Distance Learning Course for Healthcare Professionals: Continuing Education in Tuberculosis

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Abstract

Background: *Continuing education of healthcare workers (HCWs) is an essential strategy for the control of tuberculosis (TB) transmission, enabling HCWs in early detection and appropriate treatment of TB cases.*

Methods: *We developed a distance learning (DL) course on TB for nurses. We conducted a quasi-experimental before and after study to evaluate the DL community at the participant's learning level. In addition, to evaluate the DL community at the level of participant satisfaction, a cross-sectional study was carried out after the course. Nurses involved in active inpatient or outpatient care of patients were recruited to participate in the study.*

Results: *Sixty-six participants started and completed the course and they were included in the analysis. The overall mean pretest and post-test scores were 10.3 ± 2.2 and 11.4 ± 2.7, respectively. Participants increased their knowledge to a statistically significant degree ($p < 0.0001$). At baseline, the frequency of correct answers was very low in some questions: number of people infected by* Mycobacterium tuberculosis *in the world (10.6%); number of TB cases in Brazil (36.4%); contagiousness of latent TB infection (LTBI) (28.8%); and definition of active case finding (45.5%). Course feedback was mostly positive, with majority of users saying they were satisfied or totally satisfied.*

Conclusions: *A brief DL course on TB was associated with some improvement in knowledge among nurses. The baseline knowledge was low regarding TB epidemiologic data, concepts on LTBI, and active case finding. This finding emphasizes the need to further improve the competencies and knowledge of nurses.*

Keywords: *tuberculosis, distance education, information technology, distance learning, continuing education, health education, e-health*

Introduction

Tuberculosis (TB) is a major public health problem worldwide, particularly in low- and middle-income countries. It is estimated that one-third of the world population is infected with *Mycobacterium tuberculosis*. Brazil is in 16th place among the 22 countries that collectively account for 80% of TB cases globally, with reported incidence of 30.9 cases/100,000 inhabitants/year in 2015.[1] Porto Alegre is the second Brazilian capital with the highest number of TB cases, with an incidence of 88.8 cases/100,000 inhabitants, and a high percentage of TB-HIV (25.2%).[2]

The essential components of TB control are early diagnosis and appropriate treatment.[1] Several studies with TB patients showed a long time until the start of treatment.[3–7] One of the possible explanations for this delay would be the lack of recognition of TB symptoms by healthcare workers (HCWs) due to nonspecific symptoms or radiological findings of TB, especially in areas with a high prevalence of HIV infection.[8–10] It is known that the delay in diagnosis is an important risk factor for mortality and dissemination of TB.[11–13]

For the control of TB transmission within health institutions, administrative, environmental (or engineering), and respiratory protection measures are recommended. Environmental measures are considered second line and do not function without administrative measures.[14] Continuing education of HCWs is one of these administrative measures and is an essential strategy for the control of TB transmission, enabling HCWs in early detection and appropriate treatment of TB cases.[15] The quality of this training has a strong influence on the quality of care provided to the patient. To improve the quality of TB training in developing countries, it is suggested that a minimum training curriculum be developed and revised regularly.[16] Continuing education includes face-to-face and distance learning (DL) methods. The globalization of DL provides many opportunities

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for developing countries to scale up TB training at a fraction of the cost of learning approaches in the classroom. DL is a strategy that has become popular,[16] especially in healthcare.[16–18] Because of the limited time available, different work shifts, and high employee turnover in some hospital settings, DL is a very interesting approach to continuing TB education for HCWs. The objective of this study is to design a teaching community in the modality of DL focused on continuing education in TB for HCWs.

Materials and Methods

STUDY DESIGN AND LOCATION

A DL course on TB for healthcare professionals, specifically nurses, was developed. We conducted a quasi-experimental before and after study to evaluate the DL community at the participant's learning level. In addition, to evaluate the DL community at the level of participant satisfaction, a cross-sectional study was carried out after the course. Nurses involved in active inpatient or outpatient care of patients in the city of Porto Alegre and its metropolitan area that encompasses 31 municipalities (3,717,430 inhabitants) were recruited to participate in the study. The study was approved by the Ethics Committee at Hospital de Clínicas de Porto Alegre on January 16, 2016 (number 15-0574).

DL COURSE

The pedagogical model used was structured as follows[19]:

Organizational aspects. The objectives of this program are to update the participants about the main concepts in TB and to guide healthcare professionals about the clinical practice on TB care. The course was conducted in four modules of about 30 min each, including a pretest to evaluate the participant's current knowledge and a post-test with repetition of the pretest questions to find out what users learned from the module. Participants could take the course at any time; however, there was a period of 4 weeks to complete the course. The course coordinator was available by email to clear up any doubt regarding the course. A certificate was provided for each participant upon completion of the course (the test results were not considered in completion, it was a participation certificate).

Content. The content was addressed in different modules: (1) Module 1: TB Concepts and Epidemiology; (2) Module 2: Development of TB; (3) Module 3: Detection of TB cases; and (4) Module 4: TB Transmission and Biosafety Basics.

Methodological aspects. Lessons were in the form of written text on slide show presentation. Participants' satisfaction and learning were assessed according to Kirkpatrick's training program evaluation model.[17] To evaluate the DL community at participants' level of satisfaction; a questionnaire was carried out after the course. It was an electronic structured questionnaire with a Likert-type scale (totally dissatisfied, dissatisfied, satisfied, and totally satisfied), adapted from Giarola et al.,[20] including questions about course design, methodology, content, assessments, interaction with course coordination, and use of DL method. To evaluate the DL community at the participants' level of learning, a quasi-experimental before and after study was carried out, with pre- and post-tests in each module. The tests were distributed as follows: Module 1 (four questions), Module 2 (four questions), Module 3 (four questions), and Module 4 (three questions). A score for the pretest and a score for the post-test were calculated, which varied from 0 to 15.

Technological aspects. The DL course was developed within a virtual learning environment (VLE), that is, computer systems available on the Internet, intended to support activities mediated by information and communication technologies that allow integration of multiple mediums, languages, and resources to present information in an organized way, to develop interactions between people and objects of knowledge, and to elaborate and socialize productions to achieve certain objectives.[21] The VLE used was Moodle. Moodle is the acronym for Modular Object-Oriented Dynamic Learning Environment, a free learning–support software.

PARTICIPANTS

After the development of the DL course, face validation of the course/questions was conducted by colleagues in the Pulmonology Department. In addition, the DL course was tested in a group of participants (10 nurses). The data obtained were not included in the study because the purpose of this validation was to test the course for readability and ease of understanding.

Registered nurses involved in active inpatient or outpatient care of patients in the city of Porto Alegre and its metropolitan area were recruited to participate in the study.

STATISTICAL ANALYSIS

Data analysis was performed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY). Data are presented as number of cases, mean ± standard deviation (SD), or median with interquartile range. We measured learners' baseline knowledge (pretest) and knowledge upon completion of the learning modules (post-test). A score for the pretest and a score for the post-test were calculated. The Wilcoxon test

was used to assess if the learners increased their knowledge to a statistically significant degree. A value of $p<0.05$ was considered as statistically significant.

The sample size calculation for the before and after study was based on data of a previous study[22] that found an increase in the scores of 12.1% (with an SD of 2.5%) after a DL course on infectious diseases (TB, malaria, and HIV/AIDS). Thus, considering an expected magnitude of effect of 12.1 with an SD of 2.5, a beta error of 0.20, and a confidence level of 95%, we estimated a sample size of 51 participants.

Results

During the study period, 99 nurses who met the inclusion criteria were invited and accepted to participate in the study. However, only 66 started and completed the course and they were included in the analysis.

The overall mean pretest and post-test scores were 10.3 ± 2.2 and 11.4 ± 2.7, respectively. Wilcoxon's test showed that learners increased their knowledge to a statistically significant degree ($p<0.0001$). *Table 1* shows the distribution of frequency of correct answers in pretest and post-test. At baseline, participants demonstrated an overall good knowledge in many topics covered by the DL course. However, the frequency of correct answers was very low in some questions: number of people infected by *M. tuberculosis* in the world (10.6%); number of TB cases in Brazil (36.4%); contagiousness of latent TB infection (LTBI) (28.8%); and definition of active case finding (45.5%). There was statistically significant improvement in the first two questions comparing pre- and post-test, but the last two questions remained with a low percentage of correct answers (48.5% and 43.9%, respectively). We also found a statistically significant worsening in the frequency of correct answers after the course in two questions: conditions and diseases associated with increased risk of TB and responsibilities of healthcare services regarding TB control.

On completion of the course, participants were asked to give feedback through an electronic structured questionnaire with a Likert-type scale. *Table 2* shows the distribution of frequencies/percentages regarding the participants' responses to the items on satisfaction questionnaire. Feedback was mostly positive, with the majority of users saying they were satisfied or totally satisfied. The majority of participants were totally satisfied with course content (80.3%), activities (78.8%), ease of access to course coordination (78.8%), content update (78.8%), and that learning focuses on subjects of interest (83.3%).

Table 1. Distribution of Frequency of Correct Answers in Pretest and Post-test

	PRETEST, *N* (%)	POST-TEST, *N* (%)	*p*
Causative agent of TB	57 (86.4)	66 (100)	0.003
Factors associated with worldwide resurgence of TB	40 (60.6)	40 (60.6)	–
Number of people infected by *Mycobacterium tuberculosis* in the world	7 (10.6)	47 (71.2)	<0.0001
Number of TB cases in Brazil	24 (36.4)	48 (72.7)	<0.0001
Immune system is important against TB	54 (81.8)	65 (98.5)	0.001
LTBI is not transmissible	19 (28.8)	32 (48.5)	0.005
Conditions and diseases associated with increased risk of TB	40 (60.6)	30 (45.5)	0.041
Symptoms of pulmonary TB	48 (72.7)	43 (65.2)	0.059
Early diagnosis and treatment are the most important measures for the control of TB	59 (89.4)	62 (93.9)	0.083
Definition of bacilliferous patient	62 (93.9)	60 (90.9)	0.317
Definition of symptomatic respiratory patient	58 (87.9)	60 (90.9)	0.480
Definition of active case finding	30 (45.5)	29 (43.9)	0.841
How is TB transmitted	60 (90.9)	61 (92.4)	0.317
Contacts of TB patients should be evaluated	60 (90.9)	61 (92.4)	0.317
Responsibilities of healthcare services regarding TB control	60 (90.9)	50 (75.8)	0.004

LTBI, latent tuberculosis infection; TB, tuberculosis.

Table 2. Participants' Satisfaction with Distance Learning Course on Tuberculosis

	TOTALLY DISSATISFIED	DISSATISFIED	SATISFIED	TOTALLY SATISFIED
Course design	0 (0)	1 (1.5)	41 (62.1)	24 (36.4)
Methodology	0 (0)	1 (1.5)	41 (62.1)	24 (36.4)
Interaction with course coordination	0 (0)	0 (0)	46 (69.7)	20 (30.3)
Appropriate methodology tools	1 (1.5)	0 (0)	48 (72.2)	17 (25.8)
Course content: relevance, suitability of content, and organization	0 (0)	0 (0)	13 (19.7)	53 (80.3)
Activities: Relevance, degree of difficulty and time required, speed of responses, and level of readability of materials	0 (0)	1 (1.5)	13 (19.7)	52 (78.8)
Assessments: frequency, relevance, quantity of topics, and difficulty	0 (0)	1 (1.5)	54 (81.8)	11 (16.7)
Adequacy of content to the course schedule	0 (0)	0 (0)	52 (78.8)	14 (21.2)
Number of materials/contents in the VLE	0 (0)	0 (0)	40 (60.6)	23 (34.8)
Access to information on decisions taken by the course coordinator	0 (0)	0 (0)	52 (78.8)	13 (19.7)
Information about course rules and standards	0 (0)	1 (1.5)	48 (72.2)	17 (25.8)
Ease of access to course coordination	0 (0)	0 (0)	14 (21.2)	52 (78.8)
Content update	0 (0)	1 (1.5)	13 (19.7)	52 (78.8)
Good communication between the student and coordinator	0 (0)	0 (0)	48 (72.2)	17 (25.8)
The learning focuses on subjects of interest	0 (0)	0 (0)	11 (16.7)	55 (83.3)
Learning in the VLE is important for my professional practice	0 (0)	0 (0)	38 (57.6)	28 (42.4)
Stimulus of the course to follow my career	0 (0)	0 (0)	54 (81.8)	12 (18.2)
Stimulus of the course to continue studying at a distance	0 (0)	0 (0)	45 (68.2)	21 (31.8)
Labor market stimulation for DL students	0 (0)	2 (3.0)	40 (60.6)	24 (36.4)
Clarity of course objectives and mission	0 (0)	1 (1.5)	35 (53.0)	30 (45.5)

Data are presented as numbers (%).

DL, distance learning; VLE, virtual learning environment.

Discussion

This study demonstrates that a brief DL course on TB was associated with some improvement in knowledge among nurses. In addition, the baseline knowledge was low regarding TB epidemiologic data and concepts on LTBI and active case finding. In addition, the majority of users were satisfied or totally satisfied with the course.

The first and most important level of a TB infection control program is the use of administrative measures to reduce the risk of exposure to persons who might have TB disease. Education and training of HCWs on TB infection and disease are essential parts of a TB infection control program and can increase adherence to TB infection control measures.[23] Available evidence suggests significant improvements with continuing education[24–26]; however, the quality and intensity of training vary widely.[27] It is well known that quality of training has a strong influence on the quality of care provided to patients and on the efficiency of TB programs. A minimum TB training curriculum should be standardized and incorporated into continuing education of HCWs.[27]

In this context, DL programs provide flexible and cost-effective opportunities to scale up TB training, especially in developing countries. Even in settings with very limited internet connectivity, DL courses proved to be valuable and feasible. In the present study, we demonstrated that a brief DL course on TB was associated with an overall improved knowledge among nurses. One DL course that also focused on TB (diagnosis, treatment, and prevention) and involved 235 students in India and Pakistan resulted in improvements in knowledge.[28] Two other studies[22,29] used the DL method to improve knowledge on TB (and other infectious diseases) of

primary care professionals and showed an increase in knowledge and clinical competence.

At baseline, less than 40% participants answered correctly to questions about basic TB epidemiology data. There are several studies reporting that knowledge of nurses about TB is inadequate and needs improvement.[30–32] Singla et al.[32] showed that a substantial number of nurses have inadequate knowledge regarding TB causative factors, the importance of sputum examination, correct doses and duration of TB treatment, and health education instructions for patients. In addition, only 40.2% of TB nurses and 10.7% of general hospital nurses had a satisfactory level of awareness. It is noteworthy that knowledge influences the behavior and practices of HCWs. Since nurses are directly involved in many aspects of TB control, the strengthening of health education on TB for them would be necessary.

We also found a very low knowledge about LTBI and active case finding. A possible reason for this could be that both topics are relatively new and not many nurses were aware about it. In the post-test, these topics remained with a low percentage (less than 50%) of correct answers, which reinforce the need of a more intense training regarding LTBI and active case finding. Another surprising finding of the present study was a reduction in the percentage of correct answers in the post-test in two questions: conditions and diseases associated with increased risk of TB and responsibilities of healthcare services regarding TB control. Eventually, there may have been difficulty understanding due to the approach adopted in the course. We will use these findings to improve the approach to these topics in a future DL course.

This study has some methodological limitations. We used a small sample size and a before and after study, with no control group, so we cannot presume that the changes in participants' knowledge were attributable only to the DL course. Additionally, many individuals met the inclusion criteria, were invited, and accepted to participate in the study, but did not start and complete the course. Some possible explanations are that they were uncertain about the benefit of participating in a DL course related to TB or maybe they lack the experience and training required to use the computer and an LVE. While cell phones may be optimal tools for many settings, many individuals may be unfamiliar with computers.[28] Furthermore, we only evaluated the quality of TB training at the participant level. It will be interesting to assess the impact of training on job behavior. In addition, mainly post-DL improvements were registered in basic epidemiology fields, so it would be necessary to add more questions of clinical (diagnosis, care, prevention) importance, once one of the objectives of this DL course was to guide healthcare professionals about the clinical practice on TB care. However, despite these limitations, the findings of the present study highlight the importance of DL course in expanding access to training and increasing knowledge levels.

In conclusion, in the present study, we demonstrated that a brief DL course on TB was associated with some improvement in knowledge among nurses. The baseline knowledge was low regarding TB epidemiologic data and concepts on LTBI and active case finding. These findings emphasize the need to further improve the competencies and knowledge of nurses.

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Disclosure Statement

No competing financial interests exist.

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