Assessing the Impact of a Telemedicine Simulation on Clinical Learners

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Abstract

Introduction: Telemedicine is a rapidly growing clinical practice model. Despite telemedicine's growth, relatively few U.S. medical schools or residency programs incorporate telemedicine education into their curricula. The Telemedicne Objective Structured Clinical Exam (TeleOSCE) utilizes standardized patients in a simulated video visit scenario in order to address this training gap.

Materials and methods: The authors measured the impact of the TeleOSCE on third-year medical students' attitudes towards, knowledge of and confidence in telemedicine from academic year 2014-2015 (third rotation) through the end of 2015-2016. During their required Family Medicine clerkship 140 students completed the TeleOSCE (active group), while 32 did not participate (control group). All participants (n=172) completed a survey both at the clerkship beginning and end. Pre and post survey responses from both active and control groups were compared.

Results: The active group showed statistically significant improvements in the “knowledge of” and “confidence in” practicing telemedicine survey items as compared to the inactive group. There was no significant difference in the “attitudes towards” telemedicine survey items.

Discussion and conclusions: The TeleOSCE helps fill a current clinical education gap and is an effective tool in improving clinical learners' knowledge of and confidence in telemedicine. In addition to medical students, other institutions, professions and a graduate medical education programs have successfully incorporated the TeleOSCE into resident training program. The adaptability and efficacy of the TeleOSCE can help train clinical learners of different levels and professions for the future practice of telemedicine.

ABBREVIATIONS

AY: Academic Year; FM: Family Medicine Department at OHSU; OHSU: Oregon Health & Science University; SP: Standardized Patient; TeleOSCE: Telemedicine Objective Structured Clinical Exam; UC: University of California

INTRODUCTION

Telemedicine is a rapidly growing medical practice model. It includes a variety of applications and services, including two-way video, email, and telecommunication technology. Approximately 90% of healthcare executives report their organizations are developing or have implemented a telemedicine program [1]. Additionally, physician reimbursement for telemedicine services has been shown to be economically viable [2,3], with many current and pending federal and state legislation efforts aimed at reducing regulatory barriers to telemedicine reimbursement [4]. This progress indicates that telemedicine will increasingly be integrated to augment patient care. Despite telemedicine’s growth, relatively few United States medical schools or residency programs incorporate telemedicine education into clinical curricula [5]. This gap led the American Medical Association to call for increased telemedicine medical education [6].

Simulation is a growing educational method and a recent meta-analysis showed it as an effective method of teaching critical care [7]. Simulation of complex health regimens has been shown to have impact on a learner's future care [8]. In addition, simulated clinic visits also improve students’ performance compared to traditional learning in live clinic sessions [9].

The Telemedicine Objective Structured Clinical Exam (TeleOSCE) is a required, formative assessment developed to allow learners to practice telemedicine in a simulated environment. The TeleOSCE is one of a series of clinical simulations students participate in during their required Family...
Medicine Clerkship at Oregon Health & Science University (OHSU). The authors administered a pre-post survey design to measure what impact participation in the TeleOSCE had on students’ knowledge of, confidence in, and attitude towards, telemedicine. We hypothesized that learner’s who participated in the TeleOSCE would show significantly improved levels in these measures as compared to those without this experience. Positive results would support the TeleOSCE as an effective educational tool for addressing the telemedicine training gap in clinical education.

MATERIALS AND METHODS

Setting

The TeleOSCE is one of four OSCE case scenarios that each OHSU Family Medicine clerkship student completes at the end of the second week of the clerkship in a serial fashion. The OSCE is held in the second week to provide students formative feedback. Three cases simulate typical in-person ambulatory visits and the fourth is a telemedicine visit. Each case has one Standardized Patient (SP)-Faculty dyad assigned and lasts for 11 minutes. Faculty observers mark a standardized check list while the scenario. Immediately following the scenario, the SP and faculty provide verbal feedback for five minutes. Faculty also provides subsequent written feedback.

TeleOSCE Setup

The TeleOSCE utilizes Internet-based video conferencing software to simulate a clinical telemedicine environment. Using actual telemedicine software for this simulation would have increased cost and training needs while reducing scheduling flexibility, without adding significant educational value. The TeleOSCE was not designed to train students to use a specific telemedicine technology but rather to allow practice caring for patients via a video interface. Using any video conferencing system is feasible [10]; Adobe Connect™ web conferencing software (Adobe Systems, Inc., San Jose, CA) was selected because faculty was familiar with its use.

The TeleOSCE can be administered for “on-campus” learners at OHSU’s simulation center or it completely online for “online-only” students at rural clinics. The TeleOSCE created a mechanism to evaluate and provide clinical reasoning feedback for remote students. Due to hours of travel and potential missed clinic time, remote students could not participate in the OSCE; the online-only format now allows them to participate.

TeleOSCE cases

Four TeleOSCE cases were developed and are administered individually or in serial fashion. Three cases depict rural patients with the respective issues of diabetic foot ulcer, depression, and knee pain, and a fourth involves an urban-underserved patient with sinus pain utilizing a mobile phone for her telemedicine visit. A technology “stumbling block,” intended to disrupt the flow of the visit, is included in each scenario. All cases assess shared competencies:

- Clinical knowledge: assessing case specific clinical knowledge.
- Cultural/socioeconomic competency: assessing the ability to incorporate rural and underserved patient culture, socioeconomic, and resource limitations into care.
- Patient-centered use of technology: assessing the ability to remain patient focused despite technological “stumbling block” distractions.

TeleOSCE evaluation

After the TeleOSCE was shown to be financially feasible and educationally acceptable [10], the next aim was to evaluate if it results in improved learner understanding of telemedicine. University of California (UC), Davis, an innovator in telemedicine education [5], previously created a survey measuring learners’ attitudes towards knowledge of, and confidence in telemedicine. UC and OHSU faculty collaborated to adapt this survey to study the TeleOSCE. The resultant TeleOSCE survey (Appendix A) is a series of 17 statements using three Likert scales ranging from 1-5. The three Likert scales include items to be rated by Agreement level, Likely-to-Use level, and Confidence level. The higher the rating, the higher the agreement, likelihood of use, and confidence level.

Table 1 groups survey questions into knowledge, attitude and confidence categories.

Implementation methods

Starting academic years (AY) 2014-2015, rotation three, through the completion of AY2015-2016 students completed a pre- and post-survey at the start and end of their required Family Medicine clerkship. Prior to the sixth rotation of the 2015-2016 AY not all students participated in all OSCE cases due to course logistics. The students who did not participate were grouped into the inactive group (n=32). Demographic data was not collected.

After receiving consistently positive feedback from participants, logistics were altered to allow all students to participate in all OSCEs. The faculty felt that the educational benefit of providing the TeleOSCE Experience to all learners outweighed the negative impact to the power of the study. Students who participated in the TeleOSCE were grouped into the active group (n=140). During the final day of the clerkship, all students in both the active and the inactive group were administered the identical TeleOSCE survey. Study participants signed consent forms during their clerkship orientation. This study was approved by the Institutional Review Board at Oregon Health & Science University.

Analysis

We compared the TeleOSCE results examining mean differences of pre/post survey items by group (active participant group vs. inactive participant group). To analyze the data, we used a Wilcoxon Mann Whitney test, and performed analyses with SAS® 9.4 software (SAS Institute Inc., Cary, NC).

RESULTS

Of the 209 students who took the pre-exam survey, 37 (17.7%) did not complete a post-exam survey, leaving 172 (82.3%) participants with analyzable results. Differences between the pre-exam and post-exam surveys were compared to evaluate what changes occurred between active and inactive groups (Table 1).

We observed a statistically significant difference between the two groups on all items in the knowledge and confidence domains. On average, the active group rated knowledge items more than 1.0 point higher pre vs. post survey, whereas the inactive group showed less than 0.20 points higher. The active group rated the
confidence items 0.44 to 1.20 points higher after participating in the TeleOSCE, whereas the inactive group showed only at most 0.09 points higher, with the majority of items showing a decrease. There were negligible differences pre- to post for attitude items in both the active and inactive participant groups. Figure 1 illustrates the differences between the active and inactive groups.

DISCUSSION

We found that students who participated in the TeleOSCE demonstrated statistically significant improvements in their knowledge of and confidence in telemedicine versus students who did not participate. These findings suggest that the TeleOSCE can be a useful educational activity to improve skills for delivering telemedicine effectively in future practice. Interestingly, we did not find a statistically significant change in student attitudes towards telemedicine between control and intervention groups. This may be due to the attitude questions on the survey focusing on the broader application of telemedicine as a future practice model. Currently, there is no formal curriculum addressing telemedicine in the Family Medicine clerkship; the TeleOSCE itself serves as an assessment for learning activity. Students therefore may have a more difficult time understanding how telemedicine may apply to their future practice, thus explaining the statistically insignificant attitude question findings.

LIMITATIONS

Findings are specific to one institution, thus calling into question the generalizability of the findings. Additionally, the survey was subjected to an expert consensus process but was not validated. Statistical analysis of the survey is needed to ensure the validity of the tool before broader conclusions can be made. Finally, the decision to administer the TeleOSCE to all students midway through the study reduced the number of inactive participants and weakened the study’s power.

CONCLUSIONS

Our findings indicate that participation in the TeleOSCE has a significant impact on students' knowledge of and confidence in telemedicine. As the adoption of telemedicine is increasing, clinical training programs are compelled to educate learners on this new practice model. The TeleOSCE can be modified to fit different geographic regions, levels of learners, and professions. Since the start of this study, two US medical schools and a Physician Assistant program have successfully implemented the TeleOSCE. Additionally, it was adapted for graduate medical education at the Kaiser Permanente Napa-Solano Family Medicine Residency. The TeleOSCE can address the telemedicine training gap by preparing varied clinical learners for the patient-centered practice of telemedicine.

ACKNOWLEDGMENTS

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Funding Acknowledgement

This study was partially funded through the generous support
Table 1: Comparing Mean Differences by Item by OSCE Participation Group.

<table>
<thead>
<tr>
<th>Item Type</th>
<th>Item</th>
<th>Did not participate in TeleOSCE (n=32)</th>
<th>Participated in TeleOSCE (n=140)</th>
<th>Did Not Participate in TeleOSCE Mean Difference (SD)</th>
<th>Participated in TeleOSCE Mean Difference (SD)</th>
<th>z score</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>I have a good understanding of appropriate uses for telemedicine</td>
<td>2.76 (0.97)</td>
<td>2.60 (0.86)</td>
<td>3.55 (0.72)</td>
<td>-0.03 (0.86)</td>
<td>0.97 (0.88)</td>
<td>-5.311  &lt;.0001</td>
</tr>
<tr>
<td></td>
<td>I am familiar with the types of examination tools used in</td>
<td>2.09 (1.03)</td>
<td>1.89 (0.62)</td>
<td>3.02 (0.88)</td>
<td>0.06 (1.09)</td>
<td>1.11 (0.97)</td>
<td>-4.8786 &lt;.0001</td>
</tr>
<tr>
<td></td>
<td>I have a good general understanding of the field of telemedicine</td>
<td>2.55 (0.94)</td>
<td>2.41 (0.81)</td>
<td>3.49 (0.74)</td>
<td>0.19 (0.97)</td>
<td>1.08 (0.95)</td>
<td>-4.2551 &lt;.0001</td>
</tr>
<tr>
<td></td>
<td>I have a good understanding of how telemedicine is practiced.</td>
<td>2.24 (0.71)</td>
<td>2.41 (1.07)</td>
<td>3.35 (0.81)</td>
<td>0.16 (1.02)</td>
<td>1.07 (0.98)</td>
<td>-4.253  &lt;.0001</td>
</tr>
<tr>
<td>Confidence</td>
<td>Adjust a telemedicine camera to maximize my positioning and visibility</td>
<td>2.82 (1.04)</td>
<td>3.05 (1.01)</td>
<td>4.22 (0.75)</td>
<td>0.06 (1.09)</td>
<td>1.20 (1.08)</td>
<td>-4.5877 &lt;.0001</td>
</tr>
<tr>
<td></td>
<td>I feel that I would be able to communicate effectively with a patient via telemedicine</td>
<td>3.38 (0.75)</td>
<td>3.27 (0.82)</td>
<td>3.92 (0.69)</td>
<td>-0.32 (1.08)</td>
<td>0.63 (0.87)</td>
<td>-4.4244 &lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Troubleshoot poor performance with videoconferencing during your patient encounter</td>
<td>2.64 (1.17)</td>
<td>2.51 (1.07)</td>
<td>3.38 (0.98)</td>
<td>-0.19 (1.05)</td>
<td>0.83 (1.13)</td>
<td>-4.3489 &lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Take a patient history via telemedicine</td>
<td>3.55 (0.83)</td>
<td>3.59 (0.71)</td>
<td>4.34 (0.59)</td>
<td>-0.13 (1.15)</td>
<td>0.77 (0.83)</td>
<td>-4.0864 &lt;.0001</td>
</tr>
<tr>
<td></td>
<td>At the start of the visit, explain to the patient what the visit will entail and what to expect</td>
<td>3.67 (0.85)</td>
<td>3.53 (0.89)</td>
<td>4.03 (0.66)</td>
<td>-0.48 (1.26)</td>
<td>0.44 (1.05)</td>
<td>-3.6648 0.0002</td>
</tr>
<tr>
<td></td>
<td>Provide counseling to the patient for treatment and follow up via telemedicine</td>
<td>3.36 (0.78)</td>
<td>3.35 (0.77)</td>
<td>4.12 (0.61)</td>
<td>-0.03 (1.17)</td>
<td>0.78 (0.87)</td>
<td>-3.5851 0.0003</td>
</tr>
<tr>
<td></td>
<td>I feel equally prepared to present a patient to another provider via telemedicine and in person</td>
<td>3.06 (0.97)</td>
<td>2.98 (0.85)</td>
<td>3.71 (0.85)</td>
<td>0.03 (1.12)</td>
<td>0.76 (1.07)</td>
<td>-3.5446 0.0004</td>
</tr>
<tr>
<td></td>
<td>I would be able to establish rapport with a patient via telemedicine</td>
<td>3.31 (0.86)</td>
<td>3.23 (0.74)</td>
<td>3.86 (0.77)</td>
<td>-0.07 (1.23)</td>
<td>0.60 (0.82)</td>
<td>-3.1866 0.0014</td>
</tr>
<tr>
<td></td>
<td>I feel comfortable speaking in front of a camera</td>
<td>3.21 (1.14)</td>
<td>3.37 (0.84)</td>
<td>4.04 (0.78)</td>
<td>0.09 (1.06)</td>
<td>0.67 (0.85)</td>
<td>-2.84  0.0045</td>
</tr>
<tr>
<td>Attitude</td>
<td>I think telemedicine will help decrease health care disparities for underserved patients in rural areas</td>
<td>3.76 (0.66)</td>
<td>3.83 (0.76)</td>
<td>4.03 (0.69)</td>
<td>-0.22 (1.13)</td>
<td>0.21 (0.72)</td>
<td>-1.792  0.0731</td>
</tr>
<tr>
<td></td>
<td>I think telemedicine is a good alternative to face-to-face health care</td>
<td>2.97 (0.92)</td>
<td>2.97 (0.94)</td>
<td>3.31 (1.01)</td>
<td>0.00 (1.44)</td>
<td>0.35 (1.02)</td>
<td>-1.394  0.1633</td>
</tr>
<tr>
<td></td>
<td>I think telemedicine will help decrease health care disparities for underserved patients in urban areas</td>
<td>3.24 (0.87)</td>
<td>3.47 (0.86)</td>
<td>3.64 (0.88)</td>
<td>-0.16 (1.19)</td>
<td>0.16 (0.89)</td>
<td>-1.1638 0.2445</td>
</tr>
<tr>
<td></td>
<td>How likely are you to use telemedicine in your future practice?</td>
<td>3.17 (0.87)</td>
<td>3.23 (0.87)</td>
<td>3.33 (0.90)</td>
<td>0.00 (0.83)</td>
<td>0.15 (0.9)</td>
<td>-0.8624 0.3885</td>
</tr>
</tbody>
</table>

of the National Cancer Institute (1R25CA158571-01A1), the American Board of Internal Medicine Foundation and the OHSU School of Medicine.

ETHICAL APPROVAL

The study was approved by Oregon Health & Science University’s Institutional Review Board.

PREVIOUS PRESENTATIONS

The results of this manuscript were first presented at the 43rd Annual Society of Teachers of Family Medicine Medical Student Education Conference, Anaheim, California, and February 11, 2017.

REFERENCES


### Appendix A: The adapted TeleOSCE survey.

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Agree (5)</th>
<th>Agree (4)</th>
<th>Neutral (3)</th>
<th>Disagree (2)</th>
<th>Strongly Disagree (1)</th>
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</tr>
</tbody>
</table>

- **How likely are you to use telemedicine in your future practice?**
- **How confident are you to...**
  - At the start of the visit, explain to the patient what the visit will entail and what to expect
  - Take a patient history via telemedicine
  - Adjust a telemedicine camera to maximize my positioning and visibility
  - Provide counseling to the patient for treatment and follow up via telemedicine
  - Troubleshoot poor performance with videoconferencing during your patient encounter

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