug duration audit and feedback, prospective audit of monitored antimicrobials with direct feedback, and prior approval of restricted antimicrobials. Except for the prior approval of restricted antimicrobials, the other components of their AMS program are only implemented in specific areas of the hospital.[23]

CONCLUSION AND RECOMMENDATIONS

With the perceived enablers and challenges identified in this study, the hospital's implementation of its AMS program can be strengthened and improved. The hospital's Pharmacy Department specifically can also relate the findings of this study to their current work environment and assess what areas need improvement and/or further evaluation.

The limitations of this descriptive study include the timeline covered for the AMS program implementation (focusing only on year 2021 onwards), sample size, and mode of conduct. Additionally, as the research instrument used a Likert-type scale, biases (e.g., central tendency bias, acquiescence bias, social desirability bias) may possibly distort the resulting data. It is also noted that this study does not measure any AMS performance indicators, and the identified enablers and challenges are not officially reported by the hospital administration.

Future researchers may conduct interviews and/or focus group discussions face-to-face if the situation allows for more detailed information. The use of actual hospital documents, if possible, is also recommended for validation of the initial perceived enablers and challenges, which then can yield actual enablers and challenges unique to the hospital's AMS program implementation. Hospitals classifying under Levels 3 and 2 with institutionalized AMS programs may also be included to evaluate the success of training programs and the AMS program implemented at a national level, such as the Makati Medical Center and The Medical City, to gather a wider perspective of the overall AMS implementation within the country. Performance indicators, as provided in the DOH National AMS Program Manual of Procedures, should also be measured and evaluated to objectively assess the overall effectiveness of the implementation of the AMS program in hospitals and compliance to current DOH standards to achieve the national goals to combat AMR.

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