Original Article

Developing knowledge and clinical competency in a respiratory system-based practice of final-year medical students through a novel structured bedside teaching module

Lalita Fernandes, Anthony Menezes Mesquita

Abstract:

BACKGROUND: Respiratory diseases are a major cause of mortality and morbidity worldwide. A sound knowledge of management of respiratory diseases is thus very vital. The clinical exposure of undergraduate medical students is limited to 2 weeks in pulmonary medicine. We hypothesized that the short duration of posting can be best utilized by developing need-based modules for bedside teaching.

AIMS: This study aimed to determine gain in knowledge and skills of final-year medical students in diagnosis and management of common pulmonary diseases and assess students' perception of the module.

METHODS: A one-group pretest-posttest quasi-experimental study design enrolled a convenience sample of 48 final-year medical students. Twenty-four students were posted at a given time for the bedside clinical posting in pulmonary medicine between August 2013 and November 2013. These students were divided randomly into two groups of 12 students each. All students consented to be part of the study. Two trained faculty taught in rotation. The bedside teaching module was prepared by Delphi technique and curriculum was based on Kern's six-step approach. History taking, physical examination, tuberculosis, chronic obstructive pulmonary disease, asthma, lung cancer, chest X-rays, and spirometry were taught. Students were administered pre- and post-test questionnaires to assess knowledge, while Objective Structured Clinical Examination assessed skills. Students' feedback questionnaire evaluated the teaching module. A two-tailed paired sample *t*-test assessed mean gain in knowledge and skills. Effect size was calculated by Cohen's *d,* while Cronbach's alpha estimated the reliability testing of perception questionnaire. Statistical analysis was performed using statistical software package IBM SPSS version 23.

RESULTS: Mean pre- and posttest knowledge scores were 12.46 (8.09) and 43.17 (10.7), respectively, $P = 0.001$. Mean pre- and posttest skills scores were 7.00 (4.76) and 24.79 (3.31), respectively, $P = 0.001$, and Cohen's *d* showed large effect size. Most students stated that the module enhanced their clinical skills, helped to understand difficult material, and promoted inquiry and thinking. Cronbach's alpha for perception questionnaire was 0.854.

CONCLUSIONS: Structured bedside teaching module in pulmonary medicine improved the knowledge and skills of undergraduate medical students. The contents and various teaching methodologies were evaluated positively.

Keywords:

Curriculum, education, educational measurement, medical, teaching methods, undergraduate

Department of Pulmonary Medicine, Goa Medical College, Bardez, Goa, India

Address for correspondence:
Dr. Lalita Fernandes, CA 3/8, Sapana Gardens, Chogm Road, Alto Porvorim, Bardez - 403 521, Goa, India.
E-mail: drlalitafernandes@gmail.com

Introduction

Respiratory diseases are a major cause of mortality and morbidity worldwide.[1] Tuberculosis (TB) is a major infectious disease and in 2014, India contributed to 23% of the global TB load.[2] Chronic obstructive pulmonary disease (COPD) is currently the 3rd most common cause of death,[3] and asthma afflicts 235–300 million people worldwide.[4] Respiratory cancers cause 1.5 million deaths annually, which account for over 15% of all cancer-related deaths.[5] Over 50% of patients visiting doctors suffer from respiratory disorders,[6] and a significant proportion of patients report to primary care physicians. With respiratory diseases being a major health-care problem, there is a need to have a well-trained and competent workforce, focusing on the competencies defined by the Medical Council of India (MCI). Competency-based education helps integrate health needs of the country with the values of profession.[7,8]

All over the world including the United States, Canada, the United Kingdom, Australia, and New Zealand, there is a movement in clinical education toward an approach based on competencies.[8-10] The identified competence areas are developed through specific teachings with special focus on clinical information.

As per MCI guidelines, students are posted for clinical posting in pulmonary medicine for 2 weeks. The competencies identified by the MCI are knowledge of common chest diseases, clinical manifestations, diagnosis and treatment, ability to recognize, diagnose, and manage pulmonary TB as per the National Tuberculosis Control Program and ability to manage respiratory emergencies in primary care, and timely adequate referral to secondary or tertiary care centers.[11] Due to content overload, it becomes difficult to teach all relevant topics during this short duration. Hence, there is a need to develop innovative active teaching–learning modules which generate student interest and enthusiasm and transfer knowledge and skills in a healthy learning environment. Keeping this in mind, a need-based structured module for bedside teaching was developed.

Bedside teaching is defined as teaching in the presence of the patient, literally at the bedside, and is an important form of teaching during the medical studentship. It is an effective method to improve clinical and communication skills of students.[12-15]

Modular teaching has been used successfully.[16,17] The teaching modules are well-conceptualized, self-contained instructional units of content and technique aimed to develop competencies. The modules are offered as models to the instructor to follow the set objectives. We developed modules for bedside teaching as per identified competencies.

Therefore, the aim of the study was to determine the gain in knowledge and skills of final-year undergraduate medical students in the diagnosis and management of common pulmonary diseases by developing and implementing a bedside teaching module. The secondary objective was to assess students' perception on content and usefulness of the module.

We hypothesized that a structured bedside teaching module would significantly improve the knowledge and skills in the diagnosis and management of common respiratory diseases.

Methods

We performed an interventional study; quasi-experimental one-group pre- and posttest study design with convenience sampling. The study was approved by the Institutional Ethics Committee and conducted in accordance with the ethical principles stated in the Declaration of Helsinki.

The study was conducted in the chest diseases hospital of a tertiary care teaching institution from August 2013 to November 2013.

Twenty-four final-year (8th semester) medical students were posted at a given time for their bedside clinical posting in pulmonary medicine between August 2013 and November 2013. After informed consent, a total of 48 undergraduate final-year (8th semester) medical students posted in the wards of pulmonary medicine were enrolled. Each group of 24 students posted between August and November were randomly divided into two groups of 12 students each.

The bedside teaching module was prepared by the Delphi technique.[18] A panel of five faculty members of pulmonary medicine generated a consensus opinion on contents and methods of the bedside teaching module based on the respiratory health needs of our society. Three series of rounds finalized the module. The curriculum development was based on Kern's six-step approach.[19] Content covered was history taking, general examination, respiratory system examination, TB, COPD, asthma, lung cancer, pneumonia, chest X-rays, and spirometry. Briefly, the goals were to develop competencies in history taking and examination, narrowing the differential diagnosis, planning clinical management, questioning on areas not understood, and planning for self-directed learning. A guiding document (module) and a standardized checklist for faculty were prepared. Bedside teaching of general

examination and respiratory system examination was complemented by video presentations on the technique of examination. Teaching on TB, COPD, asthma, lung cancer, and pneumonia was based on " model of best teaching practices" where emphasis was given on attending to patient comfort, focused teaching of each case, and group dynamics. For focused teaching, the skills were taught and observed, stimulated professional thinking, problem-solving, decision-making, and finally provided feedback to students.

The independent variable (exposure) was the bedside teaching module and the dependent variable (outcome) was knowledge, skills, and students' perceptions. The students were administered a validated pretest multiple-choice and short answer questionnaire to assess knowledge (31 questions; a total score of 60), while skills were assessed by Objective Structured Clinical Examination (OSCE) (10 stations; a total score of 30). Then, two trained faculty members taught the group in rotation for 2½ h/day for 2 weeks. After completion of the bedside teaching module, students were assessed for knowledge by a similar posttest questionnaire and skills by OSCE. Students anonymously evaluated the contents and qualities of teaching on a Likert scale ranging from strongly agree to strongly disagree.

The pre- and posttest questionnaires consisted of 31 questions some of which were single best option, multiple true/false questions, and short answer questions. The OSCE consisted of ten stations which assessed the ability of chest percussion, demonstration of use of inhalers, chest radiograph interpretation, spirometry reading, and interpretation of clinical data. The Likert scale to assess students' perception on teaching module contained seven items; they were (a) helpful in application of theory knowledge, (b) helps understand difficult material, (c) enhances student's clinical skills, d) increases student's interest in subject, (e) provides a context that helps in retaining relevant information, (f) encouraged thinking and inquiry, and (g) recommend regular incorporation in curriculum. The various options for each item were strongly agree, agree, neutral, disagree, and strongly disagree. The outcome of each item was presented as proportions.

All data were tested for normality using P-P plots and Shapiro–Wilk test. Since assumptions of normality were met, descriptive data were presented using mean and standard deviation (SD) and categorical variables as percentages. Student's t-test was applied to assess gender differences and a two-tailed paired sample t-test was applied to assess mean gain in knowledge and skills. Effect size was calculated by Cohen's d, while Cronbach's alpha estimated the reliability testing of perception questionnaire. $P < 0.05$ was considered statistically significant. Statistical analysis was performed using a statistical software package IBM SPSS version 23 (IBM, USA).

Results

All students agreed to participate, with a response rate of 100%. Of the 48 study participants, 19 (39.6%) were male and 29 (60.4%) were female. The mean (SD) percentage of clinical posting attendance was 77.6 (14). Male and female students had similar characteristics [Table 1].

The knowledge and skills scores improved significantly after the introduction of teaching module, with mean pretest knowledge score of 12.46 (8.09) and posttest knowledge score of 43.17 (10.7). The mean difference was −30.7 (7.6), $P = 0.001$, with a correlation of 0.71. Furthermore, the pre- and postskills mean scores were 7.00 (4.76) and 24.79 (3.31), respectively, and the difference was a mean of −17.7 (5.3), $P = 0.001$, with correlation of 0.31 [Tables 2 and 3 and Figure 1]. Cohen's d showed a large effect size. Most students stated that the module enhanced their clinical skills, increased their interest in subject, and promoted inquiry and thinking. The students' perceptions are summarized in Figure 2. The Cronbach's alpha for students' perception questionnaire was 0.854 for all items, showing a good reliability of the questionnaire.

Discussion

In this study, we demonstrated that a structured bedside teaching module significantly improved the knowledge and skills in the diagnosis and management of common respiratory diseases among the final-year undergraduate medical students.

Measuring the impact of teaching may be difficult as many other factors may influence the learner performance.[20,21] However, this impact is measured as educational outcomes (student learning), practice outcomes (change in trainee practice), and health outcomes (effect on patient or population health).[22] Institutions determine the impact of current teaching methods by assessing the knowledge, skills, and attitudes

Table 1: Gender differences in knowledge, skills, and clinical posting attendance

	Males	Females	P
n	19	29	
Pretest questionnaire, mean (SD)	11.57 (8.68)	12.86 (7.71)	0.59
Posttest questionnaire, mean (SD)	40.31 (12.97)	45.10 (8.74)	0.13
Pretest OSCE, mean (SD)	6.78 (3.67)	7.27 (5.39)	0.73
Posttest OSCE, mean (SD)	25.13 (2.80)	24.57 (3.65)	0.57
Clinical posting attendance (%), mean (SD)	81.79 (12.28)	74.85 (15.36)	0.10

SD=Standard deviation, OSCE=Objective Structured Clinical Examination

Table 2: Students' mean scores of knowledge

	Mean (SD)	Mean difference (SD)	95% CI	P	Correlation
Pretest questionnaire	12.46 (8.09)	−30.7 (7.6)	−32.9–−28.4	0.001*	0.71*
Posttest questionnaire	43.17 (10.7)				

*Statistically significant. CI=Confidence interval, SD=Standard deviation

Table 3: Students' mean scores of skills

	Mean (SD)	Mean difference (SD)	95% CI	P	Correlation
Pretest OSCE	7.0 (4.76)	−17.7 (5.3)	−19.3–−16.2	0.001*	0.31
Posttest OSCE	24.79 (3.31)				

*Statistically significant. OSCE=Objective Structured Clinical Examination, CI=Confidence interval, SD=Standard deviation
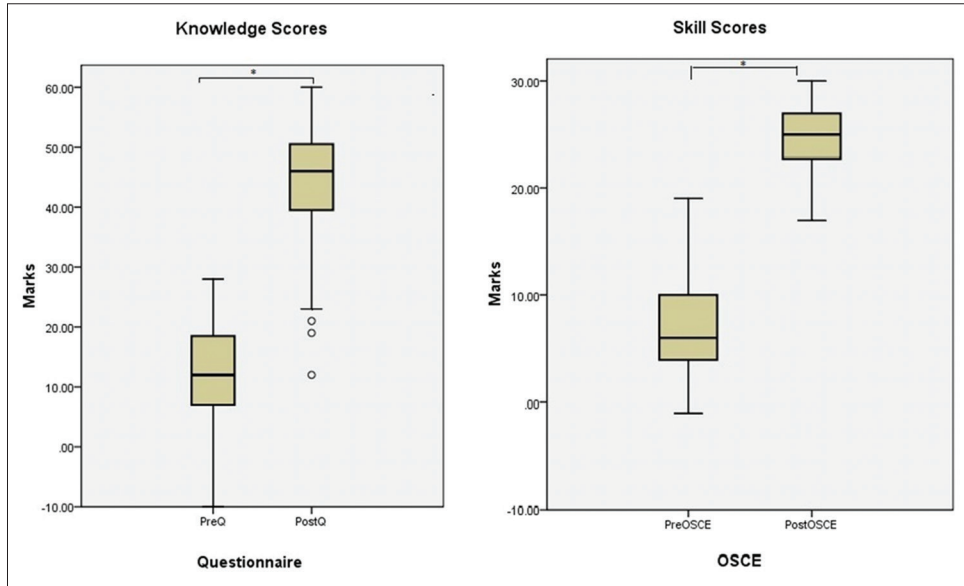

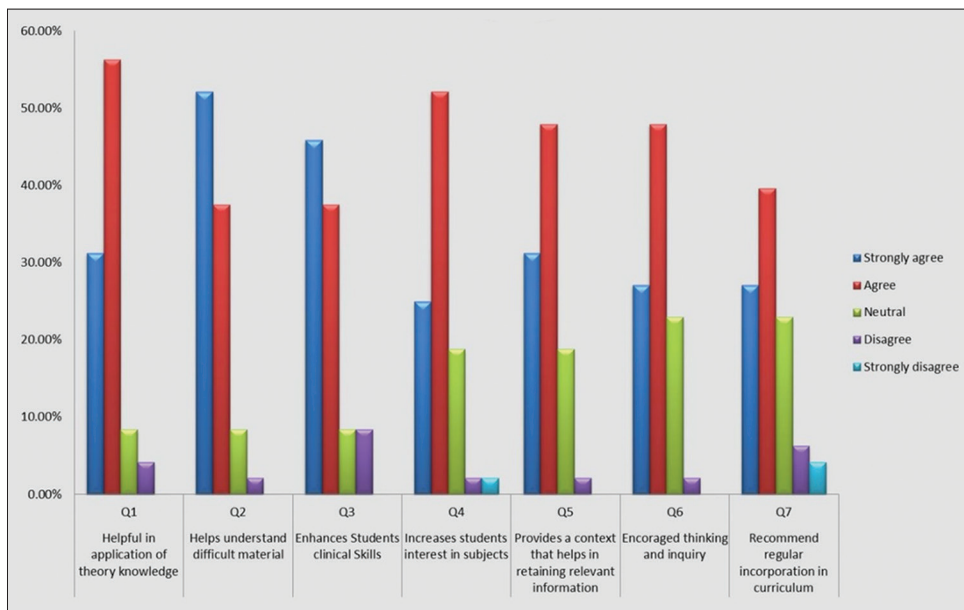Figure 1: Impact of Teaching. *=Statistically Significant

Figure 2: Students' evaluation of bedside teaching module

of learners. We evaluated the gain in knowledge and skills by using standard methods such as prevalidated questionnaires and OSCE. The baseline competencies were low which improved significantly postmodule;

change in knowledge to 71.9% and skills to 82.6%. Cohen's *d* showed a large effect size, demonstrating the magnitude of change. There was a high correlation in the knowledge score as compared to skills score. Correlation in a paired *t*-test means if correlation is high, then high score at time one is equal to high score at time two. A lower correlation in OSCE assessment is a well-known effect.

This is for the first time that we successfully adopted a novel modular pattern for bedside teaching specifically targeting those diseases that cause health concerns. These results provide further evidence that bedside teaching by structured modular training improves clinical skills in an effective way and this form of teaching is enjoyable to the students. We also compared male and female students and found no difference in their pre- and posttest scores. Both groups had low scores which improved significantly after the implementation of module.

There are not many prospective randomized studies on bedside teaching. Cooper *et al*. in a gastrointestinal bedside teaching of 4th-year medical students showed that history taking and physical examination skills improved and smaller groups had significantly better OSCE scores.[23] Another study involving 6th-year medical students with bedside teaching in neurology showed that scores of bedside teaching group improved significantly.[24] Similar observations were found in cardiology teaching.[25] We could not find studies done nationally to compare our results.

Traditionally, the entire group is taught as one unit. In this teaching program, we created small group teaching so that students benefitted in clinical reasoning and communication skills observation. We employed specific instructional strategies to maximize the use of resources for learning. There was active participation by students which was appreciated by students and faculty. Students reported that they strongly agreed that the module helped them to understand difficult material (52.08%) and enhanced their clinical skills (45.83%). Most agreed that the module was helpful in application of theoretical knowledge (56.25%), provided a context that helps in retaining relevant information (47.92%), increased interest in the subject (52.08%), and encouraged thinking and inquiry (47.92%). All these factors improved the competence and confidence of medical students and they recommended regular incorporation of the module in their curriculum. The Cronbach's alpha for students' perception questionnaire was 0.854 for all items, showing a good internal consistency of the questionnaire.

One noteworthy feature was that students were 4 months away from final examinations and were eager to learn, showing a good average attendance of 77.6%. The

challenge for this module was that the trainers had to be well trained to ensure proper coverage of the module.

Our study has a few limitations. Ideally, the study design should have been a randomized controlled study, with one group teaching the conventional way and the other using modules. However, students would have shared the module with the control group causing contamination. Also, due to time constraint, we would not have had enough time to expose this control group to the bedside teaching module if it proved to be better than the conventional form of bedside teaching. Moreover, in the paired sample design, the group acts as its own control and we can assess the differences in gain better. The modular form of teaching helps the teacher to know the objectives, content, and methods of delivery and hence there is preparedness on the part of the teacher and interest in the students.

Since we included available students in the study rather than estimating a sample size, we performed *post hoc* power calculations and obtained a power of >95% indicating that the Type 2 error is extremely low. This is reasonable as the pre-post differences are large.

Conclusions

Our study suggests that bedside teaching can be structured on need-based modules for successful learning outcomes when there are time constraints. Small group teachings should be encouraged for wider student participation as medical students find it very rewarding. This module may be replicated to study its reproducibility and usefulness in pulmonology and other health disciplines.

Conflicts of interest
There are no conflicts of interest.

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