

RESEARCH ARTICLE

Students' experience and perception of a virtual surgical advanced pharmacy practice elective

Sumaiah J. Alarfaj^{1,2}, Ghadah Abozaid¹, Amany Alboghdadly¹, Sumaya Elgadi¹, Alnada Ibrahim¹, Najla A. Altwaijry³

¹Department of Pharmacy Practice, College of Pharmacy, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia

²Department of Pharmacy, King Abdullah bin Abdulaziz University Hospital, Riyadh, Saudi Arabia

³Department of Pharmaceutical Science, College of Pharmacy, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia

Keywords

Advanced pharmacy practice experience
COVID-19
Pharmacy education
Surgery APPE
Virtual APPE

Correspondence

Sumaiah J. Alarfaj
Department of Pharmacy Practice
College of Pharmacy
Princess Nourah bint Abdulrahman
University
Riyadh
Saudi Arabia
sjarfaj@pnu.edu.sa

Abstract

Background: This article describes a virtual surgery advanced pharmacy practice experience (APPE) designed during the COVID-19 outbreak for undergraduate students. Additionally, the article evaluates the implementation process of the APPE and students' perceived effectiveness of the virtual experience on their learning. **Methods:** A virtual four-week APPE course was designed involving 12 interns using Microsoft Teams. All pre-scheduled activities and meetings with students were performed remotely. The virtual APPE was assessed through an overall outcome survey and a weekly quality survey. **Results:** The implementation of the APPE was successful with students agreeing that they effectively managed to meet the objectives of the rotation. Students believed that APPE enhanced their knowledge and skills in surgical pharmacy practice. Their interest in working in a Perioperative clinical pharmacist position increased after the rotation from 50% to 70%. **Conclusion:** A virtual surgical APPE that is positively perceived by students can be implemented. Further research is needed to assess the impact of a virtual rotation on clinical skills.

Introduction

The COVID-19 pandemic has imposed various restrictions on pharmacy education worldwide, causing a shift to virtual learning (Louiselle *et al.*, 2020). In several countries, including Saudi Arabia, health-profession schools have been instructed to restrict or prevent the presence of students and interns in training hospitals in an effort to limit the spread of the virus (Badreldin *et al.*, 2020). This has created a massive challenge for experiential education in general, and for final-year pharmacy students reaching the end of their Advanced Pharmacy Practice Experiences (APPEs), in particular.

APPEs are an essential component of the Doctor of Pharmacy (Pharm.D.) degree and constitute the last year of the programme. The Accreditation Council for Pharmacy Education (ACPE) recommends that the majority of APPEs should focus on direct patient care

through four required APPE settings, including inpatient (hospital/ healthcare system) and outpatient (community/ ambulatory) settings, while elective rotations aim to enhance the breadth and depth of experiences and provide professional maturity (Accreditation Council for Pharmacy Education, 2016). Saudi Pharmacy schools adopted and implemented the Pharm.D. programme from US programmes, where APPEs typically require practice in a training site and completing the required number of rotations and internship hours to graduate. Prior to COVID-19, APPEs were implemented through practising in-site within the healthcare delivery system. However, during the earliest stages of the COVID-19 pandemic, several schools of pharmacy throughout the world have made use of virtual or distance APPE training (Louiselle *et al.*, 2020). While most virtual APPEs reported in the literature have described the switch of currently offered APPEs to distance mode, as the authors'

affiliated university hospital was expanding their surgical services, the authors wanted to simulate an APPE experience in surgery.

Simulation is defined as a method or technique that is employed to produce an experience without going through a real event (Gaba, 2004) and can utilise various methods ranging from using a high-fidelity mannequin to roleplay and case studies. A study by Baumgartner and colleagues in 2019 describes the development of a simulated acute care APPE mock throughout the last year of didactic education for pharmacy students. During this, a case-study and case presentation method was employed to deliver the simulation experience (Baumgartner *et al.*, 2019). At PNU pharmacy school, the authors' faculty has experienced education in simulation through collaborating with and teaching in their Simulation and Skills Development Center, which is the only accredited centre of its kind in the Middle East.

Pharmacists' involvement in surgery is well established, and their role in enhancing the safety outcomes of perioperative patients and decreasing associated hospital costs is well-documented (Hick *et al.*, 2001; Bond & Raehl, 2007; Charipiat *et al.*, 2012; Neville *et al.*, 2014; Bansal & Morris, 2019; Nguyen *et al.*, 2020; Wang *et al.*, 2020). Although the American Society of Hospital Pharmacy (ASHP) has consistently reported statements highlighting the role of clinical pharmacists in perioperative settings, its implementation in practice is limited and varied (American Society of Health-System Pharmacists., 2014; Hawkins *et al.*, 2019; Patel *et al.*, 2020). Given the lack of well-established surgical pharmacy practice settings, simulating this environment can achieve the objective of expanding student access to experiences that they may not have been exposed to in a traditional experiential learning style.

The aim of this study is to: 1) Describe the design of a virtual APPE in surgery; 2) Evaluate its implementation; 3) Investigate students' perceived effectiveness of the experience on their learning.

Method

Developing/designing a virtual APPE in surgery

This APPE included pharmacy interns in the last rotation of their internship year at Princess Nourah University College of Pharmacy. A team of four preceptors designed this rotation to be delivered to 12 students over the period of four weeks using Microsoft Teams software. The aim of the virtual surgical APPE

was to simulate the experience of providing clinical pharmacy services to perioperative patients. The objectives of the rotation were adopted and modified from the ASHP sample surgery/operating room APPE student rotation (American Society of Health-System Pharmacists., 2014).

The authors focus on clinical experience in surgery without including operational surgery experience. The objectives of the APPE included: 1) Discussing issues of the perioperative setting and appropriate pharmacotherapy through the identification of nine major themes, including surgical infection prophylaxis and deep venous thrombosis (DVT) prophylaxis; pre- and post-surgery anticoagulation; sedation; anaesthesia; neuromuscular blocking agents; postoperative pain management; postoperative nausea, vomiting, and constipation; hematologic agents; and peri- and postoperative hypertension; 2) Utilising appropriate guidelines and clinical protocols to deliver pharmaceutical care; 3) Providing evidence-based and timely responses to requests for drug information; 4) Integrating patient-specific information with clinical and pharmaceutical knowledge to identify potential medication-related problems and provide patient-specific monitoring plans.

Each theme was associated with a topic discussion, patients' case presentations, journal club presentations, and at least one drug information request, all of which were integrated into a weekly plan. Due to restrictions of the authors' affiliated hospital, students were not able to access patients' medical records, and faculties were tasked with creating simulated patient cases for students to work on. To further supplement the achievements of the desired objectives, students were assigned to a longitudinal surgical care improvement (SCI) project to be completed by the end of the rotation.

The weekly plan was sent to the students one week prior, with a complete description of the topic to be discussed. An example of a weekly work plan is displayed in Table I. Students had to submit their assigned topic discussion presentation, drug information answers, and journal club presentation prior to meeting with the preceptor and then present and discuss their work on various activities during the daily virtual meeting.

Through collaboration with the university hospital, four SCI projects were identified, with each being assigned to a group of three students to be submitted prior to the end of the rotation. These included: anticoagulation regimen protocols before and after surgery, DVT prophylaxis, pre- and post-operation antimicrobial prophylaxis, and management of patients after a gastric sleeve operation.

Table 1: Example of a weekly plan

Day	Activity	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6
1		Orientation					
2	TD	Surgical infection prophylaxis PPT			DVT prophylaxis PPT		
	CP	-	-	-	-	-	-
	JC	-	-	-	-	-	-
	A	DI Question	DI Question	DI Question	DI Question	DI Question	DI Question
3	TD	-	-	-	-	-	-
	CP	DVT prophylaxis - case		Surgical infection prophylaxis case (Intra-abdominal infection)		Surgical infection prophylaxis case (Antibiotic allergy)	
	JC	-	-	-	-	-	-
	A	-	-	-	-	-	-
4	TD	-	-	-	-	-	-
	CP	-	-	-	-	-	-
	JC	JC		JC		JC	
	A	DI Question	DI Question	DI Question	DI Question	DI Question	DI Question
5	TD	Anticoagulant agent (pre, post)			Burn case		
	CP	Sepsis case		Neurological complication after surgery case			
	JC	-	-	-	-	-	-
	A	DI Question	DI Question	DI Question	DI Question	DI Question	DI Question

TD: topic discussion, CP: case presentation, JC: journal club, A: assignment, DI: Drug Information, DVT: Deep Venous Thrombosis.

Evaluating the implementation of the rotation

This virtual APPE rotation was assessed through surveys, including both a weekly quality survey and an overall outcome survey. The survey involved close-ended questions and an open-ended question to further explore students' views on different aspects during the four-week rotation.

The weekly quality survey evaluated students' perceptions as follows. First, achievement of rotation objectives within each theme, rated on a five-point Likert scale (strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, strongly agree = 5). Second, the workload or number of activities that students worked on compared to onsite rotations (less = 1, comparable = 2, more = 3). Third, if the students benefitted from the virtual rotation in relation to onsite rotations (yes/no). Fourth, if students felt that the technical issues they faced limited their overall learning experience, rated on a five-point Likert scale (strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, strongly agree = 5). This survey was sent on the last day of each week to assess the quality of the offered experience and allow for adjustments if needed.

Investigating students' perceived effectiveness of the rotation

The overall outcome survey was sent at the end of the rotation to assess the impact of the experience and overall benefit rated on a five-point Likert scale (strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, strongly agree = 5) and included the following: 1) Students' pre-

rotation interest in a surgical APPE; 2) Pre- and post-rotation likelihood of accepting a job with a surgical team; and 3) Impact of the longitudinal SCI project on students' understanding of the perioperative clinical pharmacist role. Moreover, students were presented with open-ended questions to 1) Indicate their average weekly time spent completing the requirements of the rotation; and 2) Describe this APPE rotation.

With respect to the perceived achievement of the objectives of the rotation, students were asked to rate their perception on a five-point Likert scale (strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, strongly agree = 5). Responses were collected each week.

Upon data analysis, all five-point Likert scale responses used in the rotation evaluation were re-categorised into three: 1) Strongly disagree and disagree = disagree; 2) Neutral, and 3) Strongly agree and agree = agree.

To determine the overall achievement of the rotation objectives during the full rotation, the weighted mean was calculated from the responses for each objective. The trend of students' views was calculated with reference to the weighted mean as follows: disagree = 1 – 1.67, neutral = 1.68 – 2.33 and agree = 2.34 – 3.

Statistical analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS for Windows, version 24). Descriptive statistics, such as frequencies and percentages, were conducted. The repeated measures in

the weekly quality survey were compared between weeks one and four in pre-and post-tests. The overall outcome survey results are reported in frequency (%). The weekly time spent by students was calculated using mean and median.

Open-ended questions requesting students to describe the rotation were analysed based on thematic analysis guidelines (Castleberry & Nolen, 2018).

Ethical considerations

The study obtained ethical approval from the Institutional Review Board at Princess Nourah bint Abdulrahman University (IRB Log Number: 20-0180). Students were informed about the study, its objectives, and their rights. Confidentiality of the data was also ensured.

Results

Developing/designing a virtual APPE in surgery

Students were divided into two groups (six members each), and each group worked independently with two preceptors following the same rotation format. Topics were divided between the preceptors, with each being responsible for two weeks of the rotation. Daily meetings to present and discuss students' work lasted an average of 4.5 hours (an average of 22.5 hours/week), as reported by the preceptors. For the rest of the day, students worked on the next day's activities and the longitudinal SCI project. They did not present the SCI project to the hospital due to time constraints during the pandemic; however, they submitted it in a written format and feedback was discussed with students. All students had access to a personal computer and the Internet throughout the rotation period.

Evaluating the implementation of the rotation

All 12 students who underwent this rotation were included in the study, and all surveys had a response rate of 100%.

Students' perception of the achievement of the objectives of the rotation

Students were asked to rate their perception of the achievement of the objectives of the rotation each week. Responses to this question (per week and an average value at the end of the rotation for each objective) are presented in Figures 1 and 2.

Workload, technical issues, and comparison to the onsite rotation

During the first week of the rotation, students perceived the workload of the virtual rotation to be more than that of the onsite rotation; however, it was comparable during the last week of the rotation. The perceived benefit that students gained from the virtual rotation was comparable to onsite rotations and remained the same at 11 (91.7%). Further details are listed in Table II.

The mean and median number of hours spent by students performing required rotation activities (excluding the daily meeting time) was 28.6 hours/week and 30 hours/week, respectively. This was in addition to the 22.5 hours/week spent in meeting with the preceptor, calculated from the mean meeting time reported, adding up to a total mean and median weekly time of 51.1 hours/week and 52.5 hours/week, respectively. The number of students who felt that the technical issues they faced limited their overall learning experience decreased toward the end of the rotation (Table III). The technical issues faced during the first weeks may have resulted in the students' perception of an increased workload.

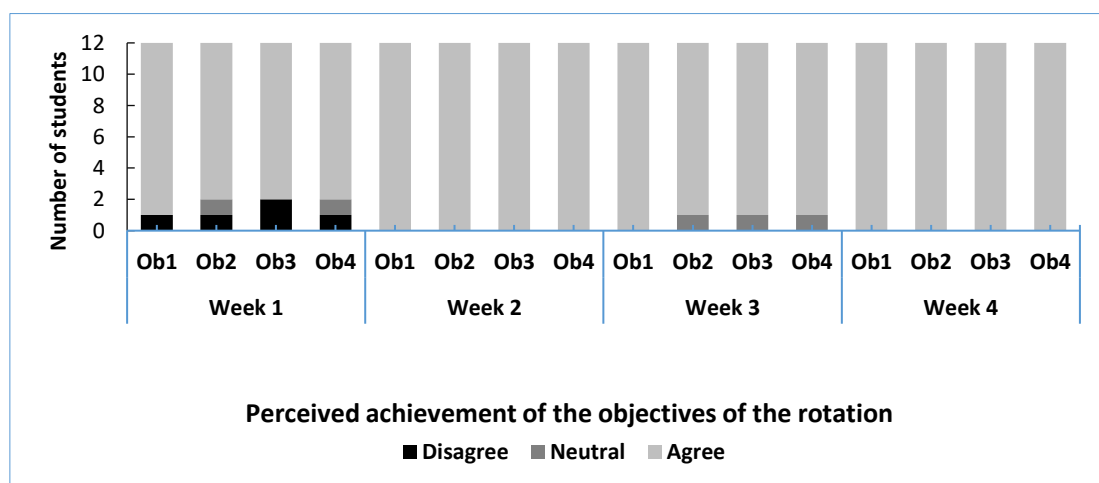
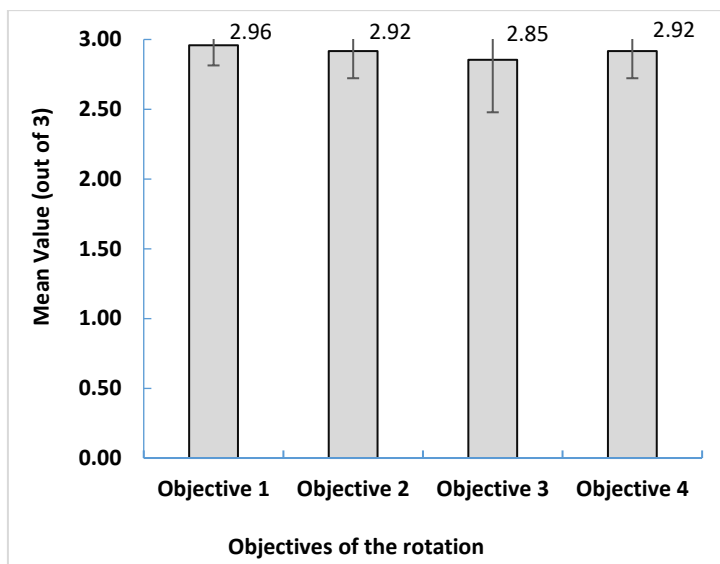


Figure 1: Students' perceived achievement of the rotation objectives during each theme of the rotation



Note: **Objective 1:** Discussing issues of the perioperative setting and appropriate pharmacotherapy through the identification of nine major themes including: surgical infection prophylaxis and deep venous thrombosis (DVT) prophylaxis; pre- and post-surgery anticoagulation; sedation; anesthesia; neuromuscular blocking agents; postoperative pain management; postoperative nausea, vomiting, and constipation; hematologic agents; and peri- and postoperative hypertension. **Objective 2:** Utilising appropriate guidelines and clinical protocols to deliver pharmaceutical care. **Objective 3:** Providing evidence-based and timely responses to requests for drug information. **Objective 4:** Integrating patient-specific information with clinical and pharmaceutical knowledge to identify potential medication-related problems and provide patient-specific monitoring plans.

Figure 2: Students' perception (mean ± SD) of the achievement of the rotation objectives during the four-week rotation period (n = 12)

Table II: Students' perception of workload and benefit

Students' perception	Week 1			Week 4		
	Yes	No	Reason	Yes	No	Reason for selection
1. Workload/number of activities is comparable to the onsite rotation	9/12 (75%)	3/12 (25%)	2/3 (there is much more work) 1/3 (no reason)	Yes 12/12 (100%)	No 0	
2. Benefit gained is comparable to the onsite rotation.	11/12 (91.7)	1/12 (8.3%)	Prefer real life patients and a flexible schedule	11/12 (91.7)	1/12 (8.3%)	"Real patients give me more skills, and I was given the time needed to finish the task"

Table III: Students' perception of "The technical issues I faced did not limit my overall learning experience"

	Pre (week 1)		Post (week 4)	
	Frequency	%	Frequency	%
Agree	8	66.7%	11	91.7%
Neutral	1	8.3%	0	0%
Disagree	3	25%	1	9.3%

Investigating students' perceived effectiveness of the rotation

Pre-rotation interest in surgical APPE and impact of the rotation on students' interest

Prior to the start of the rotation, 75% of the students were interested in a surgical APPE rotation, while 16.6%

were neutral, and 8.3% were not interested. The possibility of accepting a clinical pharmacist position with a surgical team increased after the rotation; details are listed in Table IV. Moreover, 92% of students felt that the SCI project increased their understanding of the involvement of pharmacy in surgery and anaesthesia, while 8% were neutral.

Table IV: Possibility of accepting a job with a surgical team before and after the rotation

	Pre rotation (n, %)	Post rotation (n, %)
High	6, 50%	9, 75%
Neutral	3, 25%	1, 8.3%
Low	3, 25%	2, 16.7%

Students' overall views on the rotation

Students' responses to open-ended questions describing the rotation experience fell mainly under two themes: impression about the experience and enhancement in knowledge and skills. Regarding the former, nine students described the experience positively, highlighting:

“productive rotation”, “sufficiently covering all important practices in a surgical ward”, and “it’s a beautiful and useful experience”. One response indicated that it “was one of the most exhausting rotations”.

Regarding enhancement of knowledge and skills, five students indicated that there was an improvement in their knowledge and skills during the rotation, stating:

“It was full of knowledge and new information”, “improved my knowledge on the topic”, and “considerably improved my research and JC (journal club) presentation skills, which made me confident”.

Discussion

The shift to continue the internship remotely was a quick response to an emerging academic challenge after most hospitals refrained from receiving student interns due to the COVID-19 pandemic. This study describes the development of a virtual surgical APPE during a COVID-19 lockdown and evaluates students' perspectives of this experience and their perceived benefits. The creation of this rotation was challenging given the limited time and resources available to devise an APPE course. The authors wanted to provide students with a new and beneficial experience, enhance their knowledge and skills, and allow them to complete the requirement for graduation. As this was the last rotation of the year, the majority of students had already completed their required APPEs and were offered this rotation as an elective.

In line with what the authors have done, other health colleges reached a similar concept of creating a way to conduct valuable virtual clinical training. De Ponti and colleagues in 2020, described a similar method where medical school students went into simulated cases and did their training fully online through three main stages: introduction, virtual patient-based training, and debriefing, followed by delivering a formal presentation and discussion of clinical cases. Similar to this study, student feedback was mostly positive, as indicated by a 90% student satisfaction level (De Ponti et al., 2020).

The virtual APPE described by the current study shows the comparable efforts of several schools of pharmacy that continued the APPE with limited patient contact during the lockdown period (Badreldin et al., 2020; Lucca et al., 2020; Kiles et al., 2021). Lucca and colleagues in 2020 and Badreldine and colleagues in 2020 both reported from Saudi schools and described the switch of the Pharm.D, internship rotations to online training. Unlike the authors' experience, which utilised this challenge as an opportunity to offer a new experience in surgery, previous studies offered a blend of traditional direct patient care APPEs delivered virtually, including internal medicine, infectious disease and critical care, among others. Similar to this study, student activities included topic discussions, case discussions, presentations, and drug information requests. In the study by Lucca and colleagues in 2020, student feedback was reported, showing an enhancement in learning outcomes and an overall positive experience.

In the United States, a study by Kiles and colleagues in 2021 describes a public health elective APPE that was conducted using a hybrid of videoconferencing utilising similar student activities and physically working at an emergency COVID-19 call centre. Similar to this study, students reported increased knowledge and an overall positive experience (Kiles et al., 2021).

Although their APPE options were limited, approximately half of the interns were interested in experiencing the role of pharmacists in providing pharmaceutical care in the areas of surgery and anaesthesia. Experiencing this virtual rotation increased the possibility of students being prepared to accept a clinical pharmacist position with a surgical team by 25%. The SCI project largely enhanced their understanding of the practice area. Overall, students pursued the rotation to achieve their objectives and were able to improve their knowledge and skills. This could be due to an increased understanding of the topic, especially since their exposure to perioperative didactic content was minimal (Patel et al., 2020). The rotation also affected students' interest and willingness to work in a perioperative pharmacy practice, which is an area with growing interest and impact in pharmacy practice (Patel et al., 2020). Moreover, the overall impression about the experience was positive and students described an enhancement of knowledge about the role of pharmacists in surgery and an enhancement of skills.

These findings are probably not related to the virtual design of the study, rather to the chance to experience surgical pharmacy practice as a new opportunity. The authors expect that similar findings would be reached if students completed this APPE using traditional

delivery methods, if available. However, this study highlights the importance of utilising simulation training to expand student experience beyond the limitations of current practices, especially in situations of crisis.

The reported total weekly hours spent in performing all rotation activities was around 50 hours/week, which is more than the 40 hours/week rotations required by the Accreditation Council for Pharmacy Education (Accreditation Council for Pharmacy Education, 2016). This is similar to the hours reported by Badreldin and colleagues in 2020, and slightly above Kiles and colleagues in 2021, and Lucca and colleagues in 2020. Although students were asked to estimate the weekly time spent after they completed the rotation and came to know their grades, it is possible that this number may be overestimated. However, the authors do not think it is far-fetched. This might be due to technical issues that students faced early in the rotation and the struggle to quickly adapt to the new rotation format.

The ACPE 2016 Standards for the Doctor of Pharmacy degree necessitate a minimum of 1,440 hours of APPE to be completed prior to graduation. Moreover, a minimum of 160 hours should be spent in each required APPE, with the key focus being direct patient care. It allows for a maximum of two elective experiences without patient care focus to allow students to secure a depth and breadth of knowledge, mature professionally, and experience different sectors (Accreditation Council for Pharmacy Education, 2016). As this rotation was offered to the interns at the last rotation of the year for this batch of students, all the interns had already completed their required rotations and more than 1500 hour of APPE. Although delivering this virtual rotation was a corrective response to the rapid changes that the college faced after the sudden prevention of hospitals and health centres from receiving students, it still did not affect the minimum requirements of APPE recommended by the ACPE

The need for the involvement of clinical pharmacists in surgery and anaesthesia and their impact on improving patient outcomes throughout the surgical continuum of care is well-known; however, actual practice in this area is limited (Neville *et al.*, 2014; Nguyen *et al.*, 2020; Patel *et al.*, 2020; Wang *et al.*, 2020). The number of surgeries performed in Saudi Arabia in 2012 was 3,544 per 100,000 people, and it is expected to increase (Weiser *et al.*, 2016). The costs associated with surgeries are high, and the involvement of clinical pharmacists in the perioperative setting has demonstrated huge economic benefits (Bond & Raehl, 2007; Neville *et al.*, 2014; Mahmoudi *et al.*, 2019; Kaye *et al.*, 2020). Therefore, in the education and training system, it is important to provide opportunities for

pharmacy students to experience and gain interest in this area of practice. The implementation of a virtual APPE created the opportunity to provide a virtual pharmacy practice experience in surgery and anaesthesia, allowing preceptors to create relevant cases and students to focus on pharmacotherapeutic considerations in the perioperative setting. As the pandemic has forced an accelerated shift to virtual experiential training and the practice of telepharmacy, providing remote pharmaceutical care is expected to evolve in the future, and having a chance to practice that during APPE is important to develop the required telepharmacy skills (Le, Toscani, & Colaizzi 2020; Louiselle *et al.*, 2020; Aruru, Truong, & Clark, 2021; Ibrahim *et al.*, 2021).

This study adds to the existing literature about APPEs by showcasing the implementation of virtual simulation training to explore limited areas of practice, such as surgical pharmacy practice. As shown in this study, students believed that this APPE was beneficial, and it allowed them to understand the clinical pharmacist role in perioperative settings and increased their interest in this area of practice. This is important because pharmacy practice is different from one area to the other, and sites are not always available, which can affect the learning experiences offered to students and may limit their outcomes. This study can be used as an example of utilising APPE electives to broaden the experience of students.

Limitations

The limitations of this rotation include a lack of operational experiences such as distribution and dispensing within surgical units, access to electronic medical records from the affiliated hospital, and inter-professional interactions due to the virtual method used. However, given the experience of the faculty working in the affiliated simulation centre in creating clinical scenarios and facilitating APPE learning, the preceptors were able to create patient cases and activities that enriched the learning experience of students and allowed for the coverage of all major themes of the rotation, which may not have been possible otherwise. This is further supported by the students' assessment of 2.9 out of 3 for "Objective 4: Integrating patient-specific information with clinical and pharmaceutical knowledge to identify potential medication-related problems and provide patient-specific monitoring plans". However, it is important to understand that these results are only reflective of the clinical experience in a surgical pharmacy.

The low number of participants is a limitation of the study. Moreover, given the time constraints presented by the pandemic, the authors only assessed the

students' perceptions of knowledge and objective attainment, which may introduce social desirability bias, as students are more likely to report a positive outcome.

Conclusions

The authors designed a virtual rotation in surgery based on a pre-set example released by ASHP for surgery/operating room APPE rotation. The implementation was successful with positive feedback. This study found that providing a virtual surgical APPE was beneficial to students. It improved their understanding, skills, and interest in this area of practice. The clinical pharmacist's role in the perioperative setting is still evolving, while current practices vary and may be limited by the number of established sites of practice. Therefore, creating a simulated environment to enrich the training of pharmacy students is warranted. Few studies reported their experience in providing virtual APPEs during the pandemic—to the authors' knowledge, this is the only reported experience focused on a single area of hospital practice, namely the perioperative setting. This can enhance pharmacy education and training by exploring the possibility of providing simulated elective rotations, especially when training sites are limited or practice areas are not well established.

Further research in this area can focus on the gained learning outcomes. However, while this is an interesting and progressive area to utilise in pharmacy training, it does not mitigate the need for direct patient care APPEs.

Acknowledgements

The authors would like to acknowledge the College of Pharmacy at Princess Nourah bint Abdulrahman University, the training unit, and the department of pharmacy at King Abdullah bin Abdulaziz university hospital for their support.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

References

- Accreditation Council for Pharmacy Education. (2016). Accreditation Standards and Key Elements for the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree. *ACPE*, **39**. Retrieved from <https://www.acpe-accredit.org/pdf/Standards2016FINAL.pdf>
- American Society of Health-System Pharmacists. (2014). *ASHP Sample Surgery/Operating Room APPE Student Rotation*. Section of Inpatient Care Practitioners USA. Retrieved from <https://www.ashp.org/-/media/assets/pharmacy-practice/resource-centers/preceptor-toolkit/sicp-surgery-or-appe-student-rotation-updated.pdf>
- Aruru, M., Truong, H., & Clark, S. (2021). Pharmacy Emergency Preparedness and Response (PEPR): a proposed framework for expanding pharmacy professionals' roles and contributions to emergency preparedness and response during the COVID-19 pandemic and beyond. *Research in Social and Administrative Pharmacy*, **17**(1), 2018–2022. <https://doi.org/10.1016/j.sapharm.2020.04.002>
- Badreldin, H. A., Alshaya, O., Saleh, K. Bin, Alshaya, A. I., & Alaqeel, Y. (2020). Restructuring the inpatient advanced pharmacy practice experience to reduce the risk of contracting coronavirus disease 2019: Lessons from Saudi Arabia. *Journal of the American College of Clinical Pharmacy*, **3**(4). <https://doi.org/10.1002/jac5.1237>
- Bansal, N., & Morris, J. (2019). Pharmacist involvement to improve patient outcomes in lower gastrointestinal surgery: a prospective before and after study. *International Journal of Clinical Pharmacy*, **41**(5), 1220–1226. <https://doi.org/10.1007/s11096-019-00888-2>
- Baumgartner, L., Ip, E. J., Sasaki-Hill, D., Wong, T., Israel, H., & Barnett, M. J. (2019). Implementation of mock acute care advance pharmacy practice experience simulations and an assessment rubric. *American Journal of Pharmaceutical Education*, **83**(9), 1851–1856. <https://doi.org/10.5688/ajpe7331>
- Bond, C. A. (CAB), & Raehl, C. L. (2007). Clinical and economic outcomes of pharmacist-managed antimicrobial prophylaxis in surgical patients. *American Journal of Health-System Pharmacy*, **64**(18), 1935–1942. <https://doi.org/10.2146/ajhp060631>
- Castleberry, A., & Nolen, A. (2018). Thematic analysis of qualitative research data: Is it as easy as it sounds? *Currents in Pharmacy Teaching and Learning*, **10**(6), 807–815. Elsevier. <https://doi.org/10.1016/j.cptl.2018.03.019>
- Charipiat B, Goutelle S, Schoeffler, M, Aubrun, F., Viale, J.P., Ducerf, C., et al. (2012). Prescriptions analysis by clinical pharmacists in the postoperative period: a 4-year prospective study. *Acta Anaesthesiologica Scandinavica*, **56**(8), 1047–1051. <https://doi.org/10.1177/08971900211004830>
- De Ponti, R., Marazzato, J., Maresca, A. M., Rovera, F., Carcano, G., & Ferrario, M. M. (2020). Pre-graduation medical training including virtual reality during COVID-19 pandemic: A report on students' perception. *BMC Medical Education*, **20**(1), 1–7. BMC Medical Education. <https://doi.org/10.1186/s12909-020-02245-8>

- Gaba, D. M. (2004). The future vision of simulation in health care. *Quality and Safety in Health Care*, **13**(SUPPL. 1), 2–10. <https://doi.org/10.1136/qshc.2004.009878>
- Hawkins, B., Bickham, P., Golembiewski, J., Meyer, T., Murray, C. G., & Wagner, D. (2019). ASHP guidelines on perioperative pharmacy services. *American Journal of Health-System Pharmacy*, **76**(12), 903–920. Oxford University Press. <https://doi.org/10.1093/ajhp/zxz073>
- Hick, H. L., Deady, P. E., Wright, D. J., & Silcock, J. (2001). The impact of the pharmacist on an elective general surgery pre-admission clinic. *Pharmacy World and Science*, **23**(2), 65–69. <https://doi.org/10.1023/A:1011231622947>
- Kaye, D. R., Luckenbaugh, A. N., Oerline, M., Hollenbeck, B. K., Herrel, L. A., Dimick, J. B., & Hollingsworth, J. M. (2020). Understanding the costs associated with surgical care delivery in the medicare population. *Annals of Surgery*, **271**(1), 23–28. <https://doi.org/10.1097/SLA.0000000000003165>
- Kiles, T. M., Hagemann, T., Felts, B., & Crill, C. (2021). Development of a Remote Public Health Advanced Pharmacy Practice Experience in Response to COVID-19. *Journal of Pharmacy Practice*. <https://doi.org/10.1177/08971900211004830>
- Le, T., Toscani, M., & Colaizzi, J. (2020, April 1). Telepharmacy: A new paradigm for our profession. *Journal of Pharmacy Practice*. <https://doi.org/10.1177/0897190018791060>
- Louiselle, K., Elson, E. C., Oschman, A., & Duehlmeier, S. (2020). Impact of COVID-19 pandemic on pharmacy learners and preceptors. *American Journal of Health-System Pharmacy*, **77**(14), 1097–1099. <https://doi.org/10.1093/ajhp/zxaa127>
- Lucca, J. M., Alsugeir, D. M., Al Shehail, B. M., Chandralla, V., Alshayban, D. M., & Bukhamseen, H. (2020). Redesigning the advanced pharmacy practice experiential education from hospital to home: A covid-19 scenario. *Pharmacy Education*, **20**(2), 212–220. <https://doi.org/10.46542/pe.2020.202.212220>
- Mahmoudi, L., Ghouchani, M., Mahi-Birjand, M., Bananzadeh, A., & Akbari, A. (2019). Optimizing compliance with surgical antimicrobial prophylaxis guidelines in patients undergoing gastrointestinal surgery at a referral teaching hospital in southern Iran: Clinical and economic impact. *Infection and Drug Resistance*, **12**, 2437–2444. <https://doi.org/10.2147/IDR.S212728>
- Mohamed Ibrahim, O., Ibrahim, R. M., Abdel-Qader, D. H., Al Meslamani, A. Z., & Al Mazrouei, N. (2021). Evaluation of Telepharmacy Services in Light of COVID-19. *Telemedicine and e-Health*, **27**(6), 649–656. <https://doi.org/10.1089/tmj.2020.0283>
- Neville, H. L., Chevalier, B., Daley, C., Nodwell, L., Harding, C., Hiltz, A., MacDonald, T., et al. (2014). Clinical benefits and economic impact of post-surgical care provided by pharmacists in a Canadian hospital. *International Journal of Pharmacy Practice*, **22**(3), 216–222. <https://doi.org/10.1111/ijpp.12058>
- Nguyen, A. D., Lam, A., Banakh, I., Lam, S., & Crofts, T. (2020). Improved medication management with introduction of a perioperative and prescribing pharmacist service. *Journal of Pharmacy Practice*, **33**(3). <https://doi.org/10.1177/0897190018804961>
- Patel, G. P., Hyland, S. J., Birrer, K. L., Wolfe, R. C., Lovely, J. K., Smith, A. N., Dixon, R. L., et al. (2020). Perioperative clinical pharmacy practice: responsibilities and scope within the surgical care continuum. *Journal of the American College of Clinical Pharmacy*, **3**(2), 501–519. <https://doi.org/10.1002/jac5.1185>
- Wang, R., Dong, X., Zhang, X., Gan, S., Kong, L., Lu, X., & Rao, Y. (2020). Pharmacist-driven multidisciplinary initiative continuously improves postoperative nausea and vomiting in female patients undergoing abdominal surgery. *Journal of Clinical Pharmacy and Therapeutics*, **45**(5). <https://doi.org/10.1111/jcpt.13110>
- Weiser, T. G., Haynes, A. B., Molina, G., Lipsitz, S. R., Esquivel, M. M., Uribe-Leitz, T., Fu, R., et al. (2016). Size and distribution of the global volume of surgery in 2012. *Bulletin of the World Health Organization*, **94**(3), 201–209F. <https://doi.org/10.2471/BLT.15.159293>