Simulation-based Clinical Education Versus Early Clinical Exposure for Developing Clinical Skills in Respiratory Care Students

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Abstract

Background: Early clinical exposure (ECE) has been shown to improve clinical skills, but several factors limit its implementation.

Objective: To compare the use of simulation-based education (SCE) and ECE in improving respiratory care students' clinical skills in laboratory settings.

Methodology: This experimental prospective study was conducted among respiratory care students at Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia. Students from one batch were allocated to the ECE group, and students from another batch were allocated to the SCE group to concurrently undergo clinical training. On completion of the course, students completed the Clinical Learning Environment Inventory (CLEI), and their clinical practice course grades were evaluated.

Results: A total of 72 students from the two batches completed the CLEI and clinical performance evaluation; 32 (45%) were female. The mean age was similar across both groups. Between the groups, there was no statistical difference in the mean clinical grade (95% CI) (ECE: 167.29 [164.74–169.84], SCE: 166.88 [164.12–169.65]; P = 0.837) and the CLEI score (ECE: 128.25 ± 3.9, SCE: 123.08 ± 4.2; P = 0.381). Multivariable linear regression analyses revealed no significant difference in the clinical performance grades (β = −0.09; 95% CI: −0.78–0.59; P = 0.788).

Conclusion: The study found no significant difference in the performance between ECE and SCE in laboratory settings, indicating that SCE is a viable alternative to ECE in RC clinical training. Studies with larger cohorts are required to corroborate this finding.

Keywords: Clinical education, clinical skills, early clinical exposure, medical education, respiratory care, simulation-based education

INTRODUCTION

Clinical education (CE) is essential for all healthcare professionals, including respiratory care (RC) students.\textsuperscript{[1,2]} With a concentration in cardiovascular and pulmonary disorders, an RC degree prepares students with

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specialized skill sets to address unique patient issues and disorders, and thus work as a trained medical professional. For skill optimization, in countries such as the United States, United Kingdom, and Canada, clinical practice courses are initiated from the beginning of the RC coursework.

In Saudi Arabia, clinical practice courses (i.e., clinical training) start from the third year for 4 semesters. However, in the RC program at Imam Abdulrahman Bin Faisal University (IAU), Dammam, clinical practice starts from the second semester of the second year (level 3) for 1 day/week for 14 weeks over 5 semesters in different governmental and private hospitals under the supervision of faculty from the RC Department. However, due to shortage of clinical instructors and clinical sites, early clinical exposure (ECE) imposed high pressure on the department administrators. Given that clinical environments can be complicated, challenging, and consistently developing, planning for a clinical education practicum requires considerable effort and resources. Concurrently, the availability of resources and skilled clinical instructors is critical in shaping the clinical education experiences of the students.[3]

While generally considered beneficial, ECE can also lead to negative clinical education experiences if not optimally managed, as it can result in students feeling lost and not adequately interacting with their learning environment because of hesitancy or lack of confidence.[4] Alternatively, simulation-based clinical education (SCE) has been shown to be a useful pedagogical tool that not only helps develop clinical and decision-making skills but is also effective in the psychomotor domain.[5,6] In health sciences, simulations are used to facilitate a deeper understanding of concepts and to enhance problem-solving and decision-making abilities.[7,8] In medical education, simulations have been used to advance diagnostic competencies and motor and technical skills of prospective doctors, nurses, and emergency teams.[9‑11]

Accordingly, as part of Clinical Practice Course I modification plan, the RC department administrators at IAU introduced SCE in laboratory settings as an alternative to ECE for one of the batches. However, to the best of the authors’ knowledge, studies have neither addressed the use of SCE in RC nor investigated the status of clinical education or the solutions for challenges encountered in RC. Therefore, the aim of this study was to evaluate the effect of replacing ECE with SCE in laboratory settings on the clinical skills of RC undergraduate students.

**METHODOLOGY**

**Study design and participants**

This was an experimental prospective study conducted at the RC Department, College of Applied Medical Sciences, IAU, Dammam, Saudi Arabia, between February and July 2018. The Institutional Review Board approved the study, and informed consent was obtained before enrollment. In addition, all participants received laboratory competency checklist to ensure they met the safety requirements prior to patient care.

Study samples were taken from two different undergraduate RC student batches. In Group A, students followed the traditional clinical practice course conduction plan, in which the clinical skills required by Clinical Practice Course I were taught through ECE at a hospital for one day/week for 14 weeks. This was followed by Clinical Practice Course II at affiliated hospitals.

In Group B, students followed the modified clinical practice course conduction plan (approved by the RC Department Board Members, College of Applied Medical Sciences, IAU, on May 18, 2016), in which the clinical skills required by Clinical Practice Course I were taught through SCE in the university’s laboratory for the same duration as Group A. This was followed by Clinical Practice Course II at affiliated hospitals [Figure 1].

**Simulation-based clinical education**

The laboratory session was designed in a way that enabled students to learn and perform various respiratory care practices. On a weekly basis, a specific competency skill was taught by two respiratory care instructors using laboratory equipment and simulators listed in Table 1.

Practices involved an initial assessment of simulated patient cases that required therapy and management. This is to ensure students’ attainment of entry-to-practice competencies, namely, patient assessment, respiratory therapeutic procedures, and medical gas therapy application.

On completion of Clinical Practice Course I for both Groups A and B students are required to learn the following skills:

1. Perform adult basic assessment and therapeutic management.
2. Differentiate between normal and abnormal patient assessment data.
3. Demonstrate effective communication skills (verbal and written) with patients, families, members of the health-care team, colleagues, and clinical instructors.
4. Interpret patient data using information technology and data management systems.

Questionnaire structure
The Clinical Learning Environment Inventory (CLEI), a validated questionnaire, was used in this study.\(^{12}\) CLEI is composed of 42 items divided into six domains: personalization, student involvement, satisfaction, task orientation, innovation, and individualization. The scoring is based on a five-point Likert-type scale (1 = Strongly Disagree; 5 = Strongly Agree). The Cronbach’s alpha coefficients ranged from 0.73 to 0.84.\(^{12}\)

The questionnaire was administered to Groups A and B in person after completion of Course I to examine their experiences in the clinical courses. The clinical practice course grades were also retrieved during the study period to determine differences between the groups. These grades
consist of two main components: performance evaluation, assignment, and reflection of the practical part (65%), and the theoretical exam (35%). Demographic characteristics of each participant was also recorded.

Data analysis
SPSS versions 23 and 24 (IBM Corp., Armonk, NY, USA) was used for data analysis. Comparisons in clinical skills grades between the two groups were made using t-test. Normality was assessed before the analysis. Outcome measures of clinical skills were analyzed in a multiple linear regression model. \( P < 0.05 \) was considered significant.

RESULTS
Seventy-one RC students were included in the study and completed the CLEI questionnaire: 28 and 43 students were in the ECE and SCE group, respectively (39% vs 61%, respectively). Table 2 shows the general demographic characteristics of the study participants. About 55% of the participants were male. The mean age of both groups was similar (ECE: 21.0 ± 0.81 years; SCE: 20.9 ± 0.83 years).

Students in the ECE group had higher mean CLEI, satisfaction, personalization, student involvement, task orientation, and innovation scores than those in the SCE group; however, none of these were statistically significant [Table 3]. Similarly, there were no significant difference between both groups across all clinical practice grades [Table 4]. In the multiple linear regression, where clinical skills were the dependent variable and the CLEI scale was the independent variable, no significant difference was noted in the clinical grade in relation to clinical exposure [Table 5].

DISCUSSION

The study compared the clinical skills of RC students who have undergone simulation-based curriculum and traditional early clinical exposure curriculum and found no significant difference between both groups across all measured parameters. This finding is suggestive of SCE being a viable alternative to ECE in hospital wards for RC students, which can be of considerable benefit for training in resource-constrained settings.

ECE has been shown to produce higher competencies among students than those undergoing training after course completion. [13‑15] These studies showed that ECE motivates the students to put academic findings into practice; [13] improves their confidence, motivation and interpersonal skills; [14,16] prepares them for the clinical environment; [15] and helps improve their attitude and allows more experiences. [17] ECE in correspondence with theoretical courses can also provide a framework to develop the quality and application of basic sciences. [18] ECE also has positive cognitive, psychomotor, and affective domains, [19] and it helps students link their theoretical knowledge to the medical environment. [20]

Several factors may limit the implementation of ECE. One of those factors is limited availability of resources, such as clinical instructors and sites. Another factor is limited learning opportunities: for skills acquired in environments of low-frequency, high stakes, an equal opportunity may not be possible for all students in rotations. This highlights the need for alternatives. In nursing education, simulation has been shown to be a feasible alternative to ECE, as it allows students to experience difficult situations and scope for making mistakes without resulting in harm to patients. [21]

However, to the best of the authors’ knowledge, limited research has been conducted to provide robust evidence of using SCE for educational purposes in RTs, with most publications being recommendations. [21‑23] Therefore, the current study provides valuable insight for those involved in RT curriculum development. Our finding of SCE being a useful tool for RT educational purposes is in line with studies from other clinical domains such as medical, dental, and nursing education. [5,6,24,25]

The findings of this study should be interpreted with discretion given that the study had a small sample size in both groups and that the student population is representative of a single region of Saudi Arabia. Another limitation of
the current study was that a baseline evaluation was not obtained for both groups, which would have provided a more accurate comparison. Therefore, a study with a larger sample size would provide a more statistically powerful comparison and substantiate the findings of this study.

CONCLUSION

No significant difference was found between ECE and SCE in all measured clinical practice parameters. This indicates that SCE may be a viable alternative to ECE in RC training. Further similar studies are needed to examine the different methods of clinical education across institutions in Saudi Arabia and determine the most effective strategy for teaching RC students.

Ethical considerations

This study was approved by the Institutional Review Board of IAU, Dammam (Ref. no.: IRB-2018-203-CAMS, dated: February 02, 2018). The study adhered to the Declaration of Helsinki, 2013, and all measurements were carried out following the relevant guidelines and regulations. Informed consent was obtained from all participants before enrollment.

Data availability statement

The datasets generated and/or analysed during the current study are not publicly available due to privacy and confidentiality agreements as well as other restrictions but are available from the corresponding author on reasonable request.

Peer review

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Table 4: Mean scores of students’ clinical skills, as reflected by the clinical practice grades (n=71)

| Clinical skills            | ECE (n=28) | Mean (95% CI) | SCE (n=43) | Mean (95% CI) | P     |
|---------------------------|------------|---------------|------------|---------------|-------|
| Total clinical grade      | 167.29     | (164.74-169.84) | 166.88     | (164.12-169.65) | 0.837 |
| Clinical practical-I      | 61.64      | (60.85-62.42)  | 61.21      | (60.41-62.0)   | 0.451 |
| Clinical practical-II     | 61.18      | (59.95-62.41)  | 61.69      | (60.97-62.42)  | 0.436 |
| Clinical theory-I         | 23.28      | (22.19-24.37)  | 22.16      | (20.78-23.53)  | 0.239 |
| Clinical theory-II        | 21.1       | (19.7-22.6)    | 21.8       | (20.3-23.2)    | 0.548 |

CI: Confidence interval; ECE – Early clinical exposure; SCE – Simulation-based clinical education

Table 5: Multiple linear regression with clinical skills as a dependent variable, and the Clinical Learning Environment Inventory scale as an independent variable

| Independent variables | β [95% CI]   | P     |
|-----------------------|--------------|-------|
| Unadjusted            | Adjusted     |       |
| Clinical exposure     | -0.40 [−4.33-3.52] | -1.10 [−4.47-2.26] | 0.516 |
| CLEI score            | -0.43 [−1.21-0.35] | -0.09 [−0.78-0.59] | 0.788 |

CI: Confidence interval, CLEI: Clinical Learning Environment Inventory

Conflicts of interest

There are no conflicts of interest.

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