Knowledge and practices regarding tuberculosis: a survey of final-year medical students from Canada, India and Uganda

J Emili,1 G R Norman,2 R E G Upshur,3 F Scott,4 K R John5 & M L Schmuck6

Context Tuberculosis is one of the most common infectious diseases worldwide and is responsible for the largest number of deaths from a single infectious cause.

Objective The objective of this study was to compare the knowledge of and practices regarding tuberculosis in final-year medical students at schools from endemic and non-endemic areas.

Subjects Final-year medical students at McMaster University in Canada, the Christian Medical College in India, and Makerere University in Uganda.

Methods A questionnaire consisting of 20 multiple-choice questions assessing knowledge, practices, and exposure. A total knowledge score (maximum $\leq 13$) and a total practice score (maximum $\leq 5$) were created for each study site.

Results 160 questionnaires were returned; the response rate was 68\% (65/95) for McMaster University, 39\% (23/58) for the Christian Medical College and 78\% (72/92) for Makerere University. Students from Makerere University had the highest knowledge scores but differences were non-significant after adjustment for patient exposure and curriculum time ($F(2,153) = 1.80$, $P = 0.16$). Differences in practice scores, however, remained significant after adjusting for curriculum time and patient exposure ($F(2,153) = 5.14$, $P = 0.006$). Knowledge score ($F(1,156) = 5.05$, $P = 0.02$), patient exposure ($F(1,153) = 9.11$, $P = 0.003$), and curriculum time and patient exposure ($F(2,153) = 5.14$, $P = 0.006$) were statistically significant positive predictors of the total practice score.

Conclusions This study demonstrated significant differences in undergraduate exposure to tuberculosis, total knowledge, and practice competency at three medical schools in Canada, India, and Uganda. In general, the knowledge base and practice competency of all three graduating classes was adequate.

Keywords ANOVA; Canada; clinical competence; education, medical, undergraduate; *standards; India; questionnaires; tuberculosis, *diagnosis, therapy, epidemiology; Uganda.

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Introduction

Tuberculosis is one of the most common infectious diseases worldwide and is responsible for the largest number of deaths in the world from a single infectious cause. Tuberculosis continues to be a major public health problem in both developed and developing countries as one-third of the world’s population is infected with Mycobacterium tuberculosis. In 1993, the World Health Organization declared a world emergency on tuberculosis, the first disease to be so designated by the organization. Of new active cases, 95\% occur in the developing world, the majority from Asia and Africa; 80\% of these cases occur in people in their reproductive years (15–59 years of age).1 In 1997, the World Health Organization estimated that new cases of tuberculosis totalled 8 million, including 3.5 million cases of infectious pulmonary disease. An estimated 2 million people died of tuberculosis, and the global case fatality rate was 23\% but exceeded 50\% in some African countries with high HIV rates.2 If worldwide control of tuberculosis does not improve, the annual incidence of the disease is expected to increase by 41\%
Knowledge regarding tuberculosis in final-year medical students • J Emili et al.

Key learning points

Tuberculosis is one of the most common infectious diseases worldwide and is responsible for the largest number of deaths from a single infectious cause.

80% (56/70) of Makerere students and 65% (15/23) of Christian Medical College students reported >7 curricular days spent on tuberculosis, while 94% (61/65) of McMaster students indicated <8 hours (Yates’ corrected chi-squared = 116.987, d.f. = 8, \( P = 0.0000 \)).

In the previous six months, 76% (55/72) of Makerere students estimated that they saw >25 patients with active tuberculosis and 91% (21/23) of Christian Medical College students saw >10 patients, while 77% (50/65) of McMaster students had not seen any patients with tuberculosis (Yates’ corrected chi-squared = 156.721, d.f. = 6, \( P = 0.0000 \)).

On average, higher total knowledge scores (maximum = 13) were achieved by students from Makerere (mean = 9.35, SEM = 0.141) and the Christian Medical College (mean = 9.40, SEM = 0.352) than by McMaster students (mean = 8.11, SEM = 0.224).

School differences in the knowledge score were negligible after adjusting for curriculum time and patient exposure \( F(2,153) = 1.80, P = 0.16 \).

Differences in the practice score remained significant after adjustment for curriculum time and patient exposure \( F(2,153) = 5.14, P = 0.006 \).

(3 million to 10.6 million cases per year.\(^3\)

How well are physicians managing patients with tuberculosis? The available literature shows considerable variability in the prevention, evaluation, and treatment strategies used by physicians worldwide.\(^4\)–\(^8\)

Studies of physician management of tuberculosis indicate less than optimal performance and highlight the need for further education and training in issues relating to tuberculosis.\(^9\)–\(^13\)

Physicians today and in the future need to be aware of the epidemiology, determinants, screening, and management of re-emerging infections such as tuberculosis. A recent report released by the World Health Organization emphasized the importance of undergraduate training in tuberculosis and outlined a comprehensive educational strategy to ensure students graduate with the appropriate knowledge, skills, and attitudes essential to the effective management of tuberculosis.\(^14\)

Despite the resurgence of tuberculosis, there is no information available which examines the competence of medical school graduates in providing appropriate and comprehensive care for patients with tuberculosis. The objective of this study was to compare the knowledge of and practices regarding tuberculosis in final-year medical students at three medical schools from endemic and non-endemic areas. We hypothesized that the schools would differ significantly in the number of hours in the curriculum devoted to tuberculosis and in the number of patients with active tuberculosis which students see. Consequently, we further hypothesized that the disparity in the number of hours allocated and number of patients seen would result in higher levels of awareness, knowledge, and competency at the schools in areas where tuberculosis is endemic.

Methods

The questionnaire was administered to final-year medical students in the last months of each student’s training, during a 6-month period from November 1998 until April 1999. The three institutions surveyed were McMaster University (65 students) in Canada, the Christian Medical College (23 students) in India and Makerere University (72 students) in Uganda. Ethical approval for the project was obtained at each of the study sites. All final-year students at each of the institutions were included in the sample and given the questionnaire. Students were asked to circle the most appropriate answer without referring to any resources to aid in the completion of the questionnaire. Participation was on a voluntary basis and confidentiality was assured as no identifying data were required of the participants. Students were provided with incentives to complete the questionnaire. At McMaster University, coffee was provided and after the questionnaire was completed the answers were discussed and students had the opportunity to ask questions. In India, several textbooks were donated to the main Medical Library at the suggestion of the students. In Uganda, students were provided with refreshments and a monetary donation of approximately $100 Canadian dollars was given to the Makerere Medical Student Council to be used at their discretion.

The questionnaire consisted of 20 multiple-choice questions, assessing knowledge, practices, and expo-
sure. The questions addressing knowledge and practice were compiled and modified from various self-study and examination booklets. The guidelines used to define appropriate management decisions were based on international guidelines endorsed by the World Health Organization. The initial survey was critiqued by a panel of experts in the fields of statistics and epidemiology, community medicine, family medicine, public health and respirology. The survey was then pilot tested by students in Hamilton, Canada, and India, none of whom were included in the study population.

**Statistical analysis**

The knowledge and practice items were analyzed using analysis of variance (ANOVA) and analysis of covariance (ANCOVA) designs to look for mean score differences among the three sites. After comparing the choice of categorical responses among the schools, the important elements of exposure (curriculum time and number of patients seen) were used in a more refined analysis of covariance. It was hypothesized at the outset and confirmed with exploratory descriptive statistics that exposure to a disease could influence clinical practice patterns. Therefore any adjusted means which are reported reflect the ‘true’ differences among the students’ knowledge and competency after accounting for two identified ‘situational’ constraints.

**Results**

A total of 160 questionnaires were returned. The response rate was 68.4% (65/95) for McMaster University, 39.7% (23/58) for the Christian Medical College, and 78.3% (72/92) for Makerere University. Due to the anonymous nature of the survey, we had no information about the non-responders.

**Education and exposure**

Table 1 shows the number of curriculum hours devoted to tuberculosis and the number of patients with active tuberculosis seen by students in the 6 months prior to the survey. It was reported by 80% (56/70) of Makerere students and 65% (15/23) of Christian Medical College students that >7 curricular days had been spent on tuberculosis. McMaster students estimated that significantly less time was spent on tuberculosis education, with 94% (61/65) of respondents indicating <8 hours of curricular time (Yates’ corrected chi-squared = 116.987, d.f. = 8, \( P = 0.0000 \)). In the previous 6 months, students from Makerere and the Christian Medical College had seen significantly more patients with tuberculosis than students at McMaster (Yates’ corrected chi-squared = 156.721, d.f. = 6, \( P = 0.0000 \)). Of the Makerere students, 76% (55/72) estimated that they had seen >25 patients; 91% (21/23) of Christian Medical College students had seen >10

<table>
<thead>
<tr>
<th></th>
<th>Canada McMaster University</th>
<th>India Christian Medical College</th>
<th>Uganda Makerere University</th>
<th>Total</th>
<th>Comparison between schools: Yates’ corrected chi-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Curriculum time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 hour</td>
<td>26</td>
<td>1</td>
<td>0</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>1–8 hours</td>
<td>35</td>
<td>2</td>
<td>5</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>2–3 days</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4–7 days</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>&gt;7 days</td>
<td>0</td>
<td>15</td>
<td>56</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>65</td>
<td>23</td>
<td>70</td>
<td>158</td>
<td></td>
</tr>
<tr>
<td><strong>Number of patients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>50</td>
<td>1</td>
<td>0</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>&lt;5</td>
<td>14</td>
<td>1</td>
<td>0</td>
<td>15</td>
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<tr>
<td>10–20</td>
<td>0</td>
<td>12</td>
<td>17</td>
<td>29</td>
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</tr>
<tr>
<td>&gt;25</td>
<td>1</td>
<td>9</td>
<td>55</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>65</td>
<td>23</td>
<td>72</td>
<td>160</td>
<td></td>
</tr>
</tbody>
</table>

116.987, d.f. = 8, \( P = 0.0000 \).

156.721, d.f. = 6, \( P = 0.0000 \).
patients, while 77% (50/65) of McMaster students had never seen any patients with tuberculosis.

Knowledge

A total of 13 multiple-choice questions were designed to evaluate the students’ knowledge of tuberculosis. The questions covered epidemiology, aetiology, pathogenesis, transmission, diagnosis, clinical presentation, BCG vaccination, and treatment. A total knowledge score, out of a maximum of 13 items, was created for each study site. Using ANCOVA, Table 2 shows the unadjusted and adjusted total knowledge scores for each country. Students from Makerere (mean $\bar{x} = 9.35, \text{SEM} = 0.141$) and the Christian Medical College (mean $\bar{x} = 9.40, \text{SEM} = 0.352$) achieved higher scores on average than McMaster students (mean $\bar{x} = 8.11, \text{SEM} = 0.224$). School differences in the knowledge score were negligible after adjusting for curriculum time and patient exposure $F(2,153) = 1.80, P = 0.16$.

Table 3 illustrates the positive influence of curriculum time and patient contact on total knowledge scores. Two separate one-way ANOVA designs were used to show the positive influence of exposure on the student’s ability to correctly answer the knowledge items. The results in both cases indicated a highly significant $F$ test, a strong relation between curriculum time, patient exposure, and scores on the knowledge test.

Practices

Five scenarios were used to assess the students’ ability to appropriately provide care for patients with tuberculosis. The scenarios encompassed: (1) diagnosis of active tuberculosis; (2) treatment of active tuberculosis in an HIV-positive patient; (3) initiation of chemoprophylaxis in a positive contact; (4) management of side-effects of antituberculosis therapy, and (5) evaluation of an asymptomatic patient with an upper lobe nodule found on X-ray.

Table 2 Total knowledge score (unadjusted and adjusted)

<table>
<thead>
<tr>
<th>Location/university</th>
<th>Total knowledge score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada McMaster University</td>
<td>Unadjusted: 7.68, Adjusted: 8.11</td>
</tr>
<tr>
<td>India Christian Medical College</td>
<td>Unadjusted: 9.62, Adjusted: 9.40</td>
</tr>
<tr>
<td>Uganda Makerere University</td>
<td>Unadjusted: 9.71, Adjusted: 9.35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location/university</th>
<th>SEM</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada McMaster University</td>
<td>0.224</td>
<td>27</td>
</tr>
<tr>
<td>India Christian Medical College</td>
<td>0.352</td>
<td>42</td>
</tr>
<tr>
<td>Uganda Makerere University</td>
<td>0.141</td>
<td>21</td>
</tr>
</tbody>
</table>

A total practice score for each country was created to assess competency in tuberculosis management issues using the five practice scenarios (maximum = 5). An analysis of covariance design was used to examine the possible influence of patient exposure and curriculum time on the total practice score. Table 4 shows the unadjusted and adjusted means for the total practice score of each of the sites adjusted for these two factors. Differences in practice scores remained significant after adjusting for curriculum time and patient exposure ($F(2,153) = 5.14, P = 0.006$). Knowledge score ($F(1,156) = 5.05, P = 0.02$), patient exposure ($F(1,153) = 9.11, P = 0.003$) and the synergistic actions of curriculum time and patient exposure ($F(2,153) = 5.14, P = 0.006$) were statistically significant positive predictors of the total practice score.

Discussion

This study demonstrated significant differences in undergraduate exposure to tuberculosis, total knowledge, and practice competency at three medical schools in Canada, India, and Uganda. In general, the
knowledge base and practice competency of all three graduating classes was adequate.

Our first hypothesis that there would be a significant difference in both curriculum time devoted to tuberculosis and the number of patients with tuberculosis seen by medical students at the three sites was confirmed. Our second hypothesis was that because of the disparity in exposure, students in endemic areas would have increased awareness, knowledge, and competency in tuberculosis issues. The basic level of knowledge was similar at each of the sites. McMaster students performed well on questions assessing basic knowledge despite both limited curricular time and patient exposure. This may be partly explained by the fact that the students were attending review lectures at the time the survey was administered, which included tuberculosis topics, and were also in the process of studying for their licensing exams, thus solidifying the information presented. So even though McMaster students received limited teaching about tuberculosis, a significant portion of this was done near the completion of their studies thus providing them with adequate knowledge upon graduation.

The difference between the countries was most evident in the practice scores. Overall, Makerere students performed consistently better than the students at the Christian Medical College and McMaster. Interestingly, when practice scores were adjusted for curriculum time and patient exposure, the significant effect of university disappears ($F(2,153) = 2.62, P = 0.075$). The mean practice score dropped for Makerere and the Christian Medical College when adjustment was made for these two familiarity factors, while McMaster’s mean increased (see Table 4). The adjusted practice scores again highlight how well McMaster students performed considering both limited curricular and clinical time.

Although the students at Makerere reported the highest number of curricular hours devoted to tuberculosis and saw the greatest number of patients, these two factors alone did not account for the better performance of Makerere students. Adjusting for these two exposure variables had minimal effect on the mean knowledge scores. The educational strategy used at each institution may help to explain the additional factor impacting on student performance. The students from Makerere are exposed to a centralized Tuberculosis Control Program in which all tuberculosis patients seen at Mulago Hospital, the hospital affiliated with Makerere University, are managed by the staff on the tuberculosis ward. Each student spends time with this unit and consequently received most of their teaching from one source. On the other hand, tuberculosis patients at the Christian Medical College are managed by different departments according to the site involved in the disease process. Therefore, the students at the Christian Medical College are exposed to varying policies depending on the departmental service they are affiliated with.

There are some limitations to generalizing the results of the survey reported here. In order to maximize the response rate, the questionnaire was brief. Although we believe we assessed the fundamental concepts necessary to appropriately manage patients with tuberculosis, our data are limited to specific scenarios. The response rate was variable amongst the different sites. In both Uganda and Canada, all of the students were gathered in one room for a lecture and the questionnaire could be administered at one sitting. In India, the students were never together at one time therefore the questionnaire was delivered to each student at his/her placement, making it much more difficult to administer the survey in a controlled setting and to collect it upon completion. This contributed to the lower response rate from the India site. As with any survey, there may be a difference between responders and non-responders. Non-responders might have been busier and therefore had not taken the time to complete the questionnaire or had little interest in the objectives of the study. If lack of knowledge contributed to a lower response rate, our results represent better-informed students.

Surveys of physicians have raised similar concerns regarding their ability to competently manage patients with tuberculosis and have highlighted the need for further education. Sumartojo and colleagues questioned 1772 physicians in the United States and found

<table>
<thead>
<tr>
<th>Total practice score</th>
<th>Canada McMaster University</th>
<th>India Christian Medical College</th>
<th>Uganda Makerere University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unadjusted</td>
<td>2.40</td>
<td>2.56</td>
<td>3.09</td>
</tr>
<tr>
<td>Adjusted</td>
<td>3.16</td>
<td>2.23</td>
<td>2.53</td>
</tr>
<tr>
<td>SEM</td>
<td>0.124</td>
<td>0.233</td>
<td>0.123</td>
</tr>
</tbody>
</table>

Adjusted for patient exposure and curriculum time, $F(2,153) = 5.14, P = 0.006$. 

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that only 82% were aware of any tuberculosis treatment and control recommendations and only 59% would use recommended treatment regimes, and concluded that physicians who treat tuberculosis require additional training and support. Hong et al. surveyed private general practitioners in Korea and found that considerable misunderstandings existed about basic tuberculosis concepts, sputum examinations were considerably neglected and only 11% of physicians were prescribing the current National Tuberculosis Program standard treatment regimen, but noted that 80% of general practitioners wanted to acquire more knowledge. Singla et al. found that 102 different treatment regimens were used by 187 private practitioners in Delhi, with only 29.4% of practitioners using the regimen recommended by the National Tuberculosis Program, and called for more education in this area. Uplekar & Shepard studied 102 private physicians in Bombay who prescribed 80 different regimens, most of which were inadequate and unnecessarily expensive, and found that 67 of them used pharmaceutical representatives as their primary source for tuberculosis information. The poor performance displayed by physicians in these surveys highlights the inadequacy of their undergraduate and postgraduate training in preparing them to manage patients with tuberculosis.

Where do we go from here? Firstly, we need to define the core knowledge that students and physicians require to be able to manage patients with tuberculosis appropriately. The WHO released a document produced as a result of a workshop on ‘Tuberculosis control and medical schools’, attended by 25 participants from 16 countries. The document stressed the importance of graduating students with the proper knowledge, practical skills, and attitudes necessary for the management of tuberculosis. Knowledge of the epidemiology, transmission, pathophysiology, diagnosis, treatment, side-effects, prophylaxis, and awareness of national tuberculosis programmes were considered to be essential components of a core curriculum. The attainment of skills in history taking, physical examination, record keeping, and education were deemed necessary for the competent management of patients with tuberculosis. Approaches which favoured the active participation of students were recommended using modules which integrated biomedical, clinical, and public health teaching.

Secondly, we need to decide the best method by which to deliver the information so as to maximize its effect on practice patterns. The way in which the principles of tuberculosis control are applied and the intensity of training will naturally vary according to the tuberculosis situation in each country. Having defined exposure in terms of both curriculum time and patient contact, we believe that both are necessary to varying degrees for adequately preparing students to manage patients with tuberculosis. In non-endemic areas where exposure to tuberculosis in clinical situations is limited, it is important to ensure awareness of the differential diagnosis particularly in the light of global migration patterns. Increased experience with diseases such as tuberculosis can be achieved through paper problems, educated attending physicians, and elective experiences. Although we recognize that the core curriculum is geared in some way to preparing students to pass national licensure exams, the content areas should theoretically prepare future physicians to manage a wide range of human illnesses including tuberculosis.

Recent medical school graduates and practising physicians are treating increasing numbers of patients with tuberculosis. Our findings suggest that graduates possess an adequate knowledge base concerning pertinent issues in the field of tuberculosis. A comprehensive approach to tuberculosis education includes not only imparting an adequate knowledge base but also the much more difficult task of influencing the practices and attitudes of graduating students. Resources need to be allocated to ensure information relating to tuberculosis control is taught and implemented in an effective and consistent manner.

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Contributors

J. Emili was responsible for the conception, design and administration of the survey, analysis and interpretation of the data, writing, drafting and revision, and approval of the final version. G. R. Norman, R. E. G. Upshur and F. Scott were responsible for the conception and design, analysis and interpretation of the data, drafting and revision, and approval of the final version. K. R. John was responsible for conception and design, drafting and revision, and approval of the final version. M. L. Schmuck was responsible for analysis and interpretation of the data, drafting and revision, and approval of the final version.
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References


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