Digital Health and Informatics Innovations for Sustainable Health Care Systems
J. Mantas et al. (Eds.)

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doi:10.3233/SHTI240704

Teaching and Evaluating the Virtual Physical Exam in Telemedicine

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Abstract. With the rapid adoption of telemedicine since the COVID-19 pandemic, it has become imperative to teach and evaluate health professional trainees on skills important to conducting effective virtual visits. We developed a simulation-based workshop with (1) readings, (2) a lecture covering online communication and the virtual head and neck exam, (3) a telemedicine simulation with a standardized patient observed by faculty, (4) personalized feedback from faculty, and (5) a group debrief session. We created an evaluation rubric based on three of 20 Association of American Medical Colleges (AAMC) telemedicine competencies to assess learner performance during the simulations. Students (medical and physician assistant students; n = 50), and internal medicine residents (n = 20) completed this workshop in 2023. At least 90% of trainees across the two groups were rated as approaching entrustment or entrustable in each competency. This workshop is an example of a scalable telemedicine curriculum that can be used to teach and evaluate learners in the virtual physical exam across the training continuum.

Keywords. Telemedicine, simulation, education, physical exam, evaluation

1. Introduction, Problem Statement and Aims

Since the COVID-19 pandemic, there has been increased adoption of telemedicine worldwide. In the United States (US), this presented new challenges as few clinicians received training in the effective use of telemedicine [1, 2]. While there are resources to learn about the virtual physical exam (VPE), including journal manuscripts, workshops, and continuing medical education content [3], there remains a pressing need for high-quality curricula focusing on the VPE in undergraduate and graduate medical education [4]. To provide guidance, the Association of American Medical Colleges (AAMC) published *Telehealth Competencies Across the Learning Continuum* in 2021, which lists 20 cross-cutting competencies. Several competencies focus on data collection and the

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VPE [2]. While the authors include milestones for evaluating students and residents, they do not discuss teaching strategies or measurement rubrics. Each training program is responsible for developing, piloting, and validating instructional tools and assessments.

Available telemedicine curricula vary in delivery methods and include didactic sessions, hands-on components during clinical rotations, simulations, case discussions, and a combination of approaches. Some educators have published curricula since the COVID-19 pandemic. However, few examples exist of applied evaluation tools [5]. One residency program created a mini-clinical evaluation for telemedicine and included faculty feedback guided by the ACGME core competencies [6].

At the University of Oklahoma School of Community Medicine (OUSCM), we created a telemedicine curriculum to instruct learners on communication best practices and practical methods for conducting a VPE. This article describes a pilot workshop covering vital signs and the head and neck exam. Our objectives are to (1) describe a feasible and easily reproducible method for instruction, (2) share our evaluation approach for the VPE, and (3) report trainee performance for benchmarking.

2. Setting and Methods

The workshop was conducted at the OUSCM simulation center in Tulsa, Oklahoma, US. Trainees included second-year physician assistant (PA) students, third-year medical students, and internal medicine residents. Our simulation center has 10 exam rooms, each with a computer and videoconferencing software. The learners sat in the exam rooms and connected to standardized patients (SPs) located at home (**Figure 1**). We furnished SPs with a digital blood pressure cuff and portable light source. Our faculty observed each trainee simulation over closed-circuit television.

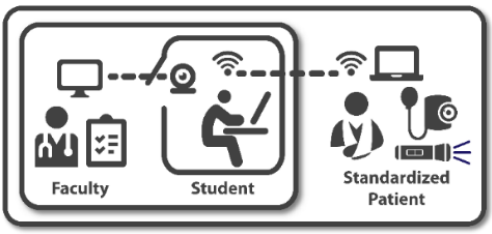

Figure 1. Schematic showing the configuration for our simulation and telemedicine technology.

The workshop included six parts in the following order: (1) We distributed reading materials to learners before the session; (2) one faculty member gave a 30-minute lecture covering online communication, collection of vital signs, and the head and neck exam; (3) faculty watched each learner complete a 15-minute simulation with an SP and (4) provided personalized feedback to learners using a standardized rubric; (5) faculty facilitated a group discussion with the class to explore themes and lessons learned; and (6) we distributed an online learner satisfaction survey immediately after the workshop.

The lecture explained how to collect vitals using the patient's blood pressure cuff and methods for conducting a VPE. Before the simulation, we provided learners with a written clinical history of their SP. The patient complained of a sore throat and requested antibiotics but did not meet the accepted criteria for a bacterial infection. Learners had to complete an assessment (including looking at the SP's oropharynx using the light source), make a provisional diagnosis, and decide on a treatment plan.

We used three strategies to evaluate the effectiveness of teaching and learning. First, we developed a learner performance assessment rubric based on three AAMC competencies (**Table 1**). We organized each competency into three to five observable tasks rated by faculty during the simulation. Based on the number of tasks observed, learners were scored as "not entrustable," "approaching entrustment," or "entrustable." Learners are entrustable if they can complete tasks without direct faculty supervision.

Table 1. Competencies adapted from the AAMC to evaluate learner performance during the simulations [2].

AAMC Category, Competency, & Description	Example Task
Communication via telehealth (**III, 1a**): Develops an effective rapport with patients, attending to eye contact, tone, body language, and non-verbal cues	The learner made regular eye contact with the camera.
Data collection and assessment (**IV, 2a**): Conducts an appropriate physical examination or collects relevant data on clinical status during the encounter, including guiding the patient	The learner examined the back of the oropharynx, using a light source to look for exudates.
Technology for telehealth (**V, 1a**): Explains the equipment required for conducting care via telehealth at both the originating and distance sites	The learner instructed the patient how to use the blood pressure cuff.

Following the simulation, faculty moderated group debriefs, allowing learners to share their insights, questions, or concerns about the simulation. Conversations were aimed at brainstorming techniques for the head and neck VPE, troubleshooting technical challenges encountered during the visit, and identifying areas for improvement.

We distributed after the workshop a previously published questionnaire adapted from Levett-Jones to evaluate learners' satisfaction with the teaching materials and simulation [7]. The questionnaire asked respondents to rate the simulation's quality and effectiveness using a five-point Likert scale, with each item anchors ranging from "strongly disagree" to "strongly agree."

3. Results

Seventy-eight learners completed our workshop last academic year: 50 students (21 PA, 29 medical) and 20 residents. Scores from both groups are shown in **Figure 2**. We scored at least 90% of all learners entrustable or approaching entrustment for each competency. Students performed best on *Communication* (Domain III, Competency 1a) with a combined percentage for entrustable and approaching entrustment of 100%. Most residents were rated entrustable in *Telehealth technology* (Domain V, Competency1a) with a score of 95%. Students and residents collected most of the required data to make a diagnosis for *Data collection*, but only 34% of students and 40% of residents were rated by faculty as entrustable. This means even residents still require some degree of supervision or faculty confirmation of the VPE.

One concern raised by students after the workshop was that the techniques being taught did not have a strong evidence base. Little published literature compares the accuracy of the VPE to a face-to-face exam. Therefore, learners are uncomfortable ruling in or out diseases over telemedicine.

Twenty-nine students (58%) and 10 residents (36%) responded to the post-workshop questionnaire. Just over 86% of students and 100% of residents either agreed or strongly agreed that the simulation developed his or her telemedicine skills. Additionally, over

79% of students and 90% of residents agreed or strongly agreed they expected to use the material presented in future practice. Respondents recommended increasing the time allotted for the simulation and developing workshops for other parts of the VPE.

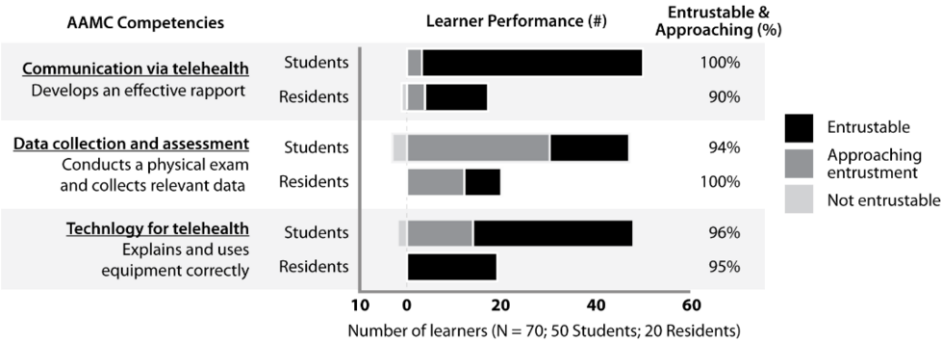

Figure 2. Summary of learner performance measured using three AAMC telemedicine competencies.

4. Discussion

This is one of the first published descriptions of an instructional workshop designed for trainees to learn and practice telemedicine [8, 9] To our knowledge, this is the first simulation focusing on collecting vital signs using the patient's home equipment or conducting a virtual head and neck exam. Therefore, we believe this work addresses an important gap in the literature: how to teach, practice, and evaluate a VPE.

Most learners were entrustable or approaching entrustment in the three competencies measured. The fewest students and residents scored entrustable on the data collection and VPE competency. This underscores the challenge of adapting exam maneuvers to a virtual environment, transferring knowledge from didactic teaching to physical exam performance, and the critical importance of dedicated instruction. We did not see much variation in performance as a function of training level. This may reflect the influence of instruction before simulation, overlap in skills across training levels, and/or an artifact of the small sample size.

Our survey results indicate that trainees value the instructional content and believe the simulation is an effective method for teaching and evaluating telemedicine skills. Anecdotally, many participants said they appreciated the individualized verbal feedback from faculty immediately following the simulation. We believe this is a critical workshop component that should not be overlooked. This study used simulation to evaluate the application of didactic components, provide hands-on practice in a safe setting, and provide immediate feedback to the learners. However, simulation may be used as a teaching methodology in and of itself with various techniques for facilitation (e.g., reflective pause, replay) and debriefing (e.g., feedback from instructors/SPs) [10-12].

This research is a first step toward measuring learner competency in telemedicine and evaluating the effectiveness of teaching interventions. Educators, accreditation bodies, and telehealth providers need standardized metrics to evaluate cross-cutting competencies in telemedicine. Our method offers a potential approach that is theoretically sound, objective, and easy to implement. However, many unknowns exist, and we must conduct more validation work. For example, did we measure the breadth of

tasks required to assess all aspects of a head and neck exam (*i.e.,* content validity)? Are the learners we rate entrustable able to correctly identify pathology or formulate a diagnosis based on a VPE (*i.e.,* construct validity)? Do the skills observed in a simulation translate to the real world (*i.e.,* predictive validity)? This will require testing in a naturalistic setting. Also, this study included a small sample size of learners, which may impact the discriminant validity measuring competencies between training levels. Finally, we do not know if learners participated in other telemedicine activities before the workshop, which limits our ability to evaluate the effectiveness of our didactics.

5. Conclusions

We created a simulation-based workshop to teach students and residents how to collect vital signs and perform the virtual head and neck exam. This workshop can be shared across training sites and used at different stages of medical training. Furthermore, we believe our methodology—including the evaluation approach—is extensible to other telemedicine competencies and other components of the VPE.

References

[1] Alkureishi MA, Lenti G, Choo Z-Y, Castaneda J, Weyer G, Oyler J, et al. Teaching telemedicine: the next frontier for medical educators. JMIR medical education. 2021;7(2):e29099.
[2] AAMC. Telehealth Competencies Across the Learning Continuum. Washington, DC: AAMC; 2021.
[3] Lu AD, Veet CA, Aljundi O, Whitaker E, Smith WB, Smith JE. A systematic review of physical examination components adapted for telemedicine. Telemedicine and e-Health. 2022;28(12):1764-85.
[4] Hilty DM, Maheu MM, Drude KP, Hertlein KM. The need to implement and evaluate telehealth competency frameworks to ensure quality care across behavioral health professions. Academic Psychiatry. 2018;42(6):818-24.
[5] Belakovskiy A, Jones EK. Telehealth and medical education. Primary Care: Clinics in Office Practice. 2022;49(4):575-83.
[6] Savage DJ, Gutierrez O, Montané BE, Singh AD, Yudelevich E, Mahar J, et al. Implementing a telemedicine curriculum for internal medicine residents during a pandemic: the Cleveland Clinic experience. Postgraduate Medical Journal. 2022;98(1161):487-91.
[7] Levett-Jones T, McCoy M, Lapkin S, Noble D, Hoffman K, Dempsey J, et al. The development and psychometric testing of the Satisfaction with Simulation Experience Scale. Nurse education today. 2011;31(7):705-10.
[8] Monkman H, Palmer R, Ijams S, Kollaja L, Rodriguez KA, Liew A, et al. Using Simulations to Train Medical Students for Unanticipated Technology Failures in Telemedicine. Studies in health technology and informatics. 2022;294:775-9.
[9] Lesselroth B, Monkman H, Palmer R, Liew A, Kendrick C, Kollaja L, et al. Teledermatology: Simulating Hybrid Workflows for Telemedicine Education. Studies in Health Technology and Informatics. 2024;310:1176-80.
[10] Clapper TC, Leighton K. Incorporating the reflective pause in simulation: a practical guide. The Journal of Continuing Education in Nursing. 2020;51(1):32-8.
[11] Bokken L, Linssen T, Scherpbier A, Van Der Vleuten C, Rethans JJ. Feedback by simulated patients in undergraduate medical education: a systematic review of the literature. Medical Education. 2009;43(3):202-10.
[12] Reis S, Cohen-Tamir H, Eger-Dreyfuss L, Eisenburg O, Shachak A, Hasson-Gilad D, et al. The Israeli Patient-Doctor-Computer communication study: an educational intervention pilot report and its implications for person-centered medicine. International Journal of Person Centered Medicine. 2011;1(4):776-81.