

Impact of Simulation Manikins to Train Pharmacy Students in Nasal, Throat, and Oral Fluid Swab Collection

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Abstract

Introduction: A point-of-care testing (POCT) certificate was implemented in a required pharmacy skills-based course. The purpose of this study was to evaluate the impact of manikins on student confidence in performing POCT swabs for infectious diseases. **Innovation:** Manikins were used to train second-year pharmacy students on nasal swabs, throat swabs, and oral fluid swabs. Student skills were assessed on manikins first, then on a peer. Proficiency was defined as a score of 90% or higher. Students completed a pre- and post-training survey regarding their confidence performing swabs. Student confidence was based on Likert style responses (i.e., 'Strongly Disagree' [score: 1], to 'Strongly Agree' [score: 5]) performing the swabs. Median change in confidence was calculated using quantile regression. **Findings:** All students (n=63) demonstrated proficiency in performing swabs. Median confidence for nasal, throat, and oral fluid swabs changed by 2.0 (95% CI: 1.5, 2.5), 2.0 (95% CI: 1.5, 2.5), and 2.0 (95%CI: 1.3, 2.7), respectively. The majority of students reported time spent practicing was adequate for the nasal (n=51, 81%), throat (n=51, 81%), and oral fluid swab (n=59, 94%). All participating students reported manikins to be moderately (n=17, 27%) or extremely (n=46, 73%) valuable, and all students rated their overall experience with manikins as positive (n=63, 100%). Student comments revealed manikins helped to visualize anatomy, practice skills without peer discomfort, and minimize risk during the COVID-19 pandemic. **Conclusion:** This study demonstrated that inclusion of practice on manikins increased student confidence in performing POCT for infectious diseases. In addition, the majority of students indicated that the use of manikins was valuable to their learning and reported feeling prepared to perform POCT in practice after using the manikins.

Keywords: manikins; point of care testing; infectious diseases; throat swab; nasal swab; oral fluid swab

Introduction

Point-of-care testing (POCT) is laboratory testing performed close to the site of patient care¹ and is a public health service that pharmacies are increasingly offering.^{1,2} Pharmacists have long offered POCT in areas such as cholesterol and blood glucose; however, the pharmacist's role is also expanding to include infectious disease tests, such as influenza, Group A Streptococcus (GAS), human immunodeficiency virus (HIV), and more recently severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

POCT training aligns with the 2016 Accreditation Council for Pharmacy Education (ACPE) Standards.³ Despite ACPE Standards and the expanding role of pharmacists in this area, only one-third (n=38) of 114 colleges of pharmacy surveyed in 2015 included dedicated POCT training for infectious diseases in their curriculum.⁴ In addition, only 15 colleges reported having a "practical" component to teach POCT related skills. The majority (84.2%) of survey respondents reported a deficiency of content in this area and stated it should be included in their curriculum.

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The temporary removal of barriers for pharmacy-based POCT during the COVID-19 pandemic has increased the number of pharmacy-based labs in the United States.^{5,6} As the demand for such services continues, long-term regulatory changes are being advocated for at the state and national level, specifically regarding test-and-treat legislation.⁷⁻⁹

In Fall 2018, POCT content on infectious diseases was integrated into the curriculum at our institution first as a pilot, then as a formal certificate in 2019. While student proficiency was strong even from the first year POCT was integrated, student feedback indicated that students lacked confidence to perform these skills, even after practicing on their peers and demonstrating proficiency. Several students indicated that practicing on a manikin prior to practicing swabs on a peer would be helpful to their learning.

Enhanced student confidence has been linked to a greater likelihood of students being able to perform a specific skill in practice, as well as a greater willingness to attempt new tasks.^{10,11} Patient simulation has been described in the literature as an effective strategy to enhance student confidence and an effective method for teaching blood pressure measurements and physical assessments in pharmacy education.¹¹⁻¹⁵ Manikins and task trainers provide an opportunity for students to visualize the anatomy of the body

while allowing students to cultivate their skills without peer discomfort or concern for error. Literature has demonstrated that the use of three-dimensional (3D) printed models or manikins to train healthcare workers on nasopharyngeal tests was useful and improved both confidence and comfort in performing the tests.¹⁶⁻¹⁸

Limited studies have highlighted educational models for teaching specimen collection for infectious diseases in pharmacy education.^{2,4,19} McKeirnan and colleagues describe implementation of POCT content for second year pharmacy students as part of a weeklong 2-credit hour required course.¹⁹ Students viewed video demonstrations, instructor demonstrations, and then practiced on their peers, however the use of manikins was not employed. To our knowledge, there is no published literature in pharmacy education discussing the role of manikins in teaching POCT, specifically in conducting swabs for infectious diseases.

Description of the Innovation

The primary objective of this study was to evaluate the impact of utilizing manikins on student comfort and confidence in performing POCT for infectious diseases. This study was innovative in that manikins were used for the specimen collection portion of the course with a goal of allowing students to visualize the anatomy as well as practice POCT skills in a low pressure setting and minimize potential physical discomfort from practicing on their peers.

This study was determined to be exempt from full Institutional Review Board (IRB) review. Second-year pharmacy students enrolled in a skills-based lab course at a Midwestern university in the United States in Fall 2020 were invited to participate in the study. The 2-hour skills-based course is one of a six semester series of courses, consisting of one hour of lecture and two hours of lab per week. Students had the opportunity to earn the National Association of Chain Drug Stores (NACDS) Community Pharmacy Based Point-of-Care Certificate²⁰ [now offered by the National Alliance of State Pharmacy Associations]²¹ as a required component of the course. As part of the certificate, students individually completed online modules (16 hours), of which one module (1 hour) was specifically devoted to specimen collection including video demonstrations of the tests. The learning objectives for this module included describing the basic process and technique of specimen collection and identifying a patient specimen that would be appropriate for a Clinical Laboratory Improvement Amendments (CLIA)-waived POCT. Students then completed a total of 4 hours of live, remote didactic instruction, consisting of two previously covered topics (blood glucose and cholesterol screenings), and two new topics (physical assessment and specimen collection for infectious diseases). Students were trained and assessed on the skills during 8-hours of in-person labs (i.e., blood glucose, cholesterol, physical assessment, and specimen collection for infectious diseases including throat,

mid-turbinate nasal, and oral fluid swabs). Manikins were used for the nasal, throat, and oral fluid swabs. Students were assessed by trained pharmacy faculty and fourth-year pharmacy students (all of which who had previously completed the NACDS POCT certificate), and student performance was measured using the NACDS certificate proficiency assessment form.²⁰ Sections included a checklist of steps for vitals, physical assessment, whole blood, nasal swab, throat swab, and oral fluid swab. Variables assessed for the swabs included telling the patient what to expect, putting on gloves, preparing the patient for the swab being performed (positioning and supporting the patient's head), collecting the specimen, appropriately disposing of the specimen, and sanitizing hands after completing the test. During assessments each student performed the swabs 2-6 times, depending on the specific skill. Students first performed the swabs on a manikin 5 times for the nasal swab, 5 times for the throat swab, and 1 time for the oral fluid swab, followed by 1 time on a peer for each skill. Proficiency was defined as a score of 90% or higher and multiple attempts were allowed.

Manikins utilized for student training can be seen in Figure 1. High fidelity manikins (Laerdal, New York; Model C) with anatomically correct nasal passages were already being utilized at the college. Internal grant funding was obtained to purchase two additional types of manikins (Nasco, New York), including a model of the nasal passageway (advertised as a nasogastric tube feeding model; Model B) and a manikin for the throat and oral fluid swabs (advertised as a tool in dentistry for training on oral anesthesia administration; Model A). The approximate cost at the time for the two additional manikins purchased was around \$2000.

Students completed an electronic survey (Qualtrics, Provo, UT) both before and after completion of the specimen collection skills lab as part of usual course activities and consented to having their survey data included in the analysis. Surveys completed prior to the use of manikins collected information on comfort with simulation manikins, perception of clinical application, and confidence performing POCT. At the conclusion of the POCT skills labs, students completed a post-survey to assess changes in comfort with simulation manikins and perceptions of the clinical application. Most survey questions were formatted as 5-point Likert-style responses (i.e., 'Strongly Disagree' [score: 1] to 'Strongly Agree' [score: 5]). The primary study endpoint was to evaluate the impact of manikins on student comfort and confidence performing POCT for infectious diseases.

Data was analyzed using SAS 9.4 TS1M7 (Cary, NC). Descriptive statistics were calculated with categorical data presented as counts with percentage and continuous data presented as measures of central tendency with dispersion. Differences in student responses across the two paired surveys based on the Likert-style response were examined using quantile regression

with estimates presented as medians with 95% confidence intervals (CI).

Critical Analysis

A total of 63 (93%) out of the 68 enrolled second-year pharmacy students were included in the study. Those excluded consisted of three students who declined to participate, one student who did not complete the post-survey, and one student who withdrew from the course.

Confidence increased significantly on the nasal swab, throat swab, and oral fluid swab as presented in Table 1. Confidence scores increased by a median 2.0 (95% CI: 1.5, 2.5), 2.0 (95% CI: 1.5, 2.5), and 2.0 (95% CI: 1.2, 2.8) for nasal, throat, and oral fluid swabs on the post-survey, respectively.

All students demonstrated proficiency (score $\geq 90\%$) in performing swabs. A majority of students reported that time spent practicing skills was adequate for the nasal swab (n=51, 81%), throat swab (n=51, 81%), and oral fluid swab (n=59, 94%). All students reported the manikins were 'Moderately' (n=17, 27%) or 'Extremely' (n=46, 73%) valuable to training students on POCT, particularly in regard to the nasal swabs in which 75% of students rated the manikins as extremely valuable vs 35% with the throat swab. In addition, all students rated their overall experience with manikins as positive (n=63, 100%). The majority (n=60, 95%) of students would recommend implementing POCT services in a community pharmacy and all students reported feeling moderately (n=36, 57%) or extremely (n=27, 43%) prepared to perform POCT in practice after using the simulation manikins.

Open-ended comments were provided by 21 (33%) students on the post-survey regarding what made their overall experience with manikins positive or negative. There were no negative listed comments related to simulation manikins. Of the 21 students who provided open ended comments, students noted that the manikins helped them to visualize anatomy and practice technique (n=9, 43%), allowed them to practice without peer discomfort (n=8, 38%), enhanced their confidence (n=3, 14%), and decreased SARS-CoV-2 exposure risk due to reduced peer contact (n=5, 24%). Faculty assessing student performance noted that the manikins allowed students a real-life experience to learn, explore, and practice their skills at an individual pace and feel secure in their skills. Faculty also observed enhanced student confidence in performing the tests on peers after completing the practice on manikins compared to previous years when students only practiced on peers. Finally, faculty graders noted decreased anxiety and increased comfort both on the part of the student swabbing and on the part of the student being tested.

This study demonstrated that inclusion of practice on manikins increased student pharmacist confidence in performing POCT for infectious diseases. To our knowledge, this is the first study

published in pharmacy literature using manikins to teach POCT for infectious diseases. Patient simulation has been documented as an effective method for teaching other pharmacy skills.¹⁰⁻¹² Similar to these studies, our study revealed student comments stating that the manikins helped students to visualize anatomy and practice without peer discomfort. Although not a predetermined objective of the study, students also commented that the use of manikins increased the ability to practice POCT skills in a safe manner during the COVID-19 pandemic. Additional COVID-19 measures were implemented, including dividing labs into smaller sections, spacing out stations, requiring masks and face shields to be worn at all times except for when a student was having nasal and oral fluid swabs performed on them, and extensive cleaning protocols.

McKeirnan and colleagues describe implementation of POCT for infectious diseases for second year pharmacy students as part of a weeklong 2-credit hour required course.¹⁹ In the study, 161 students completed a total of 3.5 hours of content on POCT, including didactic lectures and a skills assessment. Students viewed video demonstrations, instructor demonstrations, and then practiced on their peers. However, unlike the present study, the use of manikins for practice was not included. Student comfort, confidence, and interest in performing POCT was evaluated via survey before and after the training. Students indicated a significant change in comfort and willingness to perform POCT for influenza, GAS, and HIV, similar to our own study. McKeirnan et al study faculty noted that additional time for demonstration and practice may be beneficial. This is in contrast to the present study in which students overall reported that they had adequate time to practice each of the skills, despite a similar time devoted to teaching the content. This may be due in part to the fact that students in our study practiced the throat and nasal swabs on the manikin prior to swabbing a peer, or it could be due to the fact that students practiced throat and nasal swabs a total of 6 times each (5 times on a manikin and 1 time on a peer) versus only 2-3 times in the study by McKeirnan, et al.

Koch, et al assessed the use of a 3D simulator to train 589 participants to conduct nasopharyngeal swabs in 11 centers in France.¹⁶ In contrast to the present study, this study did not include pharmacy students. Instead, participants included a wide array of professionals, including physicians, midwives, nurses, paramedics, medical assistants, psychologists, physical therapists, firemen, laboratory technicians, medical students and students from all these different disciplines, as well as volunteers from the general public. Training consisted of a verbal explanation of the test, video demonstration, and practice on the simulator as many times as deemed necessary by the participant. Similar to the present study, participants in this study rated the 3D simulator as realistic, easy to use, useful to understand the anatomy, and useful to their technique. Participants also felt that their future technique would be more reliable, less painful, and easier to perform. The mean number

of swabs conducted in order for participants to feel at ease was two tests and the authors highlight that this demonstrates that technical fluency can be acquired quickly with the use of simulation. Approximately 45% of the participants had experience with conducting nasopharyngeal swabs prior to the study. Of those with previous experience, the majority reported that they would have benefited from training on the simulator before collecting their first nasopharyngeal swab (89%), their initial training was inadequate (73%), and the simulator improved their sampling technique (73%).

Limitations of the present study include a small sample size of a single attempt of the activity and a lack of a control group of students not utilizing manikins for comparison. Without such a control group or randomization, it is not fully known what component of the learners' reported changes are attributable to the manikins. Student reported confidence was the primary measurement used to assess the impact of manikins. Other objective measures of student learning, such as a knowledge based assessment, may have further added to the study. Additionally, although all students earned a proficiency of at least 90% on their skills assessment, the study was not designed to show that manikins improved scores.

Use of the manikins offered an advantage of more opportunities for the student pharmacists to practice these skills. Other advantages of using manikins included the need for less supplies, as swabs could be used on a manikin several times for practice, as well as minimizing the chance of injury to a peer when novice learners are first practicing their skills. Our data indicate that students found the most benefit with manikins when practicing the nasal swabs. This may be due to the lack of ability to visualize the nasal passageway on a patient as compared to the throat swab where students could directly see the anatomy. Furthermore, the investigators also benefited from utilizing high-fidelity manikins that were already purchased and being used by other departments on campus, as the cost of purchasing manikins may be a potential barrier. While not advertised for the purpose of POCT training, investigators were able to adapt manikins used in dentistry and anesthesia for training students in POCT.

Next Steps

Given the novelty of including dedicated curricular content for POCT in infectious diseases, studies in pharmacy education that highlight methods for teaching skills in these areas are limited. However, POCT is a growing area in pharmacy practice and as such, is being implemented in pharmacy curricula.^{1,2,4,19}

As POCT is increasingly needed in pharmacy practice settings, the authors found manikins to be an effective way to enhance student confidence in nasal, throat, and oral fluid swab collection skills and recommend this educational model be used in other programs. As described by Jessee and colleagues, use

of manikins and patient simulation can help prepare students for advanced pharmacy practice experiences (APPEs) and clinical practice by bridging the gap between didactic learning and clinical application.¹² Therefore, use of manikins to teach other pharmacy skills is an area for future study. While not a planned objective of the study, the use of manikins also increased the ability for students to practice POCT skills safely during the COVID-19 pandemic. We plan to continue to use manikins in training students in these skills in the future.

Conflict of Interest:

We declare no conflicts of interest or financial interests that the authors or members of their immediate families have in any product or service discussed in the manuscript, including grants (pending or received), employment, gifts, stock holdings or options, honoraria, consultancies, expert testimony, patents, and royalties.

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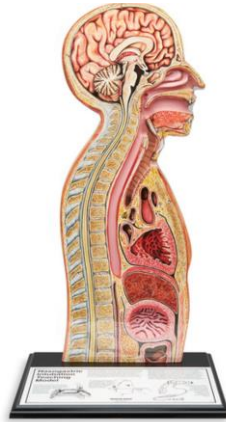
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Figure 1: Manikins

Model A



Model B



Model C

Source Model A: Oral Anesthesia Manikin, Nasco Healthcare, Saugerties, NY.

https://shop.nascohealthcare.com/products/sb50099?_pos=2&_sid=24930642c&_ss=r

Source Model B: Nasogastric Tube Feeding Model, Nasco Healthcare, Saugerties, NY.

https://shop.nascohealthcare.com/products/sb10239?_pos=1&_sid=558e9ba17&_ss=r

Source Model C: Nursing Anne (SimPad Capable) Hi-fidelity Manikin, Laerdal Medical, Wappingers Falls, NY

<https://laerdal.com/us/products/simulation-training/nursing/nursing-anne/>

Table 1: Student Confidence Performing Swabs (n = 63)

Swab Type	Period	Strongly Disagree N (%)	Somewhat Disagree N (%)	Neither Agree nor Disagree N (%)	Somewhat Agree N (%)	Strongly Agree N (%)
Nasal*	Pre	23 (37%)	16 (25%)	8 (13%)	14 (22%)	2 (3%)
	Post	1 (2%)	0 (0%)	1 (2%)	32 (51%)	29 (46%)
Throat*	Pre	21 (33%)	16 (25%)	10 (16%)	15 (24%)	1 (2%)
	Post	0 (0%)	0 (0%)	2 (3%)	23 (37%)	38 (60%)
Oral Fluid*	Pre	20 (32%)	14 (22%)	6 (10%)	22 (35%)	1 (2%)
	Post	0 (0%)	0 (0%)	1 (2%)	10 (16%)	52 (83%)

*Median reported confidence scores increased across periods by 2.0 (95% CI: 1.5, 2.5), 2.0 (95% CI: 1.5, 2.5), and 2.0 (95% CI: 1.2, 2.8) for nasal, throat, and oral fluid swabs, respectively.