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**Short Communication**

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# Assessment of Antimicrobial Stewardship through objective structured clinical examination in pharmacy education

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## Abstract

**Objectives** To describe the implementation and assess whether an objective structured clinical examination (OSCE) is a viable assessment tool for testing Antimicrobial Stewardship (AMS) principles.

**Methods** A three-station OSCE set in a hospital and community pharmacy was designed and mapped to the World Health Organisation's AMS intervention practical guide. This OSCE comprised 39 unique cases and was implemented across two campuses (Malaysia and Australia) at one institute. Stations were 8 min long and consisted of problem-solving and applying AMS principles to drug therapy management (Station 1), counselling on key antimicrobials (Station 2) or managing infectious diseases in primary care (Station 3). Primary outcome measure to assess viability was the proportion of students who were able to pass each case.

**Key findings** Other than three cases with pass rates of 50, 52.8 and 66. 7%, all cases had pass rates of 75% or more. Students were most confident with referral to medical practitioner cases and switching from intravenous to oral or empirical to directed therapy.

**Conclusions** An AMS-based OSCE is a viable assessment tool in pharmacy education. Further research should explore whether similar assessments can help improve students' confidence at recognising opportunities for AMS intervention in the workplace.

**Keywords:** education; antibiotics; OSCE; teaching methods; anti-infectives

## Introduction

*Pharmacy expertise* is recognised as one of the core elements of Antimicrobial Stewardship (AMS) programmes in hospitals, underpinning the importance of pharmacists in leading efforts to improve antibiotic use in healthcare settings.[1] Engagement of infectious disease (ID) trained pharmacists in AMS programmes is strongly associated with a reduction in inappropriate use of antimicrobial agents and thus antibiotic utilisation costs, as well as reduction in mortality rates caused by sepsis and respiratory infections.[2, 3]

With the increasing threat of antimicrobial resistance and the essential role a pharmacist can play in its prevention, The World Health Organization (WHO) has released a guide for health workers' education and recommends objective structured clinical examination (OSCEs) as a way of assessing AMS in the undergraduate curriculum.[4] A recent scoping review by Nasr *et al.*[5] revealed only seven studies have described AMS teaching in pharmacy, and highlighted the need for academics to share more educational interventions. Whilst there has been published literature of AMS OSCEs in the medical field,[6] there has been no published literature on the topic in pharmacy education. AMS principles[7] are introduced to third-year pharmacy students at both the Australian and Malaysian campuses. This paper aims to describe the implementation and assess whether an OSCE is a viable assessment tool for testing AMS principles.

## Methods

### Study design

Cross-sectional study.

### Setting

This OSCE was delivered to all third-year undergraduate pharmacy students across two campuses (Australia and Malaysia) in 2022 with the Malaysian campus running a third of each of the cases due to having a smaller cohort, and the Australian campus running the other cases. All enrolled students were included unless they could not attend the OSCE or opted out of allowing their grades to be pooled for research purposes.

### Intervention

Before the OSCE, third-year pharmacy undergraduate students were taught AMS principles, and common ID topics using a degree-wide active learning model[8] of self-directed learning, online lectures and group workshops over 7 weeks (each

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topic was taught over 1 week). A three-station AMS OSCE was designed and delivered to test the applicability of the interventions set out by WHO's AMS intervention practical guide.[7] Each station was 8 min long and conducted in one rotation. Thirteen unique cases were developed for each station. A detailed structure of the OSCE has been provided in Supplementary Appendix S1 in line with reporting guidelines for OSCEs by Patrico *et al.*[9] Station 1 was designed to simulate a hospital setting and involved the student communicating with a simulated doctor. Students were given a drug chart and patient notes to review for any AMS intervention opportunities. Stations 2 and 3 were designed to simulate a community/retail pharmacy setting where the student interacted with a simulated patient. Station 2 focussed on prescription counselling of antimicrobials. Station 3 focussed on product requests, prescription problems and customer queries. This OSCE was a hurdle requirement, meaning students must pass the OSCE to pass the unit. Each condition covered in the unit was assessed with at least one OSCE case (Table 1).

Cases were developed by AMS practitioners who based their medication-related problems on common problems they encountered; with hospital stations having a strong focus on the five ways hospital pharmacists can be antibiotic aware.[10] Experts were asked to map their final cases to the AMS WHO principles.[7] This project was approved by the Institute's Research and Ethics committee (Project ID: approval 32749).

### Outcome measures

To assess viability, the proportion of students who passed each case was used as a marker of OSCE case success. Each OSCE case score comprises of two checklists: analytical (clinical checklist) and a communication rubric. A successful station pass requires a combined total of 50% or more for both checklists.

### Data collection and analysis

OSCE scores were collected directly from the completed OSCE rubrics from the markers. Assessment data has been analysed and presented as descriptive statistics. Students' comments in the unit feedback reports were also collected and summarised.

## Results

The three OSCE stations were delivered to 404 pharmacy undergraduate students across two countries from the same institute in 2022 (Australia and Malaysia campuses) assessing 39 different cases (Table 1). Other than three cases with pass rates of 50, 52.8 and 66. 7%, all cases had pass rates of 75% or more. From analytical checklist scores (depicting clinical criteria only), the two cases in which students scored the highest in Station 1 included being able to recommend switching from intravenous to oral therapy, and to recommend switching from empirical to directed therapy. The lowest-performing two cases in Station 1 included dose adjustments. Station 2 results appeared to be the highest pass rate with a median of 100% [interquartile range (IQR) 97.2, 100] which underpinned WHO principle of *patient and public education*. From looking solely at analytical checklist scores, the two best-performing cases in Station 3 included identifying a need for prophylaxis treatment and inappropriate selection in pregnancy, whilst the two poorest-performing cases included cases where there was an over-the-counter product interaction with the antimicrobial. Referral to medical practitioner cases performed the best in Station 3 when taking into account pass rate only.

Student unit feedback reports revealed the majority of students felt the OSCE consolidated the AMS skills and gave them an opportunity to exercise the principles.

## Discussion

Outcomes from our study indicate that OSCE is a feasible assessment approach to reiterate the concepts of AMS among pharmacy students with the majority of students (97.1%) being able to pass each AMS case. OSCEs have been shown to train students to translate their academic knowledge to practical application[11] in a time-sensitive manner, similar to real-world practice, be it in primary or secondary care setting. Pharmacy students from both campuses (i.e. Malaysia and Australia) performed well in their first AMS OSCE, demonstrating ability to meaningfully recognise key AMS intervention opportunities and provide appropriate recommendations in a timely fashion. Twenty-seven out of 39 cases recorded a pass rate of more than 90% (Table 1), with students exhibiting sound analytical and communication skills particularly, in Station 2 which underpinned WHO principle of *patient and public education*. De-escalation from intravenous to oral therapy and change of therapy from empirical treatment to directed therapy based on culture and sensitivity results are AMS moments that were mentioned frequently in the curriculum throughout most topics, these moments could have stood out as easily identifiable interventions to students which could explain why students were most confident in recommending these changes in Station 1 (hospital setting).

In Station 3, which comprised of scenarios of self-medication and prescription filling in the community pharmacy setting, our students performed notably well in identifying cases that warrant referral to physicians for timely initiation of antimicrobial therapy. This supports a previous study by Farahani *et al.*[12] which showed OSCE as an effective tool in training pharmacy students on self-medication counselling which involves ensuring appropriate use of non-prescription medicines as well as referral to physicians when deemed necessary.

Our study has a few limitations that we would like to acknowledge. Whilst several WHO AMS principles were readily reproducible in an OSCE environment, some were particularly challenging, resulting in a less-than-comprehensive assessment of all the principles in our setting. Also, a parallel comparison with a control group could have lent credence to the pedagogical benefits of OSCE-based AMS training. A control group would be only possible in a mock setting as it would be impractical and unethical to run a control group during a live assessment. Acknowledging the high pass rate, there is a consideration that case writers may have made the cases too simple for the pilot and future attempts at OSCE could try to test more complex cases.

Future research could focus on obtaining qualitative data on students' perception and experience of AMS OSCE for quality improvement. It will also be worth exploring benefits of implementing a formative OSCE before a summative OSCE in consolidating students' AMS skills.

## Conclusion

An AMS-based OSCE is a feasible assessment tool in pharmacy education. Further research should explore whether similar assessments can help improve students' confidence at recognising opportunities for AMS intervention in the workplace.

**Table 1** Assessment data for OSCE cases

| Condition (number of students assessed) | Case description | AMS WHO principles[6] | Number (%) passing the case | Analytical checklist average score (%) | Communication rubric average score (%) |
|---|---|---|---|---|---|
| Station 1: Hospital (13 cases)* | | | | | |
| Acute cystitis (*n* = 36) | Inappropriate drug selection<br>**4: Avoid Treatment of Asymptomatic Bacteriuria* | 7 | 36 (50.0) | 61.4 | 74.8 |
| Acute cystitis (*n* = 37) | Inappropriate drug selection (patient allergic to drug)<br>**3: Reassess antibiotic therapy* | 7 | 35 (94.6) | 77.8 | 76.2 |
| Cellulitis (*n* = 36) | Inappropriate drug selection (directed therapy needed after microbiology results have returned)<br>**3: Reassess antibiotic therapy* | 7, 4 | 34 (94.4) | 88.9 | 80.6 |
| Cellulitis (*n* = 24) | Inappropriate dose selection (patient with renal impairment)<br>**3: Reassess antibiotic therapy* | 7, 9 | 18 (75.0) | 52.9 | 55.7 |
| Cellulitis (*n* = 30) | Inappropriate dose selection (vancomycin with weight dosing)<br>**3: Reassess antibiotic therapy* | 9, 7 | 25 (83.3) | 66.7 | 66.5 |
| Chlamydia (*n* = 35) | Inappropriate drug selection (pregnant patient)<br>**3: Reassess antibiotic therapy* | 3, 7 | 31 (88.6) | 58.6 | 66.0 |
| Community acquired pneumonia (*n* = 35) | Inappropriate duration of IV therapy (switch to oral therapy needed)<br>**5: Use the Shortest Effective Antibiotic Duration* | 8, 10 | 34 (97.1) | 91.0 | 86.7 |
| Erysipelas (*n* = 34) | De-labelling of non-true allergy<br>**1: Verify Penicillin Allergy* | 6 | 28 (82.4) | 71.7 | 81.7 |
| Hepatitis B (*n* = 26) | Inappropriate dose | 9 | 23 (88.4) | 58.3 | 71.6 |
| Hepatitis C (*n* = 36) | Inappropriate drug selection (antiviral for salvage therapy)<br>**3: Reassess antibiotic therapy* | 7 | 28 (77.8) | 80.0 | 76.7 |
| HIV (*n* = 38) | Inappropriate dose selection (PrEP therapy)<br>**5: Use the Shortest Effective Antibiotic Duration* | 9, 10 | 38 (100) | 61.4 | 92.3 |
| HIV (*n* = 36) | Incorrect therapy (PEP vs PrEP therapy)<br>**3: Reassess antibiotic therapy* | 7,9,10 | 19 (52.8) | 61.7 | 65.7 |
| Prostatitis (*n* = 39) | Inappropriate drug selection (not first line)<br>**3: Reassess antibiotic therapy* | 7 | 32 (82.1) | 67.8 | 74.1 |
| Station 2: Closed Book Counselling (drug specific) (13 cases) | | | | | |
| Acute cystitis (*n* = 36) | Trimethoprim | 2 | 35 (97.2) | 77.8 | 88.1 |
| Acute cystitis (*n* = 30) | Ciprofloxacin | 2 | 30 (100.0) | 72.7 | 70.0 |
| Acute cystitis (*n* = 26) | Nitrofurantoin | 2 | 26 (100.0) | 78.5 | 81.3 |
| C. Difficile (*n* = 35) | Metronidazole | 2 | 35 (100.0) | 76.5 | 84.1 |
| Cellulitis/Erysipelas (*n* = 14) | Fluxcloxacillin | 2 | 12 (85.7) | 66.7 | 72.1 |
| Cellulitis/Erysipelas (*n* = 38) | Co-trimoxazole | 2 | 38 (100.0) | 77.8 | 74.7 |
| Community acquired pneumonia (*n* = 35) | Doxycycline | 2 | 35 (100.0) | 81.1 | 86.7 |
| Community acquired pneumonia (*n* = 39) | Moxifloxacin | 2 | 39 (100.0) | 72.8 | 79.6 |
| Hepatitis C (*n* = 36) | Sofosbuvir and velpatasvir | 2 | 35 (97.2) | 77.8 | 90.9 |
| Hepatitis C (*n* = 24) | Glecaprevir and pibrentasvir | 2 | 24 (100.0) | 78.9 | 91.4 |
| HIV (*n* = 36) | Tenofovir and emtricitabine | 2 | 34 (94.4) | 76.2 | 76.1 |
| HIV (*n* = 34) | Abacavir+ Dolutagrevir + Lamivudine | 2 | 34 (100.0) | 83.8 | 92.7 |
| UTI (*n* = 35) | Fosfomycin | 2 | 33 (94.3) | 77.5 | 88.7 |
| Station 3: Community/Primary care (13 cases) | | | | | |
| Acute cystitis (*n* = 15) | Drug + OTC drug interaction | 2, 9 | 11 (73.3) | 67.7 | 62.5 |
| Acute cystitis (*n* = 34) | Referral for UTI (pregnant patient) | 2, 3, 7 | 33 (97.1) | 76.0 | 87.0 |

**Table 1.** Continued

| Condition (number of students assessed) | Case description | AMS WHO principles[6] | Number (%) passing the case | Analytical checklist average score (%) | Communication rubric average score (%) |
|---|---|---|---|---|---|
| Cellulitis ($n$ = 26) | Referral for skin infection | 2, 3, 7 | 25 (96.2) | 89.5 | 92.1 |
| Chlamydia ($n$ = 19) | Drug + OTC drug interaction | 2, 9 | 39 (100.0) | 87.2 | 85.6 |
| Community acquired pneumonia ($n$ = 38) | Referral to Hospital | 2, 3, 7 | 38 (100.0) | 79.2 | 75.4 |
| Community acquired pneumonia ($n$ = 30) | Suboptimal use of product | 2, 7, 9 | 30 (100.0) | 91.4 | 88.9 |
| Hepatitis B ($n$ = 24) | Inappropriate selection of antiviral in pregnancy | 2, 7 | 23 (95.8) | 95.5 | 89.5 |
| Hepatitis C ($n$ = 21) | Sofosbuvir/Ledipasvir and OTC interaction | 2 | 14 (66.7) | 73.3 | 76.7 |
| HIV ($n$ = 35) | Drug + OTC interaction | 2, 9 | 34 (97.1) | 70.6 | 74.3 |
| Otitis externa ($n$ = 35) | Inappropriate use of OTC product for otitis externa, needs referral | 2, 7, 9 | 35 (100.0) | 91.0 | 89.0 |
| Skin and soft tissue infection ($n$ = 36) | Dicloxacillin in breastfeeding patient | 2 | 34 (94.4) | 82.5 | 81.4 |
| Skin and soft tissue infection ($n$ = 36) | Prophylaxis for recurrent cellulitis | 2, 7, 9 | 35 (97.2) | 96.4 | 87.6 |
| STI ($n$ = 36) | Referral for STI | 2, 3, 7 | 35 (97.2) | 74.5 | 77.6 |

*Hospital cases were based on the five ways hospital pharmacists can be antibiotics aware.[10] (1) Verify Penicillin allergy, (2) avoid duplicative anaerobic overage, (3) reassess antibiotic therapy, (4) avoid treatment of asymptomatic bacteriuria and (5) use the shortest effective antibiotic duration.
HIV, human immunodeficiency virus; PEP, post exposure (HIV) prophylaxis; PrEP, pre-exposure (HIV) prophylaxis; OTC, over the counter; STI, sexually transmitted disease; UTI, urinary tract infection.
WHO AMS principles[7]: (1) clinician education, (2) patient and public education, (3) institution-specific guidelines for the management of common infections, (4) cumulative antibiograms, (5) prior authorisation of restricted antimicrobials, (6) de-labelling of spurious antibiotic allergies, (7) prospective audit and feedback, (8) self-directed antibiotic reassessments (antibiotics timeouts), (9) dose optimisation and (10) duration optimisation.

## Supplementary Material

Supplementary data are available at *International journal of Pharmacy Practice* online.


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## Author Contributions

All authors contributed to the assessment design, data analysis and manuscript preparation.


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## Conflict of Interest

None declared.

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