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Experiences in Teaching and Learning

Implementation and evaluation of a virtual learning advanced pharmacy practice experience

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ABSTRACT

Background and purpose: The novel severe acute respiratory syndrome coronavirus 2 restricted student involvement in direct patient care. Virtual learning is an effective education strategy in pharmacy curriculums. This study aimed to evaluate student perceptions of virtual learning advanced pharmacy practice experiences (APPE) utilizing an electronic 12-question survey.

Educational activity and setting: Virtual learning was developed and implemented, and students were surveyed at the end of the APPE. The survey was comprised of one open-ended and 11 Likert scale questions. It assessed implementation and use of virtual learning in place of a standard on-site APPE.

Findings: Responses were attained from 19 students. Questions regarding resources provided and virtual learning enabling autonomous, independent learning had the highest percent of strong agreement. No responses indicated strong disagreement. Three questions solicited >10% response rate of somewhat disagree, 16% associated with virtual learning helping the student become a better member of the healthcare team after graduation. Open-ended responses acknowledged appreciation of the virtual APPE and presented material. One in six students commented on the ability to apply the learned information to direct patient care. Feedback was delivered on consideration for increased utility of patient care-orientated applications to facilitate simulation of real-life patient cases.

Summary: Students who completed the virtual APPE were satisfied overall. Virtual teaching modalities may be incorporated into APPEs, particularly when direct patient care access is limited, but should not be used to completely replace the experience gained during direct patient care.

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Background and purpose

In January 2020, the first case of novel coronavirus, also known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was reported in the United States (US).\(^1\) By March 2020, community spread was detected across the US, prompting most major universities to transition from traditional classroom learning to virtual web-based curriculums.\(^2\) While this strategy was in the best interest of students, faculty, and overall public health, it did not directly address the students’ clinical educational experience. Those in the biomedical health field require on-site clinical training as part of their graduation and subsequent licensing requirements. In areas with significant active or anticipated community spread of SARS-CoV-2, clinical settings placed restrictions on student involvement in direct patient care. This was largely due to limited personal protective equipment and the need to minimize unnecessary exposure and potential spread of SARS-CoV-2.\(^3\) Schools and colleges of pharmacy (S/COP) needed to become creative and consider alternative approaches for anticipated advanced pharmacy practice experiences (APPE).

Virtual learning has been evaluated within pharmacy curriculums and has been found to be an effective education strategy.\(^4\) While student pharmacists generally view online learning as favorable, the use of virtual learning for APPEs is limited by accreditation standards and to our knowledge has not previously been described in the pharmacy education literature.\(^7\) The objective of this study was to evaluate student perceptions of the unanticipated transition to virtual learning after APPE completion utilizing an electronic 12-question survey.

Educational activity and setting

Previous curriculum

The Accreditation Council for Pharmacy Education (ACPE) offers guidance to S/COPs on education, achievement, and assessment.\(^9\) Standard 13 APPE Curriculum reinforces the role of APPE in integration, application, reinforcement, and advancement of student pharmacist abilities. The key elements of APPEs include, but are not limited to, patient care emphasis, duration of rotations, and required vs. elective experiences. The Ernest Mario School of Pharmacy (EMSOP) at Rutgers University requires APPE students to complete 1600 contact hours, above the state and ACPE requirement of 1440 hours, throughout nine five-week cycles during their fourth professional year. Consistent with ACPE Standard 13, there are four required experiences in acute care, including both general pharmacy practice and clinical pharmacy services, with a minimum of three precepted by EMSOP clinical faculty. The goal of both required and elective APPEs is to provide direct patient care to diverse patient populations in collaboration with an interdisciplinary healthcare team. Prior to the SARS-CoV-2 pandemic, all hours were completed at clinical sites with no hours routinely fulfilled through simulation or virtual learning.

At EMSOP, nine faculty members offer critical care experiences in settings ranging from community to tertiary care hospitals, in various specialties encompassing mixed medical/surgical to specialty intensive care units (ICU) (e.g., trauma, cardiac, neurological). During these APPEs, students routinely engage in direct patient care as part of the interprofessional team and complete routine clinical projects (e.g., journal club, seminar, patient case presentations) to develop clinical knowledge and skills. These experiences address ACPE Standards 2 (“Essentials of Practice and Care”), 3 (“Approach to Practice and Care”), and 4 (“Personal and Professional Development”), along with Standard 13 (APPE Curriculum).\(^3\) Furthermore, both elective and required APPEs align with EMSOP’s ability-based outcomes (ABOs). All ABOs were created based on the school’s mission and vision statements, incorporating the Center for the Advancement of Pharmacy Education 2013 Educational Outcomes, North American Pharmacist Licensure Examination Blueprint, and the Joint Commission of Pharmacy Practitioners Pharmacists’ Patient Care Process materials. It is expected students will attain all ABOs during APPEs, which are then included in their electronic portfolios.

Intervention

On March 11, 2020 the World Health Organization declared SARS-CoV-2 a global pandemic. Growing concerns prompted restricted access of student pharmacists at clinical practice sites impacting completion of the 1600 required contact hours.\(^\) After very careful consideration of state board of pharmacy and ACPE requirements, the opportunity for virtual learning in place of direct patient care to uphold ACPE Standard 13 and complete the 1600 total hours was deemed feasible given the extraordinary circumstances presented by the pandemic. Faculty members, in close collaboration with our experiential education office, were determined to provide students an equivalent learning experience to meet requirements for graduation. A swift decision was made to transition to a robust virtual learning platform.

Virtual learning course development and implementation

With the declaration of global pandemic and statewide SARS-CoV-2 cases on a steep rise, the first of many clinical sites announced restricted student access. With the help of our school’s experiential office, we were able to identify the critical care faculty and students potentially affected. As the number of clinical sites restricting access and need for virtual learning increased, the critical care faculty decided on a collaborative teaching approach on March 17, 2020. The collaborative teaching approach involved the distribution of virtual preceptor responsibilities among nine critical care faculty from nine separate clinical sites. All critical care faculty continued to fulfill their clinical duties throughout the virtual APPE. This disseminated structure allowed faculty to balance the growing clinical demands with the expected new virtual instructor role. Over the next seven days, a virtual learning experience was created.
Additionally, our institution created a virtual learning taskforce to address the additional faculty and non-faculty preceptors and students affected. The virtual learning APPE began on March 30, 2020.

A comprehensive course page was created on the designated learning management platform. A syllabus was developed from existing site preceptors' syllabi and included an overview, student learner expectations, and learning objectives. The objectives were created to reflect those of the originally scheduled APPE and associated ABOs identified as achievable through a virtual platform. The ABO related to the previous on-site APPE prioritized: (1) the development of the student as a learner and (2) the development of the student as a caregiver. Developing the student as a learner focused on the development, integration, and application of knowledge from the foundational sciences to evaluate the scientific literature, explain drug action, solve therapeutic problems, and advance patient health and patient-centered care. Developing the student as a caregiver encompassed the role of the student to provide patient-centered care as the medication expert. The responsibilities of the student included the following: collect and interpret evidence; prioritize, formulate assessments and recommendations; implement, monitor, and adjust pharmacotherapy plans; and document activities. A calendar for the five-week APPE was made by the group of critical care preceptors and provided to all students on the first day. A document on virtual learning etiquette was provided by the EMSOP experiential office; meanwhile additional documents created by preceptors included student instructions for presentation and presentation templates. All resources created by this core group were reviewed by the Virtual Learning Taskforce and adapted to eight other specialties at the EMSOP that were also transitioning to virtual APPE; specialties included infectious diseases, oncology, pediatrics, ambulatory care, internal medicine, community pharmacy, drug information, and hospital pharmacy. On the first day, all students met via video or telephone conferencing to review the documents with their primary preceptor.

The virtual learning initiative included topic discussions, journal clubs, case presentations, online learning modules, and formal written assignments (e.g., personal reflections, drug information questions, drug monographs). Verbal instructions regarding individual components were provided to students on the first day, and meetings were conducted through the learning management system's conferencing function. Prerequisite resources including primary literature or clinical guidelines were provided to students. Topic discussions were led by a designated preceptor or student(s) and required active participation by all participants. A total of 12 topics, an average of two to three per week, were covered during the five-week period. Faculty were assigned to lead one or two formal topic discussions, for which they created various materials aimed to increase student engagement. The dissemination of topics among faculty ensured review of relevant topics relating to critical care, without increasing the workload of the faculty members. This also provided the students with a unique opportunity to learn from their primary preceptor, as well as other critical care faculty members throughout the state. Students were expected to prepare for each topic in advance by reviewing recommended supplemental reading materials or educational videos. The duration of each topic varied, with an average duration of one to two hours. Each critical care faculty ensured assigned APPE students completed the school's requirements for a faculty-based APPE. These requirements included completion of a journal club, formal written assignment, clinical case presentation, and formal seminar presentation. Faculty were only responsible for attending their assigned topic discussions or their assigned student presentations. This allowed for a cohesive learning environment for students, while enabling faculty to remain fully engaged as a vital member of their respective interprofessional teams.

Student learners also had the opportunity to further develop clinical and critical thinking skills. Tools from didactic learning were adapted to the virtual APPE. Case presentations utilized EHR Go (Archetype Innovations, LLC), an educational electronic medical record (EMR), or similar platforms and focused on critical care disease states. The role of a critical care pharmacist and optimization of pharmacotherapy was demonstrated in patient case discussions. These skills were further reinforced through preceptor-led patient case review utilizing secured screen sharing of institution EMRs. Additional rotation assignments included completion of a longitudinal project, in this case focused on SARS-CoV-2. Each day students assigned to a pre-specified preceptor were required to identify new SARS-CoV-2 literature and provide a brief written summary. This responsibility was rotated among the students daily to ensure adequate time to review new literature.

Students were graded on several variables including participation, preparedness, quality of submitted assignments, and critical thinking skills. Faculty were responsible for scheduling of student presentations and grading of their assigned student presentations. After each virtual session, faculty who led the session reported degree of engagement for all student participants to the group of critical care preceptors. These reports were utilized to assess student participation and contributed to the student's overall grade.

All graded assignments were uploaded through the student learning system using the assignment function. Preceptors were responsible for reviewing and grading assignments using standardized rubrics. In conjunction with feedback from other critical care faculty, the final grade for each student was completed by their respective primary preceptor. Students received midpoint and final evaluations through CORE ELMS (CORE Higher Education Group), our experiential learning management software. Overall grades were submitted using standardized scoring. Preceptors discussed the midpoint and final evaluations directly with students via telephone or video conferencing.

**Integration of learning platforms**

The development of the virtual APPE required faculty to conceive innovative strategies to incorporate technology into clinical education. For it to be successful, a centralized location was used to organize rotation materials and facilitate communication between students and instructors. It served as the main platform to support the virtual APPE and provided a uniform structure for content. Within the course page, modules were created for each specialty (e.g., critical care, hospital pharmacy, pediatrics) and included a separate page for each of the five weeks. Each page contained links to student resources, including required reading materials or educational videos.

In addition to the course pages, the discussion board allowed real-time interactive conversations between the students and instructors. The assignment function in the learning platform allowed student submission of completed work for grading. Assignments were typically file uploads or multiple-choice questions, but various other options were available. BigBlueButton (BigBlueButton Inc.) and Cisco Webex (Cisco Systems) enabled virtual web-based discussions. Conferences were scheduled in advance and started by the assigned
lead faculty. The conferences allowed sharing of host screen or presentation slides to all participants. It also allowed real-time video and chat discussions which enabled student participation. This platform facilitated interactive discussions of student-reviewed materials.

Use of EHR Go (Archetype Innovations, LLC) was also incorporated into the virtual learning charge. Cases were designed to facilitate clinical discussions of patient cases or scenarios similar to those encountered during an on-site clinical APPE. Access to CORE Readiness (CORE Higher Education Group), an online repository of video-based learning modules with built-in assessments, was also available. These videos included hundreds of topics relevant to pharmacy practice that could be assigned to students and provided an added level of depth and objectivity to the course.

Evaluation of virtual learning APPE

This study was approved by the Rutgers University Institutional Review Board (Pro2020001026). All APPE learners assigned to critical care faculty were asked to complete a 12-question online survey. Critical care faculty were significantly affected by SARS-CoV-2, particularly due to the high volume of ICU patients, restricted student access into critical care areas, and increased other clinical responsibilities (e.g., institution guideline or protocol development). This group of students was selected as this was the first discipline to implement a fully virtual APPE. The survey assessed the implementation and use of a virtual learning experience in place of a standard on-site APPE. The survey was available for a five-day period during the last week of the virtual APPE. Students received electronic notification of the survey via email and announcements in the learning management system on two separate occasions. The lead faculty on the project provided students an explanation on the importance of their participation in the study and that the information obtained from the survey would be used to improve future virtual APPEs.

Prior to starting the survey, students were required to complete an electronic consent form. The consent form indicated the voluntary and anonymous nature of the survey, and if completed, submissions would be confidential. The students were not offered financial or any other incentive to complete the survey. All risks and benefits to the student were clearly described in the consent form. Contact information was provided if students had questions pertaining to the study or participation.

The 12-question survey consisted of 11 closed-ended questions regarding perceptions and experiences, and one open-ended question to provide any additional feedback on the virtual APPE. A Likert scale was used for the closed-ended questions and had six response options (strongly disagree, disagree, somewhat disagree, somewhat agree, agree, strongly agree). The questions were intended to identify differences in student expectations and experiences, and focused on resources provided, content presented and discussed, student engagement during various activities, and application of knowledge among others. All analyses were performed with Microsoft Excel Tool Pak 2016 (Microsoft, Inc.).

Findings

The survey was disseminated to 26 students, and 21 students completed a part or all of the survey questions. Two of the 21 survey responses had no responses to any of the Likert scale questions, thus they were excluded from the results. In total, 19 completed surveys were evaluated, for a survey response rate of 73.1% (Table 1).

### Table 1
Student survey responses.

| Question                                                                 | Strongly agree, n (%) | Agree, n (%) | Somewhat agree, n (%) | Disagree, n (%) | Somewhat disagree, n (%) | Strongly disagree, n (%) |
|-------------------------------------------------------------------------|-----------------------|--------------|-----------------------|-----------------|--------------------------|-------------------------|
| The instructor(s) provided clear expectations of the virtual learning experience. | 9/19 (47)             | 9/19 (47)    | 1/19 (6)              | 0               | 0                        | 0                       |
| I was provided the resources needed for my success (i.e. information on the course page). | 10/19 (53)            | 10/19 (53)   | 2/19 (10)             | 0               | 0                        | 0                       |
| The content presented, by instructor(s) and peers, was clear (i.e. information during virtual discussions). | 7/19 (37)             | 7/19 (37)    | 3/18 (17)             | 1/18 (5)        | 0                        | 0                       |
| I was engaged through the variety of activities.a | 5/18 (28)             | 9/18 (50)    | 3/18 (17)             | 1/18 (5)        | 0                        | 0                       |
| The structure of the virtual learning experience enabled autonomous (independent) learning. | 10/19 (53)            | 8/19 (42)    | 1/19 (5)              | 0               | 0                        | 0                       |
| The virtual learning experience provided a balance of clinical and non-clinical learning.a | 3/17 (18)             | 6/17 (35)    | 5/17 (29)             | 1/17 (6)        | 2/17 (12)                | 0                       |
| The virtual learning experience further developed my critical thinking skills.a | 5/17 (29)             | 5/17 (29)    | 7/17 (42)             | 0               | 0                        | 0                       |
| The virtual learning experience required application of my classroom and prior APPE knowledge. | 8/19 (42)             | 8/19 (42)    | 3/19 (16)             | 0               | 0                        | 0                       |
| Virtually learning with other students will help me become a better member of the healthcare team after graduation. | 5/19 (26)             | 10/19 (53)   | 1/19 (5)              | 3/19 (16)       | 2/19 (10)                | 0                       |
| Overall, the virtual learning experience met my expectations for the originally scheduled site-based rotation. | 5/19 (26)             | 7/19 (37)    | 2/19 (11)             | 3/19 (16)       | 2/19 (10)                | 0                       |
| I enjoyed learning in this virtual format. | 9/19 (47)             | 7/19 (37)    | 2/19 (11)             | 0               | 1/19 (5)                 | 0                       |

APPE = advanced pharmacy practice experience.

a Indicates incomplete responses from students.
Questions pertaining to the resources provided to learners and virtual learning enabling autonomous, independent learning had the highest percentage of ‘strong agreement’ responses. Although there were no responses indicating ‘strong disagreement’, three questions solicited > 10% response rate of ‘somewhat disagree’. The highest percentage ‘somewhat disagree’ (16%) was the role of virtual learning in helping the student become a better member of the healthcare team after graduation. Complete results can be found in Table 1. Six students responded with additional feedback submitted as an open-ended response. There was general acknowledgement and appreciation of the virtual learning organization and presentation of the material. The instructor- and student-led discussions also received high remarks. One student commented on difficulty in applying the learned information to direct patient care. Additional feedback was delivered on consideration for increased utility of patient care-orientated applications, such as EHR Go, to facilitate simulation of real-life patient cases.

Discussion

Clinical pharmacy education continues to provide a high level of flexibility to the faculty and preceptors involved in APPE student teaching. Considering the new SARS-CoV-2 pandemic and the restrictions it placed on pharmacy student involvement in direct patient care, our critical care faculty group quickly adapted various didactic teaching modalities to a virtual APPE. This study highlighted several adaptive approaches to clinical teaching modalities for virtual APPEs in the setting of a pandemic. While classroom resources were utilized to mimic direct patient care, real-time, faculty-led, clinical discussions brought to light pharmacotherapy challenges encountered in clinical practice. For example, students were tasked to develop safe and effective treatment and monitoring plans in the setting of new or ongoing drug shortages. Application of clinical and critical thinking skills therefore enabled students to meet ACPE Standards 2 ("Essentials of Practice and Care") and 3 ("Approach to Practice and Care"). Implementation of virtual simulation can provide alternative means for direct patient care, further increasing the likelihood for students to achieve Standards 2 and 3. A combination of virtual topic discussions (i.e., sepsis/septic shock, acid-base disorders, mechanical ventilation, cardiac arrhythmias), patient cases, and literature evaluation enabled students to further develop their personal and professional skills, as noted in Standard 4. Overall, the virtual APPE upheld ACPE Standards 2, 3, and 4, thus meeting Standard 13 (APPE Curriculum).9

The primary objective of this study was to evaluate student perceptions of the rapidly developed virtual APPE implemented in response to unanticipated and unprecedented needs presented by the SARS-CoV-2 pandemic. Based on the 12-question survey, all study participants agreed to a varying degree (from ‘somewhat agree’ to ‘strongly agree’) that clear expectations were provided to them at the start of the virtual APPE. The participants also agreed that the structure of the virtual learning experience enabled them to learn independently and the format further developed their critical thinking skills. The study investigators believed that these factors would build a strong foundation for learners, expecting not only a correlation to successful completion of the APPE, but also adaptability of learners to the ever-changing pharmacy landscape they would soon be entering. With the use of innovative technology, the newly implemented teaching functions also showed students firsthand the fine balance between increasing preceptor clinical demands and the new virtual instructor role. Capitalizing on both the vast clinical knowledge and years of clinical experience among the nine faculty instructors, the student responses indicated that the virtual APPE met the needs of the learner despite the lack of direct patient care. Moreover, a majority of the students agreed that virtual learning with other students would help them become a better member of the healthcare team after graduation. Although the students’ interactions throughout the virtual APPE were limited to the discipline of pharmacy, they were provided with an opportunity to learn from nine critical care faculty. The knowledge obtained from the various teaching styles and preceptor clinical experiences, in addition to the skills developed, would enable them to serve as a valuable member of an interdisciplinary team. Although the majority of students felt the virtual learning experience met their expectations for the originally scheduled site-based rotation, one-quarter did not agree. While further development is warranted, student goals and perceptions of critical care must be considered when evaluating success of a virtual APPE.

We found that although not ideal, a virtual learning platform as an alternative for an on-site clinical APPE was a feasible and sustainable approach. The virtual APPE addressed ACPE Standards and associated ABOs in a manner eliciting positive pharmacy student perceptions of the knowledge gained. While APPE learners had the opportunity to engage in direct patient care to a diverse patient population, modifications may be warranted to increase collaboration with an interdisciplinary healthcare team as per ACPE Standard 13. In addition, guidance on the number of simulation hours for APPEs must be considered with carefully defined expansions for extreme circumstances such as a pandemic. Following a decline in SARS-CoV-2 cases, the virtual APPE transitioned to a hybrid model. While this study did not evaluate the efficiency of a hybrid model, this approach enables more direct patient care meanwhile meeting social distancing or other environmental limitations. Our hybrid model is a combination of on-site direct patient care in the morning, followed by virtual teaching in the afternoon. Other options include select weekdays on-site and other days with virtual instruction. Virtual teaching continues to include topic discussions relevant to critical care. The topics assigned to each faculty member during the initial virtual learning experience, have remained consistent during subsequent cycles of virtual or hybrid APPEs. With limitations re-emerging during the anticipated resurgence of SARS-CoV-2 cases, our faculty has adapted newly available tools, such as Health Insurance Portability and Accountability Act-compliant conferencing. With restricted access to direct patient care, this capability supports learner evaluation of patient cases in real time. Constant reevaluation of resources by faculty will continue to reshape platforms to mimic clinical environment experiences.

This study arose from the urgent and unanticipated need to address unprecedented circumstances. As such, results of this study should be interpreted with caution due to several limitations. First, this was a small pilot study that included a critical care faculty-assigned student cohort group at a single school of pharmacy. It consisted of 26 students and thus may not reflect the perception of all students who have completed a virtual APPE. Second, students evaluated were completing their last APPE prior to graduation and it is likely that their knowledge base and skills were stronger than those starting clinical experiences at the beginning of their
APPE year. Future studies to evaluate students' perceptions at various time points throughout the APPE year to compare findings are needed. Third, this study aimed to evaluate the utility of a virtual APPE under faculty preceptors. We did not evaluate the feasibility or perceptions of students under non-faculty preceptors. Fourth, while the grades provided to each student in the virtual experience were similar to those who had completed standard on-site APPEs with the critical care faculty group prior, we did not measure student success. Lastly, the survey was only administered during the last week of the APPE without pre-/post-analysis. If redesigning this study, a pre-/post-analysis would allow the investigators an opportunity to evaluate and assess other areas of potential deficiencies in their learners.

Summary

The SARS-CoV-2 pandemic created a unique circumstance requiring an urgent transition to virtual APPE learning. Student knowledge and understanding must be taken into consideration when developing and implementing a virtual APPE, with survey data reflecting student satisfaction with the process described here within. Virtual teaching modalities may be incorporated, particularly when access to direct patient care is limited. When required, tools and teaching modalities applied to virtual learning should closely approximate the goals and methods achieved during standard on-site clinical APPEs. Virtual learning should not be used to replace the experience gained from direct patient care APPEs under usual circumstances. In scenarios where access to clinical environments may become limited, it would be prudent for ACPE and other local governing bodies to define criteria for virtual, hybrid, or simulation-based alternatives given the experiences of 2020 and predictions that such challenges will recur.

Disclosure(s)

None.

Credit authorship contribution statement

Jackie P. Johnston, PharmD BCPS: conceptualization, methodology, investigation, resources, writing – original, writing – editing and reviewing, writing – revising, supervision, project administration
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Declaration of Competing Interest

None.

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