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COVID-19 SPECIAL COLLECTION

RESEARCH ARTICLE

Virtual physical assessment training during the COVID-19 pandemic - student pharmacists' performance & perceptions

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Abstract

The COVID-19 pandemic disrupted pharmacy education and caused significant transformation in student learning and assessment. Pharmacy PA faculty transformed the traditional PA teaching and practicum to virtual utilising Zoom. PA practicum consists of demonstration of a set of short videos, followed by students identifying incorrect techniques, describing the correct technique, and the purpose of the specific PA skill. After completion of the virtual PA practicum examination, students were invited to complete a 20-item survey about their perceptions. Most students preferred blended learning (56.8%) format over in-class, even though students performed significantly better on the traditional practicum (0.89±0.13) rather than the virtual (0.84±0.11). Hands-on skills are an integral part to PA instruction and learning, making innovations in virtual delivery and assessment vital for student success. This pandemic gave opportunities to explore curricular innovations as our virtual formats provided alternative approaches to review and summative assessment of PA.

Introduction

The outbreak of the novel SARS-CoV-2 virus (COVID-19) in late 2019, along with the associated mandated stay-at-home orders and social distancing, altered the landscape of pharmacy education. Student pharmacist training in the United States encompasses a well-thought-out system of educational outcomes that are highly interactive, increasingly team-based, and guided by experienced educators (Accreditation Council for Pharmacy Education [ACPE], 2015). The current pandemic challenged traditional approaches of long-term planning and the established system of the traditional curricula. The integration of online learning in the healthcare professions is not a new concept, and as technology is seamlessly integrated into the work environment, pharmacy graduates must embrace the various teaching and learning approaches to meet a future workforce (Lean *et al*., 2020). A systematic review looking at the impact on knowledge, skills, attitudes, and satisfaction for undergraduates in health professions suggests that virtual learning is equivalent to traditional in-class learning (George *et al*., 2014). Out of 207 studies that were evaluated, they found that 29% showed significantly

higher knowledge gains, 40% showed substantially greater skill acquisition, 67% showed no difference in attitude, and 14% showed higher satisfaction with online learning than traditional learning (George *et al*., 2014).

Physical examination is the process of evaluating anatomic findings through the use of inspection, palpation, percussion, and auscultation. Physical assessments (PA) are a set of skills that healthcare professionals perform to gather objective findings. PA includes various screenings and examinations, depending on the healthcare professional's scope of practice used to assist in initial diagnosis or improve patients' outcomes for chronic conditions. In line with recognising the importance of PA, many pharmacy professional programmes began implementing PA instruction as a graduation requirement. PAs accommodate the progress of evaluating and monitoring patients, leading to therapeutic, objective and subjective data important to care provision (Accreditation Council for Pharmacy Education, 2015). The Commission to Implement Change in Pharmaceutical Education first recognised the importance of PA in pharmacy education in 1993. However, PA did not become a required component of the Pharm.D. curriculum until 2016, according to the ACPE Standards. Also, the Joint Commission of Pharmacy Practitioners (JCPP) recently emphasised the importance of physical examinations as a part of the Pharmacists' Patient Care Process (PPCP) to enhance data collection as the first step of the process (Bandura, 1986). This critical step allows pharmacists to obtain essential patient information through PA to optimise patient care (Watson *et al*., 2019).

At Western University of Health Sciences College of Pharmacy (WesternU COP), in the spring of 2020, faculty were required to transition from in-class learning to online learning via Zoom to deliver the instruction and assessments in short order. Even though significant evidence exists about the best practices for online learning, due to the short time frame for implementation, pharmacy faculty had to use innovative approaches to deliver the final PA class review session and cumulative practicum.

PA Curriculum

WesternU COP implemented a comprehensive PA curriculum in 2014-15. The instructional time is integrated longitudinally into the self-care pharmacotherapeutics courses for first-year (P1) students. Each P1 pharmacy cohort consists of roughly 120 students that are randomly divided into two different groups for PA didactic instruction due to limited quantities of equipment and to improve the student-to-faculty ratio. Each group receives a total of eight two-hour PA sessions during both autumn and spring semesters. The system topics in the autumn semester include vitals, head, ears, eyes, nose, and throat (HEENT), pulmonary, and abdominal examinations. In the spring semester, system topics included are cardiovascular, musculoskeletal, neurological, and dermatologic examinations.

Didactic PA class sessions consist of faculty lecturing with PowerPoint slides and the integration of live demonstrations. Lecture slide content is generally comprised of describing different assessments, their purpose, skills, steps, and equipment needed, and interpretation of findings. After one to three assessments are described and demonstrated by faculty, P1 students are continuously allotted time throughout the session to practice skills on their peers immediately. Additionally, after each lecture students are allowed the remainder of the class session to practice all skills learned for that system. Faculty consistently monitor and provide guidance during each practice period. In addition, P1 students are provided with an outlined checklist document for each system that lists relevant assessments and highlights some essential steps and skills. As a supplement to class sessions, PA video clips were also provided for students to review the skills and steps for correctly performing different assessments outside of class time. The PA video clips were developed by and featured upperclassmen P4 students. The development of these video clips has been previously described and was found to optimise P1 student learning (Gogineni *et al*., 2018). Finally, at the end of each semester, students are allotted a final two-hour class session in which the skills checklists are reviewed and practiced with faculty and P4 student facilitators one last time. Prior to this final class session, P4 student facilitators receive training from PA faculty to optimise their teaching skills.

PA Assessment

At the end of each semester, assessment of PA instruction is conducted through written examination questions in addition to a live skills practicum. For each practicum, students are paired with a peer student, along with a designated practicum time. The pairs may practice PA with each other in advance and must perform PA on each other during the practicum.

In the autumn semester practicum, each student is given five minutes to perform a set of three assessments on their peer partner. Two sets of rubrics are developed so that the other student is assigned different assessments.

Immediately before performing, the selected set of assessments is shown to each student on a paper. The assigned assessments tested vitals, HEENT, and pulmonary and abdominal systems. Then, in the spring semester, the practicum advances to a three-station format that allows for comprehensive cumulative testing of all systems learned in that academic year. Similarly, at each station, students are assigned a set of three assessments and have five minutes to perform on their partner. After each pair completes a station, they are given instructions to proceed to the next one until all three stations are completed. Although the dermatologic system is also taught, it is not assessed on the practicum since the skills primarily focus on visual inspection only. Students must achieve a score of ≥70% to pass the PA skills examination.

PA practicum station rubrics are developed by PA faculty and generally contain 15 items total. Each of the three assigned assessments per rubric has three to four items that represent relevant key steps or skills. Additionally, there are five standard items to assess an introductory greeting, hand-washing, communication of findings, bedside manner, and a closing statement. Each rubric item is assigned one point if performed correctly, and no partial credit is awarded. Additionally, graders are encouraged to write comments, especially if a student misses three or more items. On the morning of or the day before the PA practicum, graders are provided with a 30-minute training session to orient them to the logistics and rubrics, and to demonstrate the assessments for their designated rubric.

Virtual PA Instruction and Assessment

After the COVID-19 stay-at-home mandate was enforced in March 2020, the remaining PA instruction and practicum had to be transformed into a virtual format. At that point, all body systems were taught in the traditional manner, except the dermatologic system, the final class review, and the PA practicum. The dermatologic lecture slides were posted for students to self-review on their own. Converting the final class review session and practicum to a virtual remote format was most challenging due to the hands-on skills-based nature, the increased cumulative testing content, the students' inability to find a partner in their household to practice and perform PA, and the lack of equipment as many students left their PA equipment in the lockers at the school.

The final class review session was conducted via Zoom. The session began with an overview of instructions for their virtual practicum. Then, students were further divided into smaller groups of eight and moved into Zoom breakout rooms. Similar to the traditional live session, each team had a designated P4 student facilitator who was provided with training beforehand. Under the direct supervision of the PA faculty, P4 facilitators reviewed each skills checklist and called on P1 students to demonstrate and describe each assessment to the best of their ability with or without equipment. Although P1 students could not practice the PA skills on each other, this Zoom session still provided an opportunity to review and refine their skill set for all body systems prior to the virtual practicum.

Given concerns for lack of equipment and lack of a partner in the students' household to utilise as a mock patient, the virtual practicum shifted its focus away from the traditional. A virtual practicum was developed to test the student's knowledge of identifying the correct technique, purpose, and findings of the assessment. This is different from the regular format where students were assessed on the actual performance of their skill and bedside manners (Table I). For this virtual practicum, faculty developed a guidance document for P4 student facilitators to create videos on various body systems in which specific steps were performed incorrectly or omitted. These videos were reviewed and further edited based on PA faculty feedback on the content and the duration. Similar to the traditional PA practicum, students were instructed they could be tested on any body system in the virtual practicum except the dermatologic system.

Table I: Physical assessment practicum description – traditional vs. virtual

Traditional Fall Practicum	Traditional Spring Practicum	Virtual Spring Practicum
Instructed to perform a set of 3 assessments from the following systems: Single-Station ○ Vitals ○ HEENT ○ Pulmonary ○ Abdominal	Instructed to perform three sets of 3 assessments each from the following systems: Multi-Station* Station 1 ○ HEENT ○ Pulmonary Station 2 ○ Abdominal ○ Cardiovascular Station 3 ○ Musculoskeletal ○ Neurologic	Shown two assessment videos from the following systems and asked a series of questions: Single-Station ○ HEENT ○ Pulmonary ○ Abdominal ○ Cardiovascular ○ Musculoskeletal ○ Neurologic

* For spring: vitals are incorporated into other systems such as pulmonary and cardiovascular

On the day of the virtual PA practicum, each student was required to sign onto Zoom fifteen minutes prior to their scheduled practicum start time, and faculty graders were instructed to call students directly at their assigned time slots. The total practicum time was set for eight minutes, with additional five minutes built into the assessment to give flexibility for faculty and students to address any logistical issues. All faculty were required to follow a standard virtual practicum protocol (Figure A). Once the Zoom session was initiated, faculty graders provided a brief overview and immediately started the practicum. Each student was shown two videos, each 20-40 seconds in length. During video viewing, students were instructed to observe carefully and take notes on procedures that were performed incorrectly. Students were able to request to re-watch the videos one more time before starting oral examination questions. After each video, the faculty grader asked each student specific questions in regard to the demonstrated skill, and students were required to respond verbally. Questions focused on three different criteria: (1) Identifies incorrect or omitted items (most heavily weighted); (2) Describes corrections of incorrect items; (3) Describes purposes and/or findings.

PA virtual practicum rubrics were modified from a standard 15-point scale given the modified nature of the assessment and short duration. All faculty graders received a one-hour orientation on how to download the virtual practicum videos, install the Zoom App, make video calls using Zoom, record their Zoom sessions, and review grading rubrics and logistics associated with the technical challenges. The total possible score for each video rubric was 10.5 points (Figure B). Similar to a traditional PA practicum, the virtual practicum passing score is set greater than or equal to 70%. Students receiving a failing score, having difficulty with Zoom connection, or losing significant time during assigned time slots were rescheduled for PA remediation. Additionally, graders were encouraged to record and forward all their Zoom sessions to PA faculty, and these were utilised as a reference during student grade disputes.

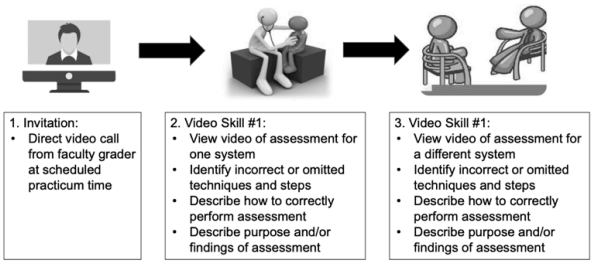

Figure I: Virtual PA Practicum Protocol -Spring 2020

Currently, there are no studies describing online PA instruction for healthcare professional students in the literature due to the hands-on skills-based nature of PA. This study aims to evaluate student perceptions of virtual PA practicum and final review sessions, assess student pharmacists' confidence in PA skills, and evaluate student pharmacists' performance via virtual assessment.

CRITERIA FOR VIDEO ASSESSMENT(S):	**Below Average** Some of response(s) correct, more deficiencies noted	**Average** Most of responses correct, some deficiencies noted	**Excellent** ALL responses answered correctly, little/no deficiencies	**CATEGORY SCORE**
A) **Identifies Incorrect or Omitted Items (4.5 points)** ○ Incorrect or omitted techniques ○ Incorrect or omitted instructions provided to patient ○ Incorrect explanations provided to patient				
B): **Corrects Items Above (3 points)** ○ Describes how to correct techniques, instructions, or explanations				
C)**: Describes Purpose and/or Findings (3 points)** ○ Purpose of assessment ○ Normal findings ○ Abnormal findings				
			TOTAL SCORE (10.5 points)	
VIDEO COMMENTS Describe incorrect responses or deficiencies. Note any other behavior that suggests lack of preparedness or unprofessionalism.				

Figure B: Virtual PA Practicum Rubric

Method

Survey

After completing the virtual PA practicum, students were voluntarily and anonymously invited to complete a 20-item survey about their perceptions of the virtual PA practicum, the virtual final class review session, and their confidence level in performing PA skills. The students had three weeks to complete the survey and were sent a reminder at the end of the second week. The survey submission was considered as informed consent to use the results for possible future presentations and publications. Students were asked to evaluate the length appropriateness and the accommodating level of the review session that was delivered using the Zoom application. Students were also requested to comment on their personal format preferences to offer the best PA learning outcomes. In addition, the survey assessed both the level of acceptance of the virtual PA practicum and the level of confidence in performing PA skills. The level of acceptance was formatted via a 4-point Likert scale (1=strongly disagree/not confident, 2=disagree/slightly confident, 3=agree/fairly confident, 4=strongly agree/ extremely confident). The confidence level was also measured using the same scale, where 1=not confident and 4=extremely confident. Survey responses were collected using Qualtrics, and data analysis was conducted using SPSS statistics. Waiver of consent and approval from the Western University of Health Sciences was granted for this study.

Study objectives included assessing student pharmacists' confidence in PA skills, student perceptions of virtual PA practicum and review sessions, and student pharmacists' practicum performance grades. Demographics, survey responses, and practicum grades were analysed with descriptive statistics. Nominal data were analysed on univariate analysis using a Chi-Squared test. Change in practicum grades from autumn to spring semesters was analysed using a paired *t*-test.

Results

Of the 109 P1 students who participated in the spring virtual PA practicum examination, 95 completed the survey, yielding an 87.2% response rate. Demographic data retrieved from the registrar for this cohort indicate that most are female (70%), of Asian descent (64%) with a mean age of 25 years. Overall, average performance on the traditional autumn live practicum (0.89±0.13) was higher than the spring virtual practicum examination scores (0.84±0.11). Additionally, the paired *t*-test demonstrated a statistically significant difference between autumn and spring scores (t_{108}=4.057, p=<0.001). Compared to the autumn, more students achieved a passing score in the spring (Table II).

Table II: Student practicum performance scores (n=109)

Scores presented on a 100-percent range

Assessment	Mean (SD)	Paired *t*-test	≥70% n (%)	<70% n (%)
Fall Traditional Live Practicum	0.89 (0.13)	*p*<0.001	102	7
Spring Modified Virtual Practicum	0.84 (0.11)		107	2

Regarding the final virtual PA review session, most students (84.2%) felt the time length was appropriate, and 96.9% found it helpful in preparing for the practicum, although to varying degrees (Table III). Students felt that the most significant benefits of conducting the PA review session virtually were staying more focused on their team (49.5%) and feeling more comfortable participating with their team (46.3%). Three students who selected "Other" commented via a free text that it is more convenient to learn from the comfort of home. Aside from the review session, most students prepared for the virtual practicum by reviewing the PA skills checklists (95.8%), watching the correct PA demonstration video clips (92.3%), and studying lecture slides (83.2%). Only a little over half of the respondents indicated that they practiced PA skills on another person. For PA learning format, complete virtual instruction was the least preferred (11.6%), while a blended approach of live and virtual was most preferred (56.8%).

Perceptions of the virtual PA practicum examination are depicted in Table IV. Overall, most students (86.3%) felt the virtual practicum examination still allowed them to demonstrate their knowledge of PA skills. Correspondingly, most students felt confident throughout the different practicum examination components, namely identifying incorrect skills (87.4%), describing corrections (90.5%), and answering questions about purpose and findings (87.4%). Additionally, most (86.3%) agreed that the length of testing time was sufficient. While 37% of respondents found the virtual practicum to be more stressful than the live format, a higher percentage (52.2%) indicated a preference for the virtual practicum format instead of the live format. Finally, 90.5% of respondents felt that the incorrect PA skills videos shown during virtual practicum could be utilised earlier in the semester as a helpful learning activity.

Table III: Student perceptions regarding virtual PA final review session and learning approaches (n=95)

Item	n (%)
Length of the virtual PA review session	
Too short	9 (9.5)
Appropriate	80 (84.2)
Too long	6 (6.3)
Helpfulness of the virtual review session for PA practicum preparation	
Not helpful	3 (3.2)
Slightly helpful	32 (33.7)
Fairly helpful	39 (41.1)
Extremely helpful	21 (22.1)
Benefits of conducting the PA review session virtually*	
It was easier to stay focused with my team on Zoom in comparison to practicing in the classroom.	47 (49.5)
I am more comfortable participating with my team through Zoom in comparison to when I am in the classroom.	44 (46.3)
I typically learn better when I am at home in comparison to the classroom.	19 (20.0)
Other	3 (3.2)
Other methods utilized for PA practicum preparation*	
Watched the correct PA demonstration video clips	88 (92.3)
Reviewed the PA skills checklists	91 (95.8)
Studied PA lecture PowerPoint slides	79 (83.2)
Practiced PA skills on a family member or friend	50 (52.3)
Searched for additional information in an online resource	39 (41.1)
Best format for learning PA overall	
Live lectures and practice in the classroom setting	30 (31.6)
Virtual lectures and small group review via Zoom	11 (11.6)
Combination of live classroom and virtual learning	54 (56.8)

*Indicates items with select all that apply for response choices

Furthermore, students were asked about their confidence in PA skills with respect to the different system topics (Table V). Students were in most agreement about their confidence in PA skills for Vitals (92.0%) and HEENT (90.5%). Conversely, students least agreed about confidence in PA skills for Neurologic (76.8%) and Cardiovascular (75.8%) systems. At the end of the survey, a free-text item was included to capture any additional comments. Of those responses, the majority indicated the Zoom review sessions are more convenient and comfortable. Overall, students felt less stressful about the virtual PA practicum compared to in-person but felt uncomfortable with the oral examination component of the practicum.

Table IV: Student perceptions of the virtual PA practicum (n=95)

Indicate your level of agreement with the following statements:	Mean (SD)	A/SA* Responses n (%)
The virtual practicum provided an opportunity to demonstrate my knowledge of PA skills.	3.16 (0.77)	82 (86.3)
I was confident in identifying the ***incorrect*** PA skills shown in the videos.	3.28 (0.70)	83 (87.4)
I was confident in describing the correct methods for performing the PA skills shown in the videos.	3.30 (0.62)	86 (90.5)
I was confident in answering questions about purpose and findings.	3.15 (0.61)	83 (87.4)
There was enough time to watch both ***incorrect*** PA skills videos and answer questions.	3.18 (0.65)	82 (86.3)
The virtual PA practicum (spring 5112) was more stressful than the traditional LIVE PA practicum (autumn 5111).	2.35 (0.92)	34 (35.8)
I would have rather completed the PA practicum LIVE instead of this virtual format.	2.52 (0.91)	44 (46.3)
Reviewing the ***incorrect*** PA skills videos earlier in the semester would be a helpful learning activity.	3.30 (0.59)	86 (90.5)

Responses based upon modified 4-point Likert scale where 1=Strongly Disagree, 2=Disagree, 3=Agree, 4=Strongly Agree.

*A/SA = Agree/Strongly Agree

Table V: Student confidence in their PA skills by system topic (n=95)

Indicate your level of agreement with the following statements:	Mean (SD)	A/SA* Responses n (%)
I am confident in performing PA skills for the following system		
Vitals	3.49 (0.60)	87 (92.0)
Head Ears Eyes Nose Throat (HEENT)	3.36 (0.60)	86 (90.5)
Pulmonary	3.21 (0.60)	83 (87.4)
Cardiovascular	2.94 (0.76)	72 (75.8)
Abdominal	3.19 (0.68)	77 (81.1)
Musculoskeletal	3.25 (0.69)	78 (82.1)
Neurologic	3.01 (0.74)	73 (76.8)

Responses based upon modified 4-point Likert scale where 1=Strongly Disagree, 2=Disagree, 3=Agree, 4=Strongly Agree.

*A/SA = Agree/Strongly Agree

Discussion

The need to disassemble group gatherings associated with the current COVID-19 pandemic caused total

transition from traditional in-class PA education to virtual online learning and assessment. Due to the short time frame for implementation of online PA learning and assessment, pharmacy faculty used pragmatic strategies such as small group reviews and short video scenarios to maintain consistency across all students. In their study, the authors found student performance for live PA practicum scores were significantly higher than the virtual practicum; this is different from Lean *et al*. (2020) where they concluded that there was no difference between an online and face-to-face learning. This difference may be associated with the nature of the assessment itself, hand-on skills versus knowledge scores.

Similar to prior studies in the pharmacy education literature, this study also demonstrated student preference and performance are not the same (Persky & Pollack, 2010; Ferreri & O'Connor 2013). The students cited benefits of this small group virtual Zoom format as increased focus and comfort, but this was not reflected in their final practicum scores, the average traditional live practicum scores were higher (0.89±0.13) compared to virtual practicum (0.84±0.11). Thus, using the Zoom breakout room feature for the virtual review session seemed effective in creating a private learning environment which allowed PA faculty to spend more time on teams needing more guidance. This is an advantage for programmes with limited campus space resources for small group room instruction.

For the overall preference of learning PA, the authors' findings indicated the most preferred learning format for PA was a blend of live and online learning (56.8%), followed by all live instruction (31.6%). This aligns with other studies examining online pharmacy class delivery which reported stronger student preferences for blended learning formats versus a single format (Phillips, 2015; Wanat, Tucker & Coyle, 2016). Another study by Hamilton et al. (2020) reports that most pharmacy students prefer live or hybrid formats over an online-only format for learning new material, retaining material, and working through cases. Using a blended instructional approach may serve to accommodate multiple learning styles. In preparation for the virtual practicum, respondents reported using the skills checklists, correct PA demonstration video clips, and lecture slides the most. However, only about half of respondents actually practiced PA skills on another person. This finding is expected, given that many students previously reported the lack of a household member to practice PA on during the end of this semester. Literature suggests that pharmacy students prefer to learn PA skills on fellow peers or standardised patients over a mannequin or other simulation method (Barry, Turgeon & Ellis, 2020).

Overall, a majority of P1 students reported feeling confident about the virtual practicum examination, including identifying incorrect PA skills demonstrated in the videos (87.4%), describing correct methods for performing those PA skills (90.5%), and answering questions about purpose and findings (87.4%). Although students felt confident in the virtual PA practicum, there was significant variability among various body systems. Students were most confident in performing vitals (92%), which is unsurprising given that this topic has simpler and fewer skills than other PA systems. In addition, students are likely most familiar with this topic due to repeatedly having their vital signs taken at healthcare appointments. While the PA curriculum greatly varies amongst Pharm.D. programmes, vital signs are one of the most covered PA topics in addition to pulmonary and cardiovascular systems (Spray & Parnapy, 2007; Barry, Turgeon & Ellis, 2020). In contrast, the least amount of confidence was reported when performing cardiovascular (76%) and neurologic (77%) assessments. In a study assessing PA skills of Japanese pharmacy students during an objective structured clinical examination, cardiovascular auscultation was noted to be one of the areas with the lowest performance (Tokunaga *et al*., 2014). To remedy this in the curriculum, PA faculty with high fidelity manikins will be used to better demonstrate abnormal heart sounds. The teaching of the neurologic system contains the highest number of assessments. Anecdotally, student feedback has implied difficulty with learning the numerous reflexes and motor strength examinations. These findings were similar to the study published by Coleman *et al*. (2018), they reported that their third-year medical students needing improvement in deep tendon reflexes and the motor strength examinations. Moving forward, improvements will be made to divide the class into smaller groups, increase practice time, faculty observation, and individual feedback.

Since the virtual practicum examination was modified to have an oral examination component at the end, this model may have been more intimidating to some students. One study reporting on the use of virtual faculty evaluations for pharmacy skills-based laboratory activities indicated that students preferred live evaluations for most aspects (Beal *et al*., 2020). The sole exception was that students only preferred video evaluations when asked about which format made them less nervous. Thus, virtual delivery for oral and other skills-based examinations may pose an advantage for students who have heightened test anxiety.

To the authors' knowledge, there are currently no other studies assessing total virtual delivery for live summative skills-based or oral assessments. Although the primary

limitation for the virtual practicum examination was unable to assess students' hands-on performance, this virtual examination was able to uniquely evaluate students' knowledge of PA skills using videos demonstrating incorrect techniques.

Limitations

Several limitations exist for this study. Devising and conducting a virtual PA practicum via Zoom requires a team of faculty and students, an operational plan, reliable Internet connections, and personal devices with built-in audio and video capabilities. Although training was provided to faculty and resident graders on the examination rubrics and logistics, some variability is still inevitable for oral examination questioning style and strictness in grading. In addition, each student was only tested on two assessments due to time restrains for the virtual testing day. Thus, students could have been less or more knowledgeable about the particular assessments assigned to them. In contrast, the traditional live spring practicum examination tests students on nine different assessments, giving them ample opportunities to demonstrate their skills. Despite making different rubrics and strategically scheduling them throughout the testing day, it is difficult to sequester students during virtual assessments and effectively prevent the electronic sharing of information from earlier to later examination takers. Finally, the survey was administered in the summer after semester grades were finalised. While this may have helped to reduce social desirability bias, the time-lapse may have increased the level of recall bias in survey responses.

Future directions

Future directions for the PA curriculum include an increase in anatomy review, more emphasis on the purpose and findings of assessments, and a review of videos showing incorrect and omitted techniques for formative assessment in the P1 year. Additionally, workshops for heart, lung, and abdominal sound auscultation will be implemented with newly acquired mid-fidelity simulation manikins. More studies examining structured skills-based examination methods for assessing student pharmacist PA skills should be conducted to develop best practices. Additionally, more research should explore the utilisation of virtual patients, software, videos, and other simulation methods to further delineate the best instructional tools to supplement live PA instruction.

Conclusions

Although hands-on skills are integral to PA instruction and learning, innovations in the virtual delivery of PA learning and assessment are necessary. These curricular innovations should be explored due to likely ongoing instructional limitations due to COVID-19, optimising flexibility for faculty grader time and resources, accommodating varying learning preferences, and increasing utilisation of telehealth encounters. To the authors' knowledge, this is the first pharmacy education study utilising a virtual format to review PA skills and administer a practicum examination. Although students could not directly perform PA skills, virtual formats provided reasonable alternatives for PA skills review and summative assessment. The majority of students found the final virtual review session to be helpful to some extent. Likewise, most students felt that the virtual practicum examination still provided an opportunity to demonstrate knowledge of PA skills.

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