

Original Research

A questionnaire based survey among pharmacy practitioners to evaluate the level of knowledge and confidence towards antimicrobial stewardship

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Abstract

Objective: Our study aimed to assess the knowledge, understanding and confidence of the practicing pharmacists in UAE as an antimicrobial Stewards. Antimicrobial resistance threatens the achievements of modern medicine globally, and it's highly required for the AMS principles to be implemented in our communities. **Methods:** A cross-sectional online- questionnaire based survey was used among UAE pharmacy practitioners from different areas of practice who are holding pharmaceutical degrees and/or licensed pharmacists. The questionnaire was sent to the participants via social media platforms. The questionnaire was validated, and reliability assessment was made prior to the conduct. **Results:** A total of 117 pharmacists responded to this study, out of which (70.9%, n=83) were females. Pharmacists which are from various practice fields participated in the survey, but the majority were pharmacists in Hospital pharmacies or Clinical pharmacists (47%, n=55), also community pharmacists (35.9%, n=42), while only (16.9%, n=20) were from other areas of pharmacy including industrial pharmacy and academia. The majority of participants 88.9% (n= 104) were interested in pursuing their career as an Infectious disease pharmacist or getting a certificate in antimicrobial stewardship. The mean scores in the knowledge towards antimicrobial resistance was 3.75 (poor: 1-1.6, moderate: 1.7-3.3, Good: 3.4-5), indicates that the pharmacists have a good level of knowledge towards AMR. A total of 84.3% of participants succeeded in Identifying the correct intervention for antibiotic resistance. The findings also showed that the total mean score of hospital pharmacists (mean=10.6±1.12), and the average of the scores of community pharmacists (mean=9.8±1.38), were non-significant between the different area of practice. 52.3% of the participants had a training on antimicrobial stewardship during their experiential rotation which reflected on their confidence in their performance and knowledge assessment (p value < 0.05). **Conclusion:** The study concluded good knowledge and high confidence levels among practicing pharmacists in UAE. However, the findings also identify areas of improvement in the practicing pharmacist, and the significant relationship between the knowledge and confidence scores reflects the ability of the practicing pharmacists to integrate the AMS principles within the UAE, which aligns with the attainability of the improvement

Keywords: antimicrobial resistance; pharmacists; antimicrobial stewardship; knowledge; confidence; stewards

INTRODUCTION

Antimicrobial resistance (AMR) demonstrates a major concern globally, leading public health and clinical outcomes to decline, and patient safety to be impacted negatively. It also threatens the achievements of modern medicine,¹ as it makes the treatment of severe infectious diseases efficiently and appropriately a significant challenge, knowing that the development of new antimicrobials is currently rare.^{1,2} This creates a major burden on health care systems around the globe.³

The spread of the AMR issue that is occurring worldwide has resulted in developed countries reporting high levels of resistant organisms.⁴ This is thought to be related to the absence of self-consciousness of responsibility for combating AMR from both health workers and professionals when prescribing antimicrobial agents in addition to the public who are primary consumers who may be utilizing leftover antibiotics at home.⁵ This kind of irrational handling of antimicrobials is widely occurring across the world, especially in countries where self-prescribed antibiotics can be easily bought from drug stores and pharmacies without supervision from the government, management, and/or the authorized bodies.⁶

Inappropriate handling of antimicrobial agents was demonstrated across the globe, in both developed and developing countries, and was strongly suggested by several studies that the effect is significant.⁷⁻⁹ The major cause of the misuse of antimicrobials is the lack of awareness amongst the population, and perhaps the lack of knowledge among the prescribers^{10,11} which may lead them to choose an inappropriate therapy plan or therapeutic agent, which in turn increases the chance of developing resistance among microorganisms. In addition, the inappropriate following of infection prevention and control parameters at both health care facilities and amongst the population also has an impact

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on the deterioration in clinical outcomes, as well as public and population health.¹²

The literature highlighted the role of pharmacists in proving their significant value in the community and their possible interventions as first-line healthcare professionals, who are known to be easy to-approach by the patients.^{13,14} A qualitative study showed that pharmacists perceived themselves as “antibiotic gatekeepers”, stating that the promotion of rational use of antibiotics is essential in their jobs hence, they have the ability to make an impact.¹⁵ Many elements, such as the tendency towards self-medication in many countries, contribute directly to the misuse of antimicrobial agents.¹⁶ Some are related to the wrong prescribing behaviors of physicians, which also might be due to several reasons and factors, such as the pressure added by the community and/or the patients. Because they are expecting a treatment, physicians may prescribe the antibiotic to meet patient expectations.^{17,18} The role of the pharmacist has a great potential to promote the proper use of antibiotics in the community, as they have the ability for effective and rational prescribing. The pharmacist’s role is vital in providing knowledge and advising patients about the importance of the recommended treatment regimens.¹⁶

According to the Centers for Disease Control and Prevention (CDC), approximately 2 million patients are infected yearly with antimicrobial resistant pathogens in the U.S. This attributes directly to the increase in deaths which reached 23,000 per year, resulting in taking an action through implementing the antimicrobial stewardship programs in acute care or primary care hospitals.¹⁹

It is recommended by the CDC that pharmacists are considered as the core of antimicrobial stewardship program (ASP) team, due to their provision of drug expertise. A pharmacist can have the role of the leader of the ASP in different healthcare settings.²⁰ The Middle East/North Africa (MENA) region countries including United Arab Emirates (UAE) suggested involving the clinical pharmacist in the activities of infection control, where they can help optimize the treatment, improve clinical outcomes, and enhance the rational prescribing at the bedside and control the antimicrobial resistance.²¹

The importance of integrating the stewardship principles into pharmacy education and training cannot be denied as it will be essential to filling the needs established by professional standards and regulatory requirements. This integration doesn’t only include the Continue Medical Education required by the government but also in the university’s educational curriculum.¹ Providing interactive learning sessions and pieces of trainings to working pharmacists can have a huge impact.¹⁰ These educational sessions should contain all information needed in the practice that’s related to antimicrobials²¹ and the management of infectious diseases, in addition to educating pharmacists on recent updates on antimicrobial resistance patterns.^{22,23}

The literature showed that having adequate knowledge and confidence, with a strong medical background and evidence-

based practice among the different healthcare professionals will lead to better clinical outcomes.^{24,25}

This study is designed to identify the preparedness of the pharmacist of the UAE in terms of knowledge and training, their ability to fulfill their responsibilities in combating AMR, and act as stewards in their practice to meet the expectations of the government of the UAE. The objective of the study is to assess the knowledge of pharmacists practicing in the United Arab Emirates about antimicrobial resistance and their awareness and understanding of appropriate antimicrobial therapies. The secondary objective was to assess the confidence of pharmacists practicing in the United Arab Emirates in the information about antimicrobial resistance.

MATERIALS AND METHODS

Study design

A cross-sectional study was conducted by distributing an online-based self-filled/self-administered questionnaire among pharmacy practitioners in the United Arab Emirates.

Ethical approval

We obtained an Institutional Review Board approval from the research committee at the Gulf Medical University to proceed with our project, the approval was obtained on the 7th of October of 2021 with a reference no of IRB/COP/STD/81/Oct-2021. Any data collected are used only to conduct the research and any data collected is treated confidentially.

Study population

The study population included pharmacists of the UAE; data was collected by convenience sampling. The calculated sample size was 183 and we expected a 50% response rate.

Sampling technique/ Research tool

The data was collected using Google forms and Survey Monkey, and the questionnaire was self-filled. The data was collected between December 2021-July 2022. The survey link was sent to pharmacists, and pharmacy degree holders from all around the UAE using social networking platforms (e-mailing, messaging). Participants also included pharmacists practicing in the UAE and holding their pharmacy degree either from inside or outside the UAE. The convenient sampling techniques was used to invite participants in this study.

The survey included multiple choice questions to assess the knowledge and the pharmacy practitioners assessed their confidence by rating their confidence in multiple aspects. Valid responses were taken into consideration when calculating the percentages of the total correct answers, but only the completed responses were scored.

Data collection

Responses were collected by Google forms & Survey Monkey and then converted into spreadsheets to be analyzed descriptively, our survey questions were divided into sections:



Demographics including the area of practice,
 Knowledge of antibiotic resistance,
 Knowledge of appropriate antibiotic therapy,
 Training in Antibiotic resistance and stewardship

Validation of the questionnaire

Two academics and field experts were invited to review the structure and content validity of the questionnaire. A pilot study was conducted among pharmacists, a total of n=15 participants were included, and a Cronbach alpha value was > 0.7.

Inclusion

Pharmacy practitioners in the UAE practicing in a pharmaceutical company, community pharmacy, hospital, or institution.

Statistical analysis

The Statistical Package for Social Science (SPSS) was used for data analysis. The descriptive analysis was used to express the frequencies and percentages. The Chi-squares test was also used to assess the association between dependent and independent variables. The $p < 0.05$ was considered a significant association.

RESULTS

Characteristics of the sample

A total of 117 pharmacists responded to this study, out of which 70.9% (n=83) were females. Pharmacists are from various practice fields, but the majority were from hospital pharmacies or clinical pharmacists (47%, n=55), followed by community pharmacists (35.9%, n=42). The rest (16.9%, n=20) were from other areas of pharmacy including industrial pharmacy and academia (Table 1 and 2).

A total of 59.0% (n=69) of the participating pharmacists received their pharmaceutical degree from the UAE, followed by 15.4% (n=14) of the participants holding their degrees from India or Egypt 12.8%. The rest are from a variety of countries including the Philippines, Syria, Canada, Pakistan, Kingdom of Saudi Arabia, and Lebanon. The majority of participants 88.9% (n=104) were interested in pursuing their career as an infectious disease pharmacist or getting a certificate in antimicrobial stewardship, while the rest 11.1% (n=13) were not interested.

Knowledge of antimicrobial resistance

Generally, UAE pharmacists who participated in our study demonstrated a good level of knowledge towards antimicrobial resistance questions. The mean of their scores in the knowledge of antimicrobial resistance was 3.75 (poor 1-1.6, moderate 1.7-3.3, Good 3.4-5), which indicates that the pharmacists have a good background when it comes to AMR (Table 3).

A total of 80% correct response were reported among

Table 1. Gender distribution among study population

Gender	Percentage (N)
Female	70.9% (83)
Male	29.1% (34)
Total	100% (117)

Table 2. Practice areas

Area of Practice	Percentage (N)
Hospital Pharmacy/ Clinical Pharmacy	47% (55)
Community Pharmacy	35.9% (42)
Industrial	1.7% (2)
Academia	1.7% (2)
Undecided	6.8% (8)
Other Areas of Pharmacy	6.8% (8)
Total	100% (117)

Table 3. Knowledge in AMR (Question Vs. Correct answers frequency)

Questions	Frequency correct (%)
Define the mean of the term antibiotic resistance	80.2 (81)
Mechanism of antibiotic resistance	47.5 (48)
The consequence of antibiotic resistance infection	86.1 (86.9)
Promotes antibiotic resistance	82.2(81)
Antibiotic hydrolyzed by beta-lactamase enzyme	82.2 (81)

participants in 4 out of 5 questions, and only one question asking about the mechanism of antibiotic resistance received 47.5% correct responses, as we may consider this question quite detailed which led to variation in response. In this section a very high percentage of pharmacists (86.1%) answered correctly the question of “antibiotic resistance infection consequences” which is “Longer Hospital stay” as the most appropriate answer in our survey, besides knowing what promotes antibiotic resistance (82.2%). This demonstrates a high level of awareness by the pharmacists in our sample in terms of AMR danger on patients’ health (Figure 1).

Knowledge of appropriate antibiotic therapy

A total of 78.6 % (n=92) of the 117 participants completed these questions. Fewer participants correctly answered the questions that are more advanced and might need a higher level of specialization or experience. The questions related to the antibiotic effective in crossing the BBB (58.7% correct response), and OB-GYN asks for a recommendation for an antibiotic for surgical prophylaxis (41.3% correct response). In contrast questions asking for an effective antibiotic against MRSA, and antibiotics that have activity against anaerobes were answered correctly by more than 80% of the participants (Table 4).

Antimicrobial Stewardship training

When the pharmacy practitioners were asked about the goal of



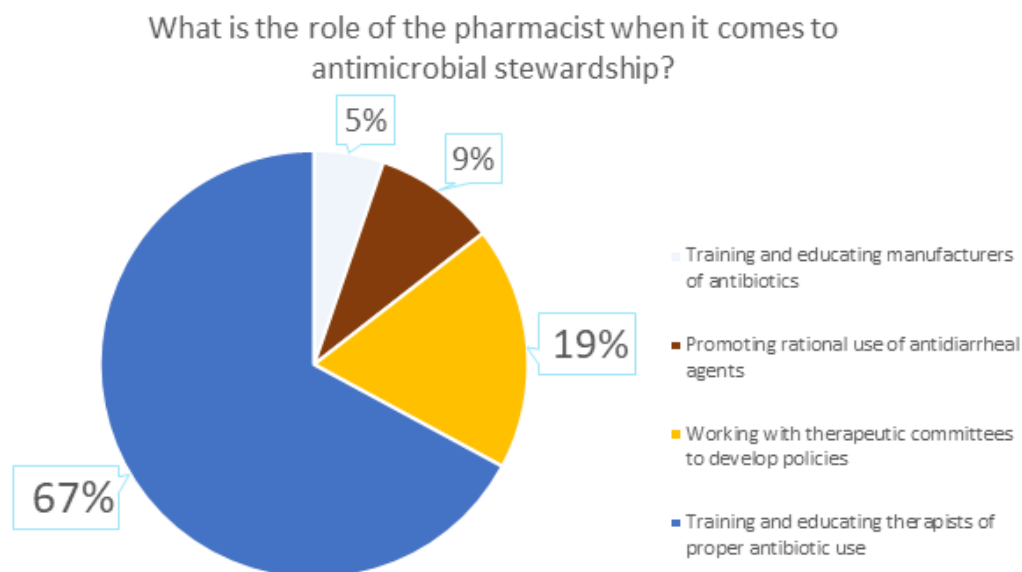


Figure 1. Role of pharmacist in antimicrobial stewardship

Question	Frequency correct (%)
Antibiotic that is safe during pregnancy	88 (81)
Antibiotic most effective in crossing the BBB	58.7 (54)
Antibiotic effective against MRSA	73.9 (68)
OB-GYN asks for a recommendation for an antibiotic for surgical prophylaxis	41.3 (38)
Antibiotic that has the best activity against anaerobes	80.4(73)
ID physician asks for a recommendation for a suitable antibiotic for <i>C. difficile</i> positive stool culture	67.4(62)

antimicrobial stewardship, 77.5% of them answered correctly and 84.3% of them succeeded in identifying the correct intervention to fight antibiotic resistance. However, only 18% of the participants were able to answer correctly about the role of the pharmacist. The study showed that the majority of the pharmacists chose role as an educator and trainer on proper antibiotic use (Figure 2).

The results also showed that the mean of the scores for the hospital pharmacists (mean=10.6), and the average of the scores of community pharmacists (mean=9.8), were slightly different but not significant p value > 0.1, hence future studies

will be conducted to clarify the significance and increase the sample size to get accurate results.

On the other hand, more than 50% of the participants had training on antimicrobial stewardship during their experiential rotations which reflected on the confidence in their performance and knowledge assessment where p value < 0.05 (Table 5).

Confidence in antimicrobial therapy

The highest percentage of confidence was demonstrated in identifying infections that do not require an antibiotic (46.6%), followed by planning de-escalation or streamlining of antibiotic therapy (45.5%). In contrast, 40.9% of pharmacists reported moderate confidence in interpreting microbiological results. There was a significant relationship found between the knowledge scores of the pharmacists and their confidence p value < 0.05 (Table 6).

DISCUSSION AND LIMITATIONS

This study was conducted to assess the knowledge of UAE pharmacy practitioners which will provide us with the information to identify their preparedness to be antimicrobial stewards in their area of practice. This study is the first of its kind in the region, unlike other studies that assess the knowledge and behavior of the public or the healthcare students^{17,22} or in some

Questions	Frequency correct (%)
NOT a goal of antimicrobial stewardship	77.5
Role of the pharmacist when it comes to antimicrobial stewardship	18.0
An intervention for fighting antibiotic resistance	84.3
An antimicrobial stewardship intervention	59.6

Which of the following is an antimicrobial stewardship intervention?

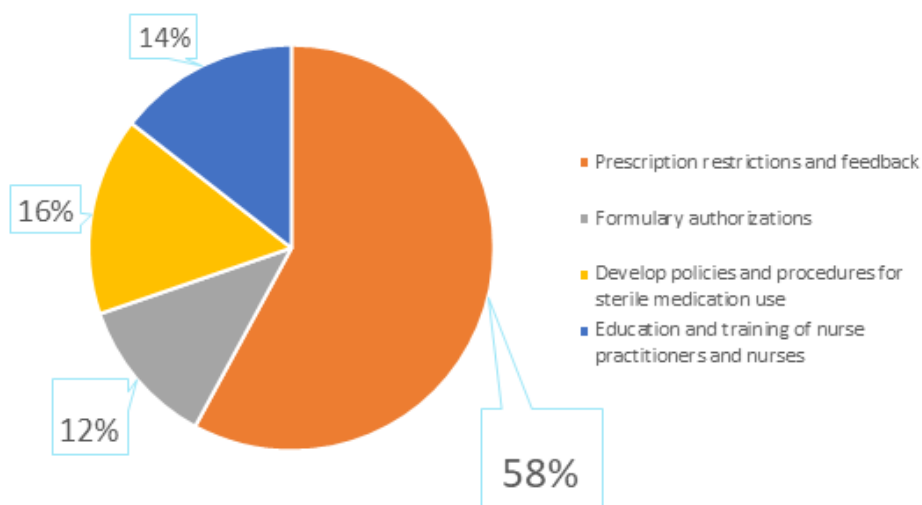


Figure 2. Antimicrobial stewardship interventions

Question	Not Conf	Mod. Conf.	Conf.	Extreme Conf
Choosing appropriate empirical therapy	14.8%	35.2%	38.6%	11.4%
Identifying infections that do not require an antibiotic	10.2%	28.4%	46.6%	14.8%
Interpreting microbiological results	10.2%	44.3%	31.8%	13.6%
Choosing antibiotic combinations when appropriate	11.4%	40.9%	35.2%	12.5%
Choosing between intravenous and oral administration	10.2%	30.7%	39.8%	19.3%
Choosing the correct dose of antibiotics	9.1%	31.8%	34.1%	25.0%
Choosing the appropriate dosage interval/frequency	10.2%	33.0%	30.7%	26.1%
Choosing the appropriate duration of treatment	5.7%	36.4%	37.5%	20.5%
Planning de-escalation or streamlining antibiotic therapy	10.2%	33.0%	45.5%	11.4%
Describing the correct spectrum of activity for different antimicrobials	10.2%	36.4%	38.6%	14.8%
Understanding the basic mechanisms of antimicrobial resistance	8.0%	26.1%	40.9%	25.0%
Finding reliable sources of information to treat infection	4.5%	25.0%	40.9%	29.5%
Monitoring efficacy and safety of the chosen antimicrobial therapy	4.5%	33.0%	36.4%	26.1%

other articles the attitude of healthcare professionals towards AMR.¹² Here, we have focused on pharmacy practitioners' knowledge, surveying pharmacists from various practice areas of pharmacy in the UAE, as pharmacists are considered easily accessible health care professionals.¹⁶

A national action plan to combat emerging antimicrobial resistance was issued in 2019 and is expected to last until 2023. The application of this plan has already started in 2020 in a large number of healthcare facilities in the region,¹ hence, the evaluation of the preparedness of the pharmacists and their confidence in delivering the optimal healthcare services to the patients based on using the gold standard for applying the novel antimicrobial stewardship (AMS) principles in their area of work, is essential.^{6,23}

Even though there are various disparities in the education and knowledge amongst pharmacists and pharmacy practitioners in the UAE, the knowledge of our participants was good of a mean reflecting (mean±S.D 10.2±2.11).

While we were assessing the knowledge of our pharmacy practitioners in the UAE we found that 84.9% of the pharmacists in the UAE chose the "increased length of stay" of the patients as a consequence of the infections of antimicrobial resistant pathogens. This indicates their high level of awareness of this worldwide challenge, and that would reflect in their self-consciousness regarding their responsibility in providing the best care and choosing the optimal antimicrobial therapy.^{5,8} It was suggested that pharmacists as health care professionals are the most aware of their responsibility and their role in the fight against the AMR war and the application of the guidelines



and AMS standards.^{10,12}

It's worth mentioning that throughout the practice of the participants and their training and participation in the ASP training, it was mentioned by one of them that they used to assess their preceptors in Audit and Feedback activities, while another one stated that she assessed her preceptor developing guidelines, by looking up local and international guidelines and comparing the local antibiogram. These are considered to be the responsibility of the pharmacy team in the hospitals here in the UAE.

The development of a clear pathway to put an end to the persisting trends of emerging antimicrobial resistance is yet to be achieved.^{24,25} The delay in the application of an action plan to put an end to emerging antimicrobial resistance hinders the achievement of the optimal prevention and treatment of dangerous and persistent diseases. As multiple reasons are the cause of this antimicrobial resistance dilemma,²⁶ it is well known that misusing and overusing various antibacterial agents in the healthcare industry is thought to be the main cause of the emergence of antimicrobial resistance. It is well accepted that unnecessary antibiotic exposure leads to spontaneous evolution, bacterial mutation, and horizontal gene transfer of resistance genes.²⁶ All should agree on the health care professional's responsibility to provide the best care possible for the patient and optimize clinical outcomes.²⁷ The term "stewardship" is used to refer to the duties and obligations of a steward, or in other words, the responsible and meticulous handling of something under one's care.^{27,28}

Education is considered fundamental to the implementation of antimicrobial stewardship principles in the practical field,⁹ and involving students, prescribers, and healthcare providers including pharmacists and nurses in the learning process of the rational use of antimicrobial prescribing through the educational syllabus and the CME sessions, is an essential step to control antimicrobial resistance.²⁹ The efforts of antimicrobial stewardship are dedicated to preserving antimicrobials for the patients who need them now and in the future, despite the definition of stewardship which is as mentioned previously, a responsibility of handling and managing meticulously patients and responsibilities under one's care.²⁷

The Infectious Disease Society of America (IDSA) defined ASP as "a set of coordinated interventions designed to improve antimicrobial use in terms of selecting the appropriate agent, dose, route of administration, and therapy duration without compromising patient outcomes".^{30,31} The literature showed that receiving successful training gives the the clerk or trainee the opportunity to be exposed to the clinical environment along with benefiting from the existing structure.^{20,30} In our sample (n=88) 52% (n=46) of practitioners had an experience in AMS rotations, which is a close result to a study that was done on Australian healthcare professionals where 48% of them reported working in a facility that has an AMS Program.²³

In other studies, done in the Middle East, there was awareness among the healthcare professionals and pharmacists,^{30,31} but

the limited resources were the major challenge to limiting the students and the pharmacists to undergo training related to AMS and be exposed to an ASP team.^{32,33} In another study the high assumption of their knowledge is a result of the high level of confidence that they have due to their experience in antimicrobial stewardship rotations and the training they received (p-value <0.001). There is no significant value of the relation between the rating of the pharmacists' knowledge from 1-4 and their scores in the knowledge and training questions, even though they demonstrated good knowledge in regard to antimicrobial resistance and stewardship and ASP training.

This study showed that the education can have a remarkable impact on the results demonstrated.³⁴ If we were to provide an educational session related to providing appropriate antimicrobial therapies and antimicrobial stewardship principles for pharmacists and participants, then run the survey afterward that might enhance the knowledge scores additional to generating a relationship between the knowledge and confidence scores.^{35,36} The guidelines for implementation of ASP 2016, don't only recommend relying solely on education, but also the methods to be integrated with the ASP interventions.^{1,7}

As per a systemic review that was done in 2016, the ASP proved its efficacy in terms of reducing antimicrobial consumption.¹⁹ This study evaluated the effect of ASP on the prevalence of resistant strains derived from infections. Methicillin-resistant *Staphylococcus aureus* (MRSA) infections were significantly lower after the implementation of the ASP, and the same was noted for imipenem-resistant *Pseudomonas aeruginosa* and extended-spectrum beta-lactamase (ESBL)-*Klebsiella spp.*¹⁹ A positive impact of the ASP in health care settings was also demonstrated by many studies and reviews,^{2,4} and in this study with the purpose of identifying the preparedness of the pharmacists to become antimicrobial stewards. This will apply to the national action plan of implementing an antimicrobial stewardship program in the UAE health care facilities.³⁸ As previously mentioned it was strongly suggested that pharmacists have an effective role in containing the threat of antimicrobial resistance,³⁹ hence, empowering the UAE with the right knowledge through various delivery systems possible will make the difference, and the application of the national plan will be continuous.^{1,40}

The distribution of responsibility clearly and effectively will always be needed, in order to be interpreted into a job description where it becomes context-specific and time-limited actions and responsibilities, that can be audited, and feedback can be provided.^{10,41} The UAE has a clear regulation that only allows the pharmacists to dispense antibiotics as prescription only medications, but unfortunately some pharmacists deviate from these rules, so in order to contain this issue the government limited the types of antibiotics that are allowed to be available in the community pharmacies. This restricted the use of antimicrobials within health care facilities, and created the addition of monitoring parameters of the consumption of restricted antimicrobials used within those healthcare facilities.



CONCLUSION

This study concluded that pharmacists in the UAE have good knowledge of AMR and antimicrobial therapy with high levels of confidence in applying the AMS principles. The study also showed that pharmacists have an effective role in containing the threat of antimicrobial resistance, which in turn proves the ability of the pharmacists to apply their knowledge and integrate the principles of AMS within the community of the UAE. However, the findings also identify areas of improvement in the practicing pharmacist. The study didn't find a significant difference among knowledge of pharmacists working in hospital compared to pharmacists working in the community

setting.

AUTHOR(S) ROLE

SWG: Methodology, supervision, final drafting, validation, tool development

MKSS: Data collection, resources, data analysis, tool development

DES: Conceptualization, content validation, reviewing, tool development

References

1. United Arab Emirates: National strategy and action plan for combatting antimicrobial resistance (NAP-AMR). 2019-2023. 2019. [Microsoft Word - NAP AMR English 13 Jan\[2\].docx \(who.int\)](#), 2022;14.
2. Thomas B, Abdulrouf P, Elkassem W, et al. Clinical and economic impact of antimicrobial stewardship interventions reported among hospital inpatients in the Middle East: a systematic review protocol. 2020.
3. MacBrayne CE, Williams MC, Levek C, et al. Sustainability of handshake stewardship: extending a hand is effective years later. *Clinical Infectious Diseases*. 2020;70(11):2325-2332. <https://doi.org/10.1093/cid/ciz650>
4. Karanika S, Paudel S, Grigoras C, et al. Systematic review and meta-analysis of clinical and economic outcomes from the implementation of hospital-based antimicrobial stewardship programs. *Antimicrobial Agents and Chemotherapy*. 2016;60(8):4840-4852. <https://doi.org/10.3410/f.726394411.793522941>
5. Pinder RJ, Berry D, Sallis A, et al. Antibiotic prescribing and behavior change in healthcare settings: literature review and behavioral analysis. 2015.
6. Aryee A, Price N. Antimicrobial stewardship—can we afford to do without it? *British Journal of Clinical Pharmacology*. 2015;79(2):173-181. <https://doi.org/10.1111/bcp.12417>
7. Haddadin RN, Alsous M, Wazaify M, et al. Evaluation of antibiotic dispensing practice in community pharmacies in Jordan: A cross sectional study. *PloS One*. 2019;14(4):e0216115. <https://doi.org/10.1371/journal.pone.0216115>
8. Raza UA, Khurshed T, Irfan M, et al. Prescription patterns of general practitioners in Peshawar, Pakistan. *Pakistan Journal of Medical Sciences*. 2014;30(3):462. <https://doi.org/10.12669/pjms.303.4931>
9. Saleh D, Abu-Farha R, Mukattash TL, et al. Views of community pharmacists on antimicrobial resistance and antimicrobial stewardship in Jordan: A qualitative study. *Antibiotics*. 2021;10(4):384. <https://doi.org/10.3390/antibiotics10040384>
10. Pinder RJ, Berry D, Sallis A, et al. Antibiotic prescribing and behaviour change in healthcare settings: literature review and behavioural analysis. 2015.
11. Bai Y, Wang S, Yin X, et al. Factors associated with doctors' knowledge on antibiotic use in China. *Scientific Reports*. 2016;6(1):1-5. <https://doi.org/10.1038/srep23429>
12. Barchitta M, Sabbatucci M, Furiozzi F, et al. Knowledge, attitudes and behaviors on antibiotic use and resistance among healthcare workers in Italy, 2019: Investigation by a clustering method. *Antimicrobial Resistance & Infection Control*. 2021;10(1):1-10. <https://doi.org/10.1186/s13756-021-01002-w>
13. World Health Organization. Pharmacists have decisive role in combating antibiotic resistance, says new WHO European survey. 2014. WHO Regional Office for Europe. 2017.
14. Wickens HJ, Farrell S, Ashiru-Oredope DA, et al. Antimicrobial Stewardship Group of the Department of Health Advisory Committee on Antimicrobial Resistance and Health Care Associated Infections (ASG-ARHAI), Cooke J, Sharland M, Ashiru-Oredope D, McNulty C, Dryden M. The increasing role of pharmacists in antimicrobial stewardship in English hospitals. *Journal of Antimicrobial Chemotherapy*. 2013;68(11):2675-2681. <https://doi.org/10.1093/jac/dkt241>
15. Nasr ZG, Higazy A, Wilbur K. Exploring the gaps between education and pharmacy practice on antimicrobial stewardship: a qualitative study among pharmacists in Qatar. *Advances in Medical Education and Practice*. 2019;10:287. <https://doi.org/10.2147/amep.s198343>
16. World Health Organization. Pharmacists have decisive role in combating antibiotic resistance, says new WHO European survey. 2014. WHO Regional Office for Europe. 2017.
17. Scaiola G, Gualano MR, Gili R, et al. Antibiotic use: a cross-sectional survey assessing the knowledge, attitudes and practices amongst students of a school of medicine in Italy. *PloS One*. 2015;10(4):e0122476. <https://doi.org/10.1371/journal.pone.0122476>
18. Rodrigues AT, Roque F, Falcão A, et al. Understanding physician antibiotic prescribing behaviour: a systematic review of qualitative



- studies. *International Journal of Antimicrobial Agents*. 2013;41(3):203-12. <https://doi.org/10.1016/j.ijantimicag.2012.09.003>
19. Karanika S, Paudel S, Grigoras C, et al. Systematic review and meta-analysis of clinical and economic outcomes from the implementation of hospital-based antimicrobial stewardship programs. *Antimicrobial Agents and Chemotherapy*. 2016;60(8):4840-4852. <https://doi.org/10.3410/f.726394411.793522941>
 20. Pollack LA, Srinivasan A. Core elements of hospital antibiotic stewardship programs from the Centers for Disease Control and Prevention. *Clinical Infectious Diseases*. 2014;59(suppl_3):S97-100. <https://doi.org/10.1093/cid/ciu542>
 21. Wickens HJ, Farrell S, Ashiru-Oredope DA, et al. Antimicrobial Stewardship Group of the Department of Health Advisory Committee on Antimicrobial Resistance and Health Care Associated Infections (ASG-ARHAI), Cooke J, Sharland M, Ashiru-Oredope D, McNulty C, Dryden M. The increasing role of pharmacists in antimicrobial stewardship in English hospitals. *Journal of Antimicrobial Chemotherapy*. 2013;68(11):2675-2681. <https://doi.org/10.1093/jac/dkt241>
 22. Akkawi ME, Al-Shami N, Al-Worafi YM, et al. Knowledge, Attitude, and Practice Towards Antibiotic Use Among the Public in the City of Kuantan, Pahang State, Malaysia. *Journal of Pharmacy*. 2022;2(2):149-158. <https://doi.org/10.37231/ajmb.2021.5.s2.456>
 23. Cotta MO, Robertson MS, Tecey M, et al. Attitudes towards antimicrobial stewardship: results from a large private hospital in Australia. *Healthcare Infection*. 2014;19(3):89-94. <https://doi.org/10.1071/hi14008>
 24. Foreman BJ, Westerhof L, Benzer J, et al. Impact of order sentence implementation on outpatient antibiotic prescribing for urinary tract infection and skin and soft tissue infection. *Journal of the American College of Clinical Pharmacy*. 2022;5(3):283-290. <https://doi.org/10.1002/jac5.1578>
 25. Lim CJ, Kwong M, Stuart RL, et al. Antimicrobial stewardship in residential aged care facilities: need and readiness assessment. *BMC Infectious Diseases*. 2014;14(1):1-0. <https://doi.org/10.1186/1471-2334-14-410>
 26. Cassidy SS, Sanders DJ, Wade J, et al. Antimicrobial surfaces: A need for stewardship? *PLoS Pathogens*. 2020;16(10):e1008880. <https://doi.org/10.1371/journal.ppat.1008880>
 27. Dyar OJ, Huttner B, Schouten J, et al. What is antimicrobial stewardship? *Clinical Microbiology and Infection*. 2017;23(11):793-798.
 28. Pulcini C, Morel CM, Tacconelli E, et al. Human resources estimates and funding for antibiotic stewardship teams are urgently needed. *Clinical Microbiology and Infection*. 2017;23(11):785-787. <https://doi.org/10.1016/j.cmi.2018.01.009>
 29. Abbo LM, Cosgrove SE, Pottinger PS, et al. Medical students' perceptions and knowledge about antimicrobial stewardship: how are we educating our future prescribers? *Clinical Infectious Diseases*. 2013;57(5):631-638. <https://doi.org/10.1093/cid/cit370>
 30. Thomas B, Abdulrouf P, Elkassem W, et al. Clinical and economic impact of antimicrobial stewardship interventions reported among hospital inpatients in the Middle East: a systematic review protocol. <https://doi.org/10.21203/rs.3.rs-50679/v1>
 31. Dellit TH, Owens RC, McGowan JE, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clinical Infectious Diseases*. 2007;44(2):159-177. <https://doi.org/10.1097/pcp.0b013e318068b1c0>
 32. Tahoona MA, Khalil MM, Hammad E, et al. The effect of educational intervention on healthcare providers' knowledge, attitude, & practice towards antimicrobial stewardship program at, National Liver Institute, Egypt. *Egyptian Liver Journal*. 2020;10(1):1-7. <https://doi.org/10.1186/s43066-019-0016-5>
 33. Satterfield J, Miesner AR, Percival KM. The role of education in antimicrobial stewardship. *Journal of Hospital Infection*. 2020;105(2):130-141. <https://doi.org/10.1016/j.jhin.2020.03.028>
 34. Pisano J, Pettit N, Bartlett A, et al. Social media as a tool for antimicrobial stewardship. *American Journal of Infection Control*. 2016;44(11):1231-1236. <https://doi.org/10.1016/j.ajic.2016.11.023>
 35. Lubwama M, Onyuka J, Ayazika KT, et al. Knowledge, attitudes, and perceptions about antibiotic use and antimicrobial resistance among final year undergraduate medical and pharmacy students at three universities in East Africa. *Plos One*. 2021;16(5):e0251301. <https://doi.org/10.1371/journal.pone.0251301>
 36. Behaviour change and antibiotic prescribing in healthcare settings Literature review and behavioural analysis, 2015 Feb, https://spiral.imperial.ac.uk/bitstream/10044/1/22194/2/Behaviour_Change_for_Antibiotic_Prescribing_-_FINAL.pdf 2022;15.
 37. Akbar Z, Alquwez N, Alsolais A, et al. Knowledge about antibiotics and antibiotic resistance among health-related students in a Saudi University. *The Journal of Infection in Developing Countries*. 2021;15(7):925-933. <https://doi.org/10.3855/jidc.12329>
 38. Kullar R, Nagel J, Bleasdale SC, et al. Going for the gold: a description of the centers of excellence designation by the Infectious Diseases Society of America. *Clinical Infectious Diseases*. 2019;68(10):1777-1782. <https://doi.org/10.1093/cid/ciy797>
 39. Al Salman J, Al Dabal L, Bassetti M, et al. Promoting cross-regional collaboration in antimicrobial stewardship: Findings of an infectious diseases working group survey in Arab countries of the Middle East. *Journal of Infection and Public Health*. 2021;14(7):978-984. <https://doi.org/10.1016/j.jiph.2021.04.009>
 40. Pakyz AL, Moczygamba LR, VanderWielen LM, et al. Facilitators and barriers to implementing antimicrobial stewardship strategies: results from a qualitative study. *American journal of infection control*. 2014;42(10):S257-263. <https://doi.org/10.1016/j.ajic.2014.04.023>
 41. Essack S, Bell J, Shephard A. Community pharmacists—Leaders for antibiotic stewardship in respiratory tract infection. *Journal*



Gillani SW, Shahwan MKS, Szollosi DE. A questionnaire based survey among pharmacy practitioners to evaluate the level of knowledge and confidence towards antimicrobial stewardship. *Pharmacy Practice* 2022 Oct-Dec;20(4):2757.

<https://doi.org/10.18549/PharmPract.2022.4.2757>

of *Clinical Pharmacy and Therapeutics*. 2018;43(2):302-307. <https://doi.org/10.1111/jcpt.12650>

42. Cappelletty D, Jacobs D. Evaluating the impact of a pharmacist's absence from an antimicrobial stewardship team. *American Journal of Health-System Pharmacy*. 2013;70(12):1065-1069. <https://doi.org/10.2146/ajhp120482>

43. Nori P, Madaline T, Munjal I, et al. Developing interactive antimicrobial stewardship and infection prevention curricula for diverse learners: a tailored approach. *In Open Forum Infectious Diseases*. 2017;4(3). <https://doi.org/10.1093/ofid/ofx117>

