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Impact of a multi-patient simulation event on physical therapy student confidence: a quasi-experimental study

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Abstract

Purpose: Simulation is a long-established learning and assessment activity in healthcare education. Simulation has been used to provide opportunities for students to experience complex patient interactions in a low-risk setting to prepare students to manage all the demands of total patient care as new practitioners. The purpose of this quasi-experimental, single cohort study, with pre–post quantitative survey analysis including theme frequency, was to determine how participating in a multi-patient simulation consisting of different clinical settings and diagnoses would impact physical therapy students' confidence in clinical and decision-making skills.
Methods: Thirty-three, entry-level Doctor of Physical Therapy students completed a simulation and debriefing across four different healthcare settings while addressing different aspects of patient management within each of these settings. Students completed two surveys before and after this simulation to measure their self-appraised confidence. Quantitative data from these surveys were analyzed using Wilcoxon tests and the free-response entries from the surveys were analyzed for theme occurrence frequency.
Results: Students' total clinical skill confidence scores decreased ($P = 0.015$), specifically in areas of strength testing ($P = 0.008$), postural assessment ($P = 0.002$), and planning an appropriate intervention plan ($P = 0.033$). Students' total decision-making confidence scores did not significantly change; however, areas of improvement included recognizing physiological and psychological changes in patients in a timely manner ($P = 0.025$) and distinguishing between clinically important and lower priority impairments ($P = 0.048$). Occurrence of theme frequencies from free responses revealed a decrease in student confidence related to "flow and organization" as well as "evaluation."
Conclusion: While incorporating a multi-patient simulation improved some aspects of students' self-appraised confidence in clinical decision-making skills, there was an unexpected decrease in students' overall confidence.

Keywords: *healthcare; education; clinical decision-making*

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Simulation is a long-established learning and assessment activity in medical and nursing education, and military and aviation training.[1] Physical therapy (PT) education also utilizes simulation to advance the skills and practice of students. The increased use of simulation-based learning activities has been largely driven in part by the need for PT students to get familiarized with complex patient interactions in a low-risk setting.[2] Traditional clinical education, consisting of live one-to-one instruction in a clinical setting, does not have these types of encounters with the frequency and control that students need to enable them to become entry-level clinicians.[3] Simulation, with quality debriefing and feedback, can provide students the opportunity to hone their skills, engage in clinical decision-making, reflect on their actions, and advance their mastery in clinical skills and decision-making.[3]

Researchers, in a variety of healthcare education fields, have consistently demonstrated that simulations increase students' confidence in their clinical practice, including clinical skills and decision-making.[2,4–6] Silberman et al.[7] reported that PT students who participated in high-fidelity simulations had significantly more confidence afterward and at the midpoint in a subsequent acute care rotation. Ohtake et al.[8] found that participation in simulation

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activities had a significant improvement in PT students' self-reported confidence in all areas, with the largest improvement in the area of cognitive performance. Wright et al.[9] utilized an 18-day intensive simulation-based learning activity to investigate PT student confidence. The experimental group demonstrated significantly higher confidence with each 6-day core practice block within the 18-day event, although the improvement was not cumulative over the 18 days. The experimental group of students also had higher competency scores on their subsequent clinical education experience performance assessments.[9]

New practitioners are expected to enter the healthcare workforce ready to manage all the demands of patient care, including the safety, efficiency, and effectiveness of clinical practice.[10] To help prepare students for entry-level demand prior to final clinical education experience, a low-stakes formative multi-patient simulation learning event was designed that required students to manage patients in back-to-back succession. While not consistent with traditional clinical practice, the multi-patient simulation event was designed to also be comprehensive in nature, by covering didactic content across the curriculum through cases involving a variety of clinical settings, health conditions, life-spans, and across the Patient-Client Management (PCM) Model.[11] The objective of the multi-patient simulation event was for the students to self-assess their current levels of clinical skills, knowledge, and critical thinking in preparation for entry into terminal clinical education experiences.

Much of the current research on the impact of simulation-based learning on PT student confidence and clinical decision-making entails simulation events that are single-patient in nature, concentrated to one body system (e.g. cardiopulmonary, musculoskeletal, or neurologic), and are not in rapid succession like a clinical environment.[6–9] The purpose of this study was to examine the impact of a multi-patient simulation event on physical therapy student confidence regarding both their clinical and decision-making skills. We hypothesized that students would perceive greater levels of confidence in psychomotor and clinical decision-making skills following a multi-patient simulation learning activity.

Methods

Design

This was a quasi-experimental study, with an assessment survey administered before and after a multi-patient simulation learning event. The study protocol was prospectively approved by the Institutional Review Board along with an exemption of informed consent.

Subjects

This study utilized a convenience sample of a single cohort of third-year Doctor of Physical Therapy students from a private southeastern university within a nonmedical college of health science. The students were completing their seventh and final semester of didactic course work prior to entering the final two 14-week clinical education experience. There were no exclusion criteria. Thirty-three students participated (mean age 24.8 ± 1.47 [range 23–31], 11 males and 22 females). All of the students had previously completed a 4-week clinical education experience in semester four, and participated in various stand-alone simulation activities that were integrated into individual courses throughout the curriculum.

Assessment surveys

Two measures were used to assess student confidence before and after the simulation event. A clinical confidence survey designed to assess change in student confidence was modified from the self-assessment created by Alexander et al.[12] The learning experience used by Alexander et al. was solely focused on musculoskeletal presentations, necessitating modifications for this simulation-based learning activity.[12] The students were asked to rate their level of confidence on a five-point Likert scale, ranging from very confident (score of 1) to strongly lacking confidence (score of 5). Seven items were maintained from Alexander's original survey – history taking, systems review, palpation, strength testing, goniometry, posture assessment, and sensation assessment.[12] Because of the diversity of the multiple patient scenarios in our simulation event, the neuromuscular screening item from Alexander et al. was modified to a generic screening item. To fully assess the confidence of the students across the complexity of cases in the simulation, functional mobility and balance assessment items were added. We also added four items to this survey to assess student confidence with these clinical decision-making skills: planning an appropriate intervention plan, executing an appropriate intervention plan, modifying the plan in response to patient presentation, and planning treatment progression or discharge decisions. Not included from the Alexander et al. survey[12] were four items, including edema assessment, complete PT examination, PT differential diagnosis, and basic patient care at your first clinical education experience. Retained from the survey were two free-response questions that followed the Likert scale confidence questions: "In which skill(s) do you have the [greatest/least] confidence? Why?" (Appendix 1). These two free-response questions allowed students to detail their perceptions of confidence in their clinical skills.

A second survey was chosen to assess student confidence in making clinical decisions, the Clinical Decision-Making (CDM) tool created by Brudvig and Macauley.[13] This survey has been through several revisions, reduced from 25 to 12 items, and has been used to assess physical therapy students' perception of their CDM skills. The CDM survey demonstrated face validity in assessing students' perceived levels of CDM ability and has high internal

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consistency.[14] The tool incorporates professional behaviors and key components of the Physical Therapy Clinical Performance Instrument. The survey utilizes a four-point Likert scale, by which the students assess the level of assistance they believe they need for each item. The scale ranges from "I need direct assistance to do this in the clinic" (score of 1) to "I am capable of teaching this to others in the clinical setting" (score of 4).[14]

The students completed the surveys 1 day before and immediately after the 2-day simulation event. The surveys were distributed and collected anonymously using Qualtrics, an online survey software.

Simulation event

The simulation event was conducted within the university's experiential learning and simulation center, with seven standardized patients (SPs) portraying the patient cases. The SPs received their cases several weeks prior to the event and participated in a 1-hour training session with PT and simulation center faculty just prior to the event. The four patient cases (Table 1) were written by physical therapy faculty, based on clinical expertise, to cover different health care settings – acute care, skilled nursing and rehabilitation, outpatient, and home health, as well as addressing different aspects of the PCM Model.[11] Two SPs were assigned to each case, with the exception of one SP assigned to home health.

The students were provided with evaluation and/or progress notes pertaining to the home health and skilled nursing cases 1–2 days ahead of the simulation event. This allowed the student to prepare their treatment plans for their respective cases. Conversely, for the acute care and outpatient evaluation cases, the students were provided with case information at the time of the experience.

The event was scheduled across two consecutive days, with two 4-hour blocks each day. Each student was randomly assigned to one of those blocks (Table 2). All the student–patient interactions were one-on-one with the exception of the home care case. The University's Simulation Center has only one home care suite, which necessitated pairing the students so that all could participate in the home care case within the 2-day schedule. The students had 30 minutes for each patient scenario, rotating through all the settings. There were 30-minute small group debriefings between every other scenario session.

During the simulation, faculty observed all the simulations remotely in real-time via LearningSpace™ (https://caehealthcare.com/learningspace/), an audiovisual simulation center management program. Small group debriefings of four to five students each were facilitated by two physical therapy faculty members who observed those specific scenarios. The faculty utilized the GAS Model (Gather, Analyze, Summarize) for the debriefing sessions.[15] The faculty involved in the debriefing process participated

Table 1. Simulation case descriptions

Setting	Simulation objective (based on patient-client management model)	Case description
Acute	1. Complete a physical therapy examination 2. Based on exam findings, prescribe and deliver appropriate interventions 3. Recommend appropriate discharge location	Motor vehicle accident, significant pain in neck and left knee and lower leg, no fractures or injuries reported from the emergency room
Skilled nursing	1. Complete a final discharge treatment session 2. Reassess outcome measures 3. Complete discharge education	4 weeks after cerebrovascular accident with right hemiparesis, discharging to home with spouse
Outpatient	1. Complete a physical therapy examination 2. Determine the physical therapy diagnosis	Direct access scenario, low back pain, history of poor lifestyle choices and depression
Home care	1. Complete a basic treatment session 2. Educate the patient on diagnosis-related information	Right total knee arthroplasty 5 days ago, evaluated by home health physical therapy 2 days ago

Table 2. Sample of event's block scheduling

	Acute care 1	Acute care 2	Skilled nursing facility 1	Skilled nursing facility 2	Outpatient 1	Outpatient 2	Home health
10-1030	Students 1 & 2	Student 3	Student 4	Student 5	Student 6	Student 7	Students 8 & 9
1030-11	Student 4	Student 5	Student 1	Students 2 & 3	Student 8	Student 9	Students 6 & 7
11-1130	Joint Debriefing of Acute Care and Skilled Nursing Facility				Joint Debriefing of Outpatient and Home Health		
1130-12	Student 6	Student 7	Student 8	Student 9	Student 2	Student 1&3	Students 4 & 5
12-1230	Student 8	Student 9	Student 6	Student 7	Student 4	Student 5	Student 1,2, &3
1230-1	Joint Debriefing of Acute Care and Skilled Nursing Facility				Joint Debriefing of Outpatient and Home Health		

in a pre-event discussion and planning session related to the use of the GAS model for debriefing. Faculty were encouraged to utilize the witnessed simulation, student reflection, and faculty observation to guide the stages of the GAS structure rather than using a scripted debriefing. While global feedback was provided during these debriefings, students did not receive individual feedback.

Statistical analysis

SPSS software was utilized for all data analyses (IBM Corp., Armonk, NY). Due to the small sample size, the nonparametric nature of the data from the Clinical Decision-Making survey, and the quantitative portion of the clinical confidence survey, Wilcoxon tests were used to determine if there were a significant difference between the pretest and posttest surveys. The use of unadjusted P-values in this study can increase the chance of false positives but reduces the chance of false negatives. Thus, unadjusted P-values were used to avoid overlooking significant findings that may be worthy of future study. Free-response questions were assessed and tabulated for predetermined themes, as they related to the PCM components, including the flow and organization of the patient interactions. Initially, the authors independently assigned themes to each student's comments. These theme assignments were then compared, and the differences in theme assignments were resolved by the investigators through discussion and consensus. The frequencies of occurrance of each theme on the pre and post surveys were tabulated, as well as comparing the differences between each theme pre versus post survey.

Results

All 33 participants completed the surveys, including the free-response questions. The clinical skills confidence survey demonstrated a significant decrease in overall student confidence ($P = 0.015$). Several of the skills did not show a significant change; however, the following skills were significant for a decrease in student confidence: strength testing ($P = 0.008$), postural assessment ($P = 0.002$), and planning an appropriate intervention plan ($P = 0.033$). Table 3 provides a summary of the data related to student confidence in their basic clinical skills.

Two individual items in the CDM survey did achieve statistically significant improvement, while there were no changes in the total survey score of student confidence from pretest to posttest. Students reported increased confidence in recognizing physiological and psychological changes in patients in a timely manner ($P = 0.025$) and distinguishing between clinically important and lower priority impairments ($P = 0.048$) (Table 4).

The frequency of themes occurring in the free-response questions was consistent from pretest to posttest, with the following exceptions. When students were asked to identify skills they had the least confidence in, there was an 83.3% increase in the frequency of occurrences of student comments (three pre, 18 comments post) recognizing 'flow and organization' as an area they had least confidence in after this simulation. There was an opposite shift in the frequency of occurrences noted with a 63.6% decrease in the number of student comments (22 pre, eight post) claiming 'evaluation' as their least confident skill after completing this simulation. Table 5 provides a summary of the free-response data.

Discussion

This study explored the effects of participating in a multi-patient simulation event that consisted of managing patients across clinical settings, lifespan, and the PCM Model[11] on physical therapy students' self-assessment of confidence in clinical decision-making and performance of basic clinical skills. Overall, the data suggest that students' confidence in discrete aspects of clinical decision-making skills increased after the simulation. However, contrary to previous research findings,[6–9] the students' confidence in basic clinical skills decreased.

Contrary to current research, which reports increased student confidence with simulation experience,[2] this study showed a significant decrease in overall confidence in basic clinical skills, especially strength testing, postural assessment, and intervention planning, after completing this simulation. Much of the previous research has focused on isolated, single-patient or concentrated practice area simulation events that are not in rapid succession like a clinical environment.[6–9] Therefore, comparing the effects of this simulation to other research findings is difficult.

There are a few potential reasons for the decrease in student confidence after this simulation event. Based on the research by Morgan and Cleav-Hogg,[16] our students should have entered this simulation with confidence, as they have had numerous formal and informal opportunities to practice and perform basic clinical skills. However, it had been up to 2 years since these students were instructed and assessed in some of the basic clinic skills material, and students were not held accountable to practice these learned skills. The span of time between initial learning and competency assessments to this simulation event, and the lack of continuous practice of these skills, may have led to an overconfidence exhibited during the pretest.

Another possible reason for the decrease in student confidence may be related to the demands of one of the simulation cases that did not allow for prior preparation. A distinct trend was noted during each of the debriefings after the outpatient scenario. Students consistently reflected that they felt unsuccessful in the outpatient scenario, as they were not able to determine a diagnosis. They attributed this to the challenge of planning

Table 3. Clinical skill confidence survey results

	Very confident	Somewhat confident	Undecided	Somewhat lacking confidence	Strongly lacking confidence	Mean	Wilcoxon *P*-value
History taking	Pre 14 (42.42%)	19 (57.58%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.58 (± 0.49)	0.366
	Post 14 (42.42%)	17 (51.52%)	1 (3.03%)	1 (3.03%)	0 (0.00%)	1.67 (± 0.68)	
Systems review	Pre 7 (21.21%)	24 (72.73%)	2 (6.06%)	0 (0.00%)	0 (0.00%)	1.85 (± 0.50)	0.132
	Post 6 (18.18%)	22 (66.67%)	4 (12.12%)	1 (3.03%)	0 (0.00%)	2.00 (± 0.65)	
Screening	Pre 8 (24.24%)	23 (69.70%)	1 (3.03%)	1 (3.03%)	0 (0.00%)	1.85 (± 0.61)	0.248
	Post 9 (27.27%)	17 (51.52%)	6 (18.18%)	1 (3.03%)	0 (0.00%)	1.97 (± 0.76)	
Palpation Assessment	Pre 12 (36.36%)	18 (54.55%)	3 (9.09%)	0 (0.00%)	0 (0.00%)	1.73 (± 0.62)	0.366
	Post 11 (33.33%)	17 (51.52%)	5 (15.15%)	0 (0.00%)	0 (0.00%)	1.82 (± 0.67)	
Strength testing	Pre 28 (84.85%)	5 (15.15%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.15 (± 0.36)	0.008*
	Post 21 (63.64%)	12 (36.36%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.36 (± 0.48)	
Goniometry	Pre 19 (57.58%)	12 (36.36%)	0 (0.00%)	2 (6.06%)	0 (0.00%)	1.55 (± 0.78)	0.180
	Post 16 (48.48%)	15 (45.45%)	0 (0.00%)	2 (6.06%)	0 (0.00%)	1.64 (± 0.77)	
Postural assessment	Pre 25 (75.76%)	8 (24.24%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.24 (± 0.43)	0.002*
	Post 17 (51.52%)	13 (39.39%)	3 (9.09%)	0 (0.00%)	0 (0.00%)	1.58 (± 0.65)	
Sensation assessment	Pre 6 (18.18%)	22 (66.67%)	3 (9.09%)	2 (6.06%)	0 (0.00%)	2.03 (± 0.72)	1.0
	Post 5 (15.15%)	22 (66.67%)	6 (18.18%)	0 (0.00%)	0 (0.00%)	2.03 (± 0.58)	
Functional mobility assessment	Pre 21 (63.64%)	12 (36.36%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.36 (± 0.48)	0.096
	Post 17 (51.52%)	15 (45.45%)	1 (3.03%)	0 (0.00%)	0 (0.00%)	1.52 (± 0.56)	
Balance assessment	Pre 20 (60.61%)	13 (39.39%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.39 (± 0.49)	0.071
	Post 16	15 (45.45%)	1 (3.03%)	1 (3.03%)	0 (0.00%)	1.61 (± 0.69)	
Planning appropriate intervention plan	Pre 8 (24.24%)	22 (66.67%)	1 (3.03%)	2 (6.06%)	0 (0.00%)	1.91 (± 0.71)	0.033*
	Post 4 (12.12%)	22 (66.67%)	6 (18.18%)	0 (0.00%)	1 (3.03%)	2.15 (± 0.74)	
Executing appropriate intervention plan	Pre 10 (30.30%)	18 (54.55%)	1 (3.03%)	4 (12.12%)	0 (0.00%)	1.97 (± 0.90)	0.360
	Post 8 (24.24%)	22 (66.67%)	3 (9.09%)	0 (0.00%)	0 (0.00%)	1.85 (± 0.56)	
Modifying exam of treatment in the moment due to patient presentation/responses	Pre 6 (18.18%)	15 (45.45%)	10 (30.30%)	1 (3.03%)	1 (3.03%)	2.27 (± 0.90)	0.819
	Post 5 (15.15%)	18 (54.55%)	6 (18.18%)	3 (9.09%)	0 (0.00%)	2.22 (± 0.82)	
Making clinical decisions as it relates to progressing of treatment plan or discharge from services	Pre 4 (12.12%)	19 (57.58%)	8 (24.24%)	2 (6.06%)	0 (0.00%)	2.24 (± 0.74)	0.448
	Post 3 (9.09%)	23 (69.70%)	6 (18.18%)	1 (3.03%)	0 (0.00%)	2.15 (± 0.61)	
Composite score Wilcoxon test							0.015*

*Indicates significant difference from pretest to posttest ($P < 0.05$).

their examination in real-time as opposed to being able to prepare in advance. A summary of student responses included: 1) not having an examination strategy upon entering the patient's room, 2) forgetting what tests and measures to perform, and 3) not reaching a physical therapy diagnosis due to the inadequacies of their examination. These comments relate to the 'flow and organization' of the examination and were consistent with the tabulated free-response survey response frequencies that showed a decrease in confidence in student ability to coordinate the examination with "flow and organization". The student performance in this outpatient scenario certainly contributed to the overall decrease in confidence reported. It is also possible that the overall structure of the multi-patient, multi-setting event design contributed to the students' overall decrease in confidence.

Our program faculty had not anticipated the decrease in student confidence in clinical skills; however, our program's curricular structure may have had an impact on their levels of confidence in CDM. While students may not continuously practice their basic clinical skills throughout their first 2 years, our program does incorporate and emphasize CDM throughout our curriculum, as students learn to manage patients with greater complexity and complicated diagnoses as the curriculum progresses. The continual reinforcement of foundational sciences and diagnostic decision-making that is in each of our program's clinical science courses may have influenced the improvement in student confidence scores on the two subsets of the CDM survey.

A major goal of debriefing after simulation-based learning activities was to increase the self-awareness and reflective abilities of the learner. As the students complete the debriefing process, student reflection may make them more aware of areas that need improvement, which could negatively impact their confidence in those skills. As they are preparing for upcoming clinical education experience, self-awareness of areas needing improvement derived from

Table 4. Confidence in clinical decision-making survey results

	I need direct assistance to do this in the clinic	I need minimal assistance to do this in the clinic	I do this routinely without assistance in the clinical setting except in unusual cases	I am capable of teaching this to others in the clinical setting	Mean	Wilcoxon *P*-Value
Recognizing physiological and psychological changes in patients in a timely manner	Pre 0 (0.00%) Post 0 (0.00%)	21 (63.64%) 17 (51.52%)	11 (33.33%) 14 (42.42%)	1(3.03%) 2 (6.06%)	2.39 (± 0.55) 2.55 (± 0.61)	0.025*
Identifying relevant information from the patient's history to prioritize the examination	Pre 0 (0.00%) Post 0 (0.00%)	9 (27.27%) 14 (42.42%)	17 (51.52%) 15 (45.45%)	7 (21.21%) 4 (12.12%)	2.94 (± 0.69) 2.70 (± 0.67)	0.145
Identifying patients for whom physical therapy is not indicated	Pre 1 (3.03%) Post 0 (0.00%)	17 (51.52%) 18 (54.55%)	12 (36.36%) 12 (36.36%)	3 (9.09%) 3 (9.09%)	2.52 (± 0.70) 2.55 (± 0.66)	0.739
Recognizing the need for further referral and communication with other healthcare providers	Pre 3 (9.09%) Post 2 (6.06%)	19 (57.58%) 17 (51.52%)	10 (30.30%) 12 (36.36%)	1 (3.03%) 2 (6.06%)	2.27 (± 0.66) 2.42 (± 0.70)	0.132
Sequencing tests and measures in a logical manner to optimize efficiency	Pre 4 (12.12%) Post 3 (9.09%)	16 (48.48%) 24 (72.73%)	13 (39.39%) 6 (18.18%)	0 (0.00%) 0 (0.00%)	2.27 (± 0.66) 2.09 (± 0.51)	0.083
Adjusting tests, measures or interventions according to the patient's response	Pre 2 (6.06%) Post 3 (9.09%)	18 (54.55%) 17 (51.52%)	12 (36.36%) 11 (33.33%)	1 (3.03%) 2 (6.06%)	2.36 (± 0.64) 2.36 (± 0.73)	1.0
Synthesizing data to arrive at an accurate prognosis	Pre 6 (18.18%) Post 0 (0.00%)	17 (51.52%) 22 (66.67%)	9 (27.27%) 11 (33.33%)	1 (3.03%) 0 (0.00%)	2.15 (± 0.74) 2.33 (± 0.47)	0.109
Gathering information from multiple data sources to guide plan of care	Pre 1 (3.03%) Post 1 (3.03%)	15 (45.45%) 10 (30.30%)	13 (39.39%) 17 (51.52%)	4 (12.12%) 5 (15.15%)	2.61 (± 0.74) 2.79 (± 0.73)	0.157
Establishing a plan of care consistent with the examination and evaluation	Pre 3 (9.09%) Post 1 (3.03%)	14 (42.42%) 18 (54.55%)	12 (36.36%) 12 (36.36%)	4 (12.12%) 2 (6.06%)	2.52 (± 0.82) 2.45 (± 0.66)	0.637
Re-evaluating and adjusting the plan of care based on the patient's needs	Pre 4 (12.12%) Post 1 (3.03%)	16 (48.48%) 17 (51.52%)	10 (30.30%) 14 (42.42%)	3 (9.09%) 1 (3.03%)	2.36 (± 0.81) 2.45 (± 0.61)	0.467
Providing rationale for interventions selected for patients with various diagnoses	Pre 1 (3.03%) Post 0 (0.00%)	12 (36.36%) 15 (45.45%)	17 (51.52%) 14 (42.42%)	3 (9.09%) 4 (12.12%)	2.67 (± 0.68) 2.67 (± 0.68)	0.967
Distinguishing between clinically important and lower priority impairments	Pre 4 (12.12%) Post 0 (0.00%)	11 (33.33%) 11 (33.33%)	17 (51.52%) 20 (60.61%)	1 (3.03%) 2 (6.06%)	2.45 (± 0.74) 2.73 (± 0.57)	0.048*
Composite score Wilcoxon test						0.537

*Indicates significant difference from pretest to posttest ($P < 0.05$).

Table 5. Summary of students' responses to open-ended questions regarding confidence

Themes from qualitative data	In which skill(s) do you have the greatest confidence?		In which skill(s) do you have the least confidence?	
	PRE	POST	PRE	POST
Examination	55	40	9	6
	27.3% decrease		33.3% decrease	
Evaluation	9	11	22	8
	22.2% increase		63.6% decrease	
Interventions	6	4	3	3
	33.3% decrease		0% change	
Outcomes	0	0	6	3
	0% change		50% decrease	
Flow and organization	0	0	3	18
	0% change		83.3% increase	

simulated clinical experiences may help equip students for greater success and eventually instill greater confidence.

This study on a novel multi-patient simulation event has provided at least two areas for future research consideration. One such area for research is the effect of simulation on student competence. Medical students' level of confidence in the performance of specific skills has correlated with the number of times the skill has

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been performed, although level of confidence cannot predict outcomes in either clinical or written examination grades.[16] Likewise, Wright et al.[9] found that an introductory simulation-based activity for physical therapy students significantly improved student confidence in their ability to undertake clinical practice. However, there was no correlation between total confidence score and simulation-based competency grades.[9] A systematic review by Boling and Hardin-Pierce[17] found that simulation improved confidence, but also noted no direct relationship between competence and confidence in a number of studies, and emphasized the importance of evaluating both constructs.[17] One future plan is to develop a rubric for instructors to assess students' competence during this multi-patient simulation and incorporate with the program's progression standards.

A second area for research could be determining the validity of the CDM tool related to various learning activities. While the CDM tool used in this study has been previously validated,[14,18] the sensitivity of this CDM tool over a single, complex learning activity, such as this multi-patient simulation, is yet to be determined.

Limitations

The generalizability of these results is limited. The sample of a single cohort of physical therapy students was obtained through convenience sampling and only occurred in physical therapy students during their last didactic semester in one institution. There was no control group for comparison. There could have been multiple testing biases due to the nature of the pre-/posttest design, reducing the significance of some of the findings. We also reported unadjusted *P*-values because we analyzed each item within the CDM to have a more complete understanding of the students' perception of confidence. Findings should be interpreted with caution due to the possibility of false positives. The fact that the students were paired during the home care simulation created a different experience than the other three one-on-one simulations. While the original survey by Alexander et al.[12] did show content validity, the modified survey used in this study was not assessed for validity. In addition, students were not trained on the survey prior to administration. There was no follow-up survey to demonstrate long-term behavior change. It is possible that one challenging scenario may have impacted overall student confidence. Funding and facility availability may limit many institutions' ability to reproduce simulations of this scale.

Conclusion

This study examined the impact of a multi-patient simulation, which included managing patients in numerous settings, with a variety of diagnoses, and across the life span, on physical therapy students' self-appraised confidence related to performing basic clinical skills and clinical decision-making skills. Our findings suggest that incorporating a multi-patient simulation at the end of the didactic curriculum could result in decreased confidence in aspects of clinical and decision-making skills; however, the final impact of this decrease in student confidence on actual performance in subsequent clinical education experience is not yet known.

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Conflict of interest and funding

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Ethics statement

This study was approved by Samford University's IRB (number EXMT-HP-18-SUM-2).

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Appendix 1

Clinical Confidence Survey

1. Please consider your current clinical abilities. Mark which most closely describes your confidence in performing the following skills

	Very confident	Somewhat confident	Undecided	Somewhat lacked confidence	Strongly lacked confidence	n/a
History taking	1	2	3	4	5	0
Systems review	1	2	3	4	5	0
Screening	1	2	3	4	5	0
Palpation assessment	1	2	3	4	5	0
Strength testing	1	2	3	4	5	0
Goniometry	1	2	3	4	5	0
Postural assessment	1	2	3	4	5	0
Sensation assessment	1	2	3	4	5	0
Functional mobility assessment	1	2	3	4	5	0
Balance assessment	1	2	3	4	5	0
Planning appropriate intervention plan	1	2	3	4	5	0
Executing appropriate intervention plan	1	2	3	4	5	0
Modify exam or treatment in the moment due to patient presentation	1	2	3	4	5	0
Making clinical decisions as it relates to progression of treatment plan or discharge from services	1	2	3	4	5	0

2. In which skill(s) do you have the GREATEST confidence? Why?
3. In which skill(s) do you have the LEAST confidence? Why?