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Teledermatology: Simulating Hybrid Workflows for Telemedicine Education

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Abstract. Given the importance of telemedicine in improving healthcare access for underserved patients, professional students need experience using virtual clinical workflows. We developed an educational workshop with (1) readings, (2) a knowledge assessment test, (3) dermatology and teledermatology lectures, (5) a telemedicine simulation with a standardized patient, and (6) a debriefing session. The simulation included a "hybrid" workflow with live videoconferencing and store-and-forward image review. We measured student performance using three American Association of Medical Colleges (AAMC) Telemedicine Competencies for medical education. Ninety-eight medical and physician assistant students completed this workshop between 2021 and 2022, and 80% were entrustable or approaching entrustment in each competency. Some students struggled with data collection and technology use. Our results suggest that this workshop offers a practical and generalizable way to teach about multiple virtual workflows and strengthen students' telemedicine competencies.

Keywords. Telemedicine, simulation, education, store and forward, dermatology

1. Introduction

Health professional training programs have struggled to keep pace with the expansion of telemedicine during the COVID-19 pandemic [1]. Although most medical schools in the United States include some telemedicine content, it may only total several lecture hours [2]. Curricula may not cover workflows, patient safety, and – importantly – conducting a physical exam. We, therefore, see a skills gap that must be addressed.

At the University of Oklahoma-Tulsa School of Community Medicine (OUSCM), we include telemedicine instructional modules as part of a year-long health systems science course for medical and physician assistant students [3]. Because an estimated 10% of primary care visits are for a dermatologic condition, we included a workshop with a teledermatology simulation for students to practice the virtual skin exam and use workflows that combine videoconferencing with store-and-forward imaging [4,5].

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We had three objectives when developing this simulation. First, we needed to teach students a virtual skin exam. Second, we had to demonstrate a "hybrid" workflow common in teledermatology that combines live videoconferencing with store-and-forward imaging [6]. Third, we needed to evaluate student performance according to telemedicine competencies and measure the effectiveness of our approach [7].

Few published telemedicine simulations integrate store-and-forward capabilities [8]. We, therefore, created a novel workshop in 2021 that introduced the clinical material, cross-walked it with a telemedicine application, and provided the opportunity for students to practice skills and receive feedback. We describe in this manuscript our instructional case of a hypothetical patient presenting with tinea versicolor (i.e., a fungal skin infection). Our objectives are to (1) describe each section of the workshop, (2) explain how we simulated a hybrid workflow, and (3) report our results from an assessment of teaching and learning. This manuscript should interest medical educators teaching telemedicine, simulationists, and implementation scientists.

2. Methods

This workshop, with a simulated patient encounter, is part of a year-long health systems science course that includes informatics and telemedicine topics. The course is for third-year medical and second-year physician assistant (PA) students with at least six months of experience seeing patients in a primary care clinic.

We based our workshop on two pedagogical frameworks. We used Knowles' Adult Learning Theory to guide our selection of teaching methods to meet the needs of adult learners [9]. Knowles' theory says learning should be relevant to work roles, problem-focused, experiential, and open to active reflection. Our workshop created a way to connect telemedicine topics to a typical patient care scenario in primary care and give learners opportunities for experimentation, feedback, and shared reflection.

We mapped learning objectives, simulation tasks, and assessments to three of the 20 telemedicine competencies published by the Association of American Medical Colleges (AAMC) [7]. While not the only telemedicine competencies for health professionals, they include clear descriptions of each competency, example behaviors, and performance thresholds to measure student progress. We adapted three competencies relevant to the workshop that focused on communication best practices, data collection during a physical exam, and effective technology use (Table 1).

Table 1. A subset of telemedicine competencies published by the Association of American Medical Colleges (AAMC) [7]. These were the competencies we used to measure student performance.

Domain	AAMC Competency and Workshop Learning Objectives
III: Communication via Telehealth	1a. Develops an effective rapport with patients via real or simulated video visits, attending to eye contact, tone, body language, and non-verbal cues.
IV: Data Collection and Assessment via Telehealth	3a. Conducts appropriate physical examination or collects relevant data on clinical status during a real or simulated telehealth encounter, including guiding the patient and/or telepresenter (i.e., clinical assistant).
V: Technology for Telehealth	3a. Explains equipment required for conducting telehealth care at originating and distance sites.

We hosted our workshop at our simulation center, which includes ten exam rooms, each with Wi-Fi and telemedicine workstations. The workshop included (1) readings, (2) a knowledge assessment test with faculty feedback, (3) a 90-minute primary care dermatology lecture, (4) a 30-minute teledermatology lecture, (5) a 15-minute teledermatology simulation, and (6) a 30-minute, faculty-led group debriefing session. Before the workshop, we gave students readings covering dermatologic conditions and teledermatology [5]. The workshop began with a multiple-choice knowledge assessment of the readings, followed by a faculty-led group discussion. During the dermatology lecture, a faculty dermatologist (CK) used case presentations to review conditions common in primary care, including fungal infections like our case of tinea versicolor. A faculty clinician-informatician (BL) then reviewed topics in teledermatology, including technical standards, conditions appropriate for virtual care, virtual skin exams, workflows, and avoiding diagnostic pitfalls [10].

To provide students with experience using live videoconferencing and store-and-forward image review in a single encounter, we created a simulation adapted from Palmer et al. [11]. We furnished students with a clinical history describing a patient with a rash (i.e., a non-acute fungal infection called tinea versicolor). In the scenario, the patient had uploaded digital photos of the rash to the clinic. We placed on the computer desktop two digital images of skin findings (Figure 1). During the encounter with a standardized patient (SP), we expected students to (1) read the written history, (2) review the photographs, (3) complete a patient interview using videoconferencing, (4) formulate a diagnostic hypothesis, and (5) propose a management plan. After the simulation, faculty and students convened to debrief. We discussed impressions of the experience, challenges encountered, and insights. We concluded by reflecting on the role of teledermatology in primary care.

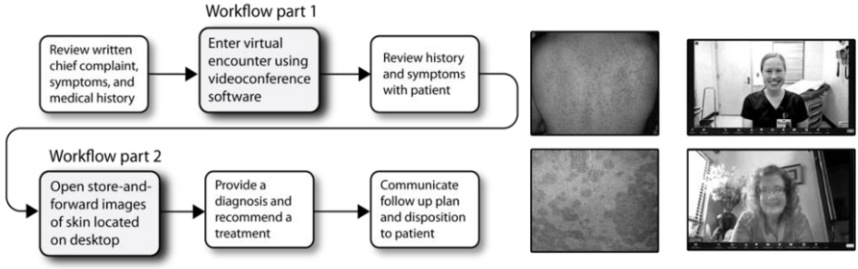

Figure 1. Schematic of the workflow, sample images of the dermatological issue available for students, and the student and simulated patient interaction during the simulation.

We measured teaching effectiveness in three different ways: (1) student competency development; (2) student attitudes about telemedicine; and (3) satisfaction with the educational module. To measure competency, we asked SPs to complete a standardized three-item rubric after each simulation. The rubric operationalized AAMC competencies using behaviors specific to the case. The SPs rated students on each competency using a 3-point scale (i.e., "not entrustable," "approaching entrustment," and "entrustable"). Entrustability is a pedagogical concept in medical education where faculty estimate competency by observing a student complete several related tasks illustrating knowledge and skill acquisition [12]. To be entrustable, the student should be trusted to perform all tasks correctly and unsupervised. We collected qualitative feedback from students exploring attitudes about telemedicine during the debriefing. Finally, to measure

satisfaction with the workshop, we adapted a questionnaire by Levett-Jones et al. and distributed it after the session [13]. Each question used a 5-point Likert scale from "strongly disagree" to "strongly agree."

3. Results

Ninety-eight students completed the workshop. For each competency, the SPs rated approximately 80% of students as entrustable or approaching entrustment (Figure 2). Some students struggled with technology or data collection. For example, some did not move the videoconferencing screen to find images on the desktop. Although it was not critical to make the correct diagnosis, most correctly diagnosed the patient or offered a provisional diagnosis and proposed an appropriate treatment and follow-up plan.

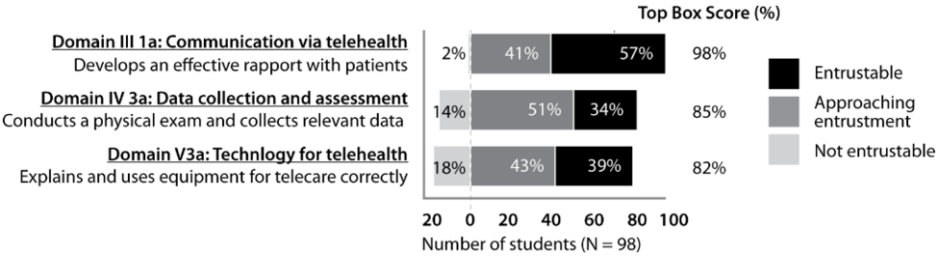

Figure 2. Summary student competency scores from the teledermatology simulation [11].

During the faculty debriefing, most students stated they preferred live encounters over virtual ones – particularly in settings of diagnostic uncertainty. Nonetheless, they agreed that this approach could provide a person-centered approach to care delivery. We received 46 responses (47% response rate) to our post-session survey (Figure 3).

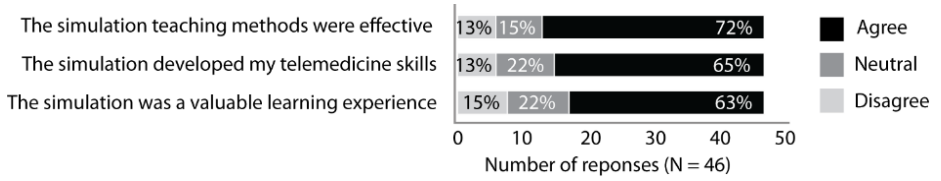

Figure 3. Excerpt from our post-session learner satisfaction survey.

4. Discussion

To our knowledge, this is the first published description of a teledermatology instructional module that combines live videoconferencing and store-and-forward technology in a hybrid workflow. Nearly all students arrived at the correct diagnosis or proposed a reasonable hypothesis and management plan. Our observations and competency scores suggest that students could perform tasks successfully by the end of the workshop. Most (98%) were approaching entrustment in their communication skills (i.e., webside manner), and most were approaching entrustment using technology (82%)

and gathering an accurate history and physical (85%). For students in their first semester of clinical rotations, these scores appeared on track for the level of training.

This work has several limitations and ways we could improve the module. First, we asked the SPs to complete the competency assessment rubric while faculty observed sessions remotely over closed-circuit cameras. In a future phase, faculty must double-code each encounter so we can compare scores to a reference standard. Second, we could increase the realism of the simulation if SPs used stage makeup to simulate skin findings. Finally, we must follow students from the classroom to the clinic to determine if instruction translates to real-world practice improvement and competence.

5. Conclusions

Pairing didactics with a simulation offered an effective and scalable approach for teaching students how to complete a visit and use technology to perform a virtual skin exam. We believe this is an ideal way to prepare students and evaluate competence before moving to a real patient care setting. Other programs, using inexpensive equipment, could easily replicate this model to teach students, residents, or faculty.

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