

Project Report

# Design and Implementation of an Antimicrobial Stewardship Certificate Program in the United Arab Emirates

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**Abstract:** Introduction: The purpose of our report is to describe the design and implementation of the first antimicrobial stewardship certificate program (ASCP) in the United Arab Emirates (UAE). Methods: The ASCP was implemented in January 2019. A needs assessment was conducted before the implementation of the program. The program delivery utilized a blended learning format with both a live and an experiential component. Learner assessments consisted of pre- and post-course assessments, as well as structured feedback throughout the course. Course assessments and post-course evaluation results were utilized to assess the certificate program (CP) outcomes. Results: Between January 2019 to March 2020, 24 pharmacists were trained through the program. All participants passed the post-course assessment. Participants scored a median of 40 percent on the pre-course assessment at the start of the program and a median of 80 percent on the post-course assessment ( $p$ -value < 0.0001), demonstrating a significant improvement in their baseline knowledge. Overall, participants were highly satisfied with the program and felt that it would enhance their ability to take care of patients and/or result in practice change in their institution. Conclusions: The ASCP enhanced the knowledge of pharmacists in antimicrobial stewardship. The implemented model provides a sustainable blueprint for future CPs in specialty areas of practice for the Middle East region.

**Keywords:** antimicrobial stewardship; experiential education; international; certificate program; pharmacy education



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## 1. Introduction

With the expanding medical needs of a worldwide aging population, healthcare systems continue to be challenged to deliver increasingly complex care. Pharmacists play an essential role in managing complicated medication regimens across the healthcare continuum, which has led to a higher demand for them to be more involved in direct patient-care roles [1,2]. In parallel, this has created the need for more post-graduate training programs, including residency training, fellowships, and certificate programs (CPs) [2,3]. Globally, there is an unmet need for pharmacist post-graduate training programs, given the increase in demand for specialized pharmacists [4,5]. In this setting, since the demand for post-graduate training is outpacing supply, CPs offer an attractive option to enhance and expand the skills of pharmacists in focused areas of practice.

There are currently several existing online CPs available for pharmacists, including medication safety, antimicrobial stewardship, pharmacy informatics and automation, to name a few [6–12]. Most of these programs provide self-paced online modules that offer flexibility in accessing the content and completing these modules at the learner's leisure [6–12]. Although some of these online programs require completion of an implementation project, they place little emphasis on preceptor-guided hands-on learning. Besides pharmacy residency programs, few CPs currently offer preceptor-guided experiential learning in specialty areas of pharmacy practice [13,14]. Clinical experiential learning is essential for the transfer

of knowledge from theory to practice and involves developing critical thinking skills to solve complex patient-care and medication-related problems [15,16]. Programs that offer these experiential learning opportunities in specialized areas often require the participant to travel abroad, which may be time- and cost-consuming.

In the United Arab Emirates (UAE), clinical pharmacy practice is still evolving [17]. Pharmacy curriculums are not standardized across the country, with the majority still offering a four- or five-year Bachelor of Science in pharmacy (BPharm) degree [18]. Academic institutions have only recently started offering the Doctor of Pharmacy (PharmD) degree, with a focus on experiential education built into the professional program [19,20]. As a result, many institutions lack advanced clinical pharmacy services [18,21]. Aside from our institution, which relies on expatriate pharmacists trained in North America, other hospitals and health-systems in the country still face a limited clinical pharmacist workforce with post-graduate residency training [18,21]. Due to the lack of standardized experiential learning in undergraduate training programs and the lack of widely available post-graduate pharmacy training, the availability of CPs became more imperative in this setting. Such CPs provide practicing pharmacists with the opportunity to train under the supervision of experts in the field and to acquire the necessary tacit knowledge and clinical skills. Such knowledge and skill transfer would not be feasible with online CPs.

In 2017, regulatory standards issued through the Department of Health Abu Dhabi (DOH) mandated the implementation of antimicrobial stewardship programs (ASPs) in healthcare facilities and required pharmacists responsible for implementing an ASP to have formalized training in this area [22,23]. In addition, hospitals accredited through Joint Commission International (JCI) were, as of July 2017, required to have an ASP to comply with the new accreditation standards [24]. This new regulatory requirement increased the demand for pharmacist training in antimicrobial stewardship and created a new niche, given the absence of structured post-graduate training programs in the country. Due to the lack of experiential learning in infectious diseases in many undergraduate pharmacy programs, the limited availability of hands-on training on ASP in the country, and the limitations of online CPs in the context of pharmacy education and clinical practice in the UAE, we developed the Antimicrobial Stewardship Program Academy (ASCP), which is described here.

## 2. Development of the Certificate Program

The ASCP was offered at a multi-specialty quaternary care hospital in Abu Dhabi, UAE. The institution is a 360-bed hospital recognized for being Joint-Commission-International (JCI)- and Magnet-accredited and having Healthcare Information and Management Systems Society (HIMSS) level-7 certification. The institution is also the only Accreditation Council for Pharmacy Education (ACPE) provider in the country and currently delivers a Post-graduate Year One (PGY1) pharmacy residency program accredited through the American Society of Health-System Pharmacists (ASHP).

Our institution has had an Antimicrobial Stewardship Program (ASP) in place since the hospital inception. The program received its Center of Excellence designation by the Infectious Diseases Society of America (IDSA) in 2021. The program is co-directed by a PGY2-trained Infectious Diseases (ID) pharmacist who oversees both the day-to-day clinical activities and the ASP Subcommittee, which addresses antimicrobial formulary changes as well as updates to antimicrobial policies, protocols, and guidelines. The program follows the Centers for Disease Control and Prevention (CDC) elements for antimicrobial stewardship, including a prospective audit with intervention and feedback, prior-authorization of broad-spectrum antimicrobials, facility-specific antimicrobial guidelines, rapid diagnostics, a real-time computerized surveillance system, and a real-time dashboard for ASP metrics [25,26]. In addition, members of the ASP are currently represented on the National Antimicrobial Resistance (AMR) taskforce.

The department of pharmacy services currently offer several educational programs for both undergraduate and post-graduate pharmacists, including student placements, clinical

observership programs, a pharmacy internship program, a pharmacy return to practice program, a pharmacist mentorship program, and an active continuing pharmacy education (CPE) program. The clinical expertise within the department, coupled with the experience in the provision of a range of pharmacy education and training programs, set the stage for the department to offer the ASCP.

### 3. Needs Assessment of ASCP

Implementing an ASP is considered an essential patient-safety and quality intervention to optimize patient outcomes while reducing untoward side effects of antimicrobials and healthcare costs [27]. In many countries, having an ASP is now a regulatory and accreditation requirement in the healthcare setting [28]. In the UAE, the high rates of antimicrobial resistance and the proven benefits of having an ASP on patient outcomes prompted our institution to implement an ASP at hospital inception [22].

Prior to offering the ASCP, a detailed needs assessment was performed to investigate whether hospital pharmacists would be interested in participating in this program. We also wanted to gauge the specific design and structure that would be most beneficial for practicing pharmacists with time constraints. The needs assessment was performed through an online survey distributed to a network of hospital pharmacists practicing in the UAE. This survey indicated that respondents favored in-person training rather than online training and favored a duration that would last at least one week.

### 4. Methods

Our study received an exemption status from the institution's Research Ethics Committee.

The ASCP was intended to provide the required knowledge, skills, and attributes needed by practicing pharmacists to implement antimicrobial stewardship activities in their home institution. The program was designed by the director and co-director of the ASP and was informed by feedback from the needs assessment survey and available best practice recommendations [27]. Program-development leads identified core competencies required for successful antimicrobial stewardship practice (Table 1). Core competencies for the program were modeled after the Department of Health, Expert Committee on Antimicrobial Resistance and Healthcare-Associated Infections (ARHAI), and Public Health England core competencies framework [29]. Core topics were defined with learning objectives (measurable knowledge, skills, and attributes to be attained by learners) specified and mapped to each competency. Educational strategies utilized a blended learning format including didactic lectures and an experiential component. Learner assessments consisted of pre- and post-course assessments and structured feedback throughout the course.

The program was reviewed and approved by our institution's medical education committee, consisting of physicians, a pharmacist, allied health, and nursing educators. Additionally, all components of the program were approved by ACPE and were routinely audited for quality by ACPE. The program was designed to be conducted four times a year with small cohorts of 4–6 participants to ensure the appropriate delivery and feedback of the experiential component. The full program, consisting of live didactic lectures and the experiential component, was approved for 30 h of ACPE CPE credits. There was no dedicated budget allocated for delivering the program. The revenue generated from program-participant fees was used to cover the operational cost of the program.

Participants were required to submit their interest to join the program through an online application form. Applicants were required to submit a letter of intent and a letter of recommendation from their current employer, stating why they are interested in the training and how they plan to use this training in their current place of employment. Priority was given to hospital pharmacists who had the responsibility for implementing and delivering an ASP at their institution. The program director reviewed the application material for completeness and the assessed applicants' qualifications based on their practice

experience. Applicants who were not pharmacists or were not practicing in the hospital setting were not accepted into the program.

**Table 1.** Competency domain mapping to the didactic sessions delivered.

Pharmacology of Antimicrobials	<ul style="list-style-type: none"> <li>• Antimicrobial Pharmacology I</li> <li>• Antimicrobial Pharmacology II</li> <li>• Antimicrobial Pharmacology III</li> </ul>
Mechanisms of Antimicrobial Resistance	<ul style="list-style-type: none"> <li>• Microbiology of gram-positive bacteria</li> <li>• Microbiology of gram-negative bacteria</li> <li>• Microbiology of fungi</li> <li>• Antimicrobial Resistance</li> </ul>
Appropriate Selection of Antimicrobials	<ul style="list-style-type: none"> <li>• Pharmacokinetics/Pharmacodynamics of Antimicrobials</li> <li>• Clinical Application of Pharmacodynamics and Pharmacokinetics</li> <li>• Management of Sepsis</li> <li>• Use of Rapid Diagnostics in Antimicrobial Stewardship</li> <li>• Management of Skin and Soft Tissue Infections</li> <li>• Management of Catheter-related Bloodstream Infections</li> <li>• Management of Lower Respiratory Tract Infections</li> <li>• Management of Urinary Tract Infections</li> <li>• Management of Central Nervous System Infections</li> <li>• Bacterial Endocarditis</li> </ul>
Antimicrobial Stewardship Strategies	<ul style="list-style-type: none"> <li>• Implementing an Antimicrobial Stewardship Program</li> <li>• Measuring Outcomes of ASP</li> </ul>
Infection Prevention and Control	<ul style="list-style-type: none"> <li>• The Role of Infection Control and Prevention Programs in ASP</li> </ul>

The ASCP included both live lectures and experiential components delivered over the course of ten days. This blended learning format was selected to encourage interaction with participants and facilitate peer-to-peer learning. Live lectures were delivered by various ASP team members, according to their specialty area, and included infectious diseases (ID) physicians, an ID pharmacist, an infection preventionist, a clinical microbiologist, and pharmacotherapy specialists specialized in critical care and nephrology. The delivery of the didactic portion of the program by various team members reflected the team's multidisciplinary approach. It also exposed participants to an optimal team make-up that promoted effective communication, multidisciplinary collaboration, and teamwork, all needed for a successful ASP implementation [25]. Further, the model of having various faculty members deliver didactic lectures ensures a better sustainability of the program in the long run.

Live lectures were each 1 h in duration and covered various broad topics that included antimicrobial pharmacology, antimicrobial resistance, ID pharmacotherapy, and ASP design, implementation and outcome measures (Table 1). Lectures were structured to be case-based in order to enhance interaction with participants and ensure that concepts were directly applied during those sessions. Attendees actively participated in daily ASP rounds and were instructed to review patient cases and present their recommendations under the supervision of the ID pharmacist. Consultation notes for patients' case reviews using the structured subjective, objective, assessment, and plan (SOAP) format were also required from each participant. Participants were expected to demonstrate the ability to collect relevant patient information, assess this information, and design an effective evidence-based, patient-specific antimicrobial regimen pharmacotherapy for patients on the ASP service. During ASP rounds, participants were instructed on how our institution implemented the CDC's core elements of antimicrobial stewardship, including measuring program outcomes using metrics such as Days of Therapy per 1000 patient days. Participants received regular feedback on their performance throughout the program using a pre-defined evaluation

rubric (Table 2). This evaluation allowed participants to make the necessary improvements based on the feedback relayed during the training period.

**Table 2.** Clinical skills assessment rubric.

Task
Appropriately collect and present patient data (e.g., subjective/objective patient data, medical history, microbiology results, radiographic results, medication list) to identify any issues with current antimicrobial therapy and selection.
Interpret if a microorganism is resistant or sensitive to an antibiotic based on laboratory culture and sensitivity report(s) and utilize appropriate interpretive reading of microbiology results.
Manage and/or recommend evidence-based antimicrobial therapy, including initiation, administration, modification, and discontinuation of therapy, according to the patient's response, change in condition, or concomitant therapy in order to optimize outcomes.
Select an antibiotic regimen based on dose, frequency, and duration. <ul style="list-style-type: none"> <li>• Apply the Cockcroft–Gault equation or other equations as appropriate.</li> <li>• Utilize appropriate weight (actual, ideal, or adjusted).</li> <li>• Utilize appropriate serum creatinine.</li> </ul>
Identify which medications can be automatically switched from IV to PO once criteria are met and there are no exclusion criteria, when applicable.
Demonstrate understanding of how to coordinate and collect drug concentration samples, e.g., vancomycin/aminoglycosides, interpret results, adjust medication dosages or make recommendations regarding adjustments, and monitor responses to treatment.
Establish and document patient-specific and measurable outcomes; state the time interval for the monitoring and follow-up of each identified drug therapy problem.
Monitor patients for adverse drug reactions and drug interactions (e.g., drug–drug, drug food, drug–disease, drug–lab, or drug–device).
Practice cost-effective decision-making.
Retrieve, appraise, and assimilate evidence from published scientific studies and make evidence-based decisions related to a patient's health problem.

At the start of the program, a pre-course assessment was designed to assess participant baseline knowledge. It consisted of a self-paced, closed-book, 15-question multiple-choice assessment. Finally, a 20-question post-course assessment containing more complex cases to be assessed was conducted.

Participants needed a passing rate of at least 80% on the post-course assessment. All competency domains (Table 1) were assessed in both and mapped to both the pre-course and post-course assessments. All pre- and post-course questions were mapped to the competencies listed in Table 1. If a passing score was not achieved on the post-course assessment, participants were allowed up to three attempts to achieve a passing score, with lecture content available for review between each attempt. Once all program requirements were completed, participants evaluated the program and speakers through an online survey prior to receiving a certificate of program completion.

## 5. Results

### 5.1. Clinical Knowledge

Between January 2019 and March 2020, five ASCP program cohorts were completed, with 24 participants trained. All participants who joined the program were hospital pharmacists practicing in the inpatient setting with 1 to 5 years of experience post-graduation. Most participants were holders of a bachelor's degree in pharmacy, with the minority of participants having a Master's degree in Clinical Pharmacy or a Doctor in Pharmacy degree. All participants passed the post-course assessment (at least a score of 80%). Pre- and post-course assessments were analyzed using an unpaired Student's t-test (RStudio).



Participants scored a median of 40 percent on the pre-course assessment at the start of the program and a median of 80 percent in the post-course assessment ( $p$ -value < 0.0001), showing a significant improvement in the knowledge base of participants.

### 5.2. Trainee Satisfaction

Post-course evaluations were positive, indicating a high level of satisfaction with the course material. The lecture material was relevant to participants' needs, and the objectives of all didactic lectures were met. This was evident in the participants' survey results, which showed that all agreed that their learning needs were met, that the educational material was useful and organized, and that their experience will result in a change in their own practice. The overall mean level of agreement was 4.9/5 on a Likert scale (1 = strongly disagree, 5 = strongly agree). The majority of participants indicated that they would change the way they manage their patients and/or plan on updating procedures, protocols, and/or guidelines as a result of their participation in the ASCP. The overall satisfaction with the program was high. Participants were asked to provide feedback and areas of improvement for the program as part of the post-course evaluation. Participants desired more content in areas outside the scope of the ASCP (e.g., HIV medicine, management of tuberculosis, and hepatitis C) (8%, 2/24). Some participants felt that they needed an extended training period to be more proficient in the covered content (8%, 2/24).

## 6. Discussion

To the best of our knowledge, we describe the first CP in the Middle East region in ASP, which provides knowledge, skills, and practical experience in inpatient care in a region where such opportunities are scarce. Preliminary results have shown that all participants completed the program with a significant improvement in baseline knowledge of antimicrobial stewardship and ID.

The program provided theoretical and experiential learning opportunities, a multi-disciplinary team approach, and a unique preceptor-guided format not afforded by most available CPs in ASP [6–12]. The program's preceptor-guided component is necessary for pharmacists practicing in the UAE, particularly for those who may not have had structured undergraduate experiential education or formalized post-graduate residency training. Additionally, existing CPs are mainly tailored to pharmacy practice in their respective region and factor in antimicrobial treatment recommendations and/or guidelines relevant to specific geographic locales [7,8]. As a result, the knowledge and skills gained through those programs may not be directly translatable to pharmacists practicing in the UAE, due to differences in pharmacy practice regulations, pharmacy practice infrastructure, and antimicrobial susceptibility patterns observed in the UAE. Additionally, our program was tailored to the specific cultural norms and customs observed in the UAE, which are important determinants of antimicrobial prescription that may not be considered in other CPs [30].

Limitations of our CP include the fact that assessments did not use validated instruments, although the results show a significant knowledge gain, with a statistically significant increase in the median scores of learner participants between pre-course and post-course assessments. Moving forward, we will consider validating the assessments with psychometric tools. Additionally, in the future we will consider having an independent scientific committee validate the training content of the CP. Another limitation is that we have capped the participant number per cohort to no more than four to six participants, which may prevent a larger audience from joining the program and may result in an overall small sample size in our study. We believe this is an ideal number per cohort to ensure the quality of the experiential component of the program. In addition, we currently deliver four cohorts a year, which can be expanded in number to capture more participants in the future. Our program currently does not offer an online, self-study option, which may deter some participants from joining. However, we view face-to-face learning as an essential aspect of the program, as it allows more interactions for learner participants. It also provides the

opportunity to work with content experts in diverse disciplines, including pharmacists, physicians, and nurses. Lastly, our program does not require participants to implement an ASP process improvement (PI) or research project in their home institution; instead, faculty utilized the experiential component to assess participants' application of conceptual knowledge during patient-care rounds. In future iterations, we will be implementing a post-course PI project in order to more adequately assess the practice-changing outcomes of the program.

## 7. Conclusions

As post-graduate training programs may not be readily available or sufficient in some areas of the world, CPs may offer valuable training opportunities to meet the increasing demand for clinical pharmacists. Well-designed programs that include didactic and experiential components, when delivered by qualified practitioners in regional state-of-the-art facilities, may offer pharmacists the skills to establish ASPs at their home institutions. Continued research on the impact of such programs on the practice and quality of patient care is essential.

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