Trends in Duration of Hospitalization for Patients with Tuberculosis in Montreal, Canada from 1993 to 2007

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ABSTRACT

Objective: To study the trend of hospital stays for patients diagnosed with pulmonary TB in Montreal from 1993 to 2007.

Methods: From the registry of hospital discharge summary information, we selected first hospitalizations for patients with a diagnosis of TB, and from the reportable diseases registry, patients with culture positive pulmonary TB. We linked the selected cases, using the first 3 characters of postal code of residence, sex and age. From the linked cases, we included those for whom date of patient's admission to hospital (from the former registry) was similar to the date of notification to the public health department (from the latter registry), while allowing for an appropriate variation.

Results: Among the 563 linked cases, the median duration of hospitalization was 17.0 days. Duration of hospitalization did not significantly decrease during the study period. Cases with positive sputum smear were more likely to stay in hospital ≥ 14 days compared to those without one (OR=1.90, 95% CI: 1.34-2.70). TB cases ≥ 50 years of age remained in hospital longer than those between 18-49 years of age (OR=1.66, 95% CI: 1.15-2.40).

Conclusion: For 63.9% (360) of the cases studied, the duration of hospitalization was ≥ 14 days, which is consistent with the minimum recommended hospital stay for patients with pulmonary TB in Canada. Further studies are necessary to examine the impact of discharging hospitalized TB patients before 14 days of hospital stay on the risk of TB transmission in the community.

Key words: Tuberculosis; hospitalization; epidemiology

La traduction du résumé se trouve à la fin de l'article.

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Although the incidence of tuberculosis (TB) is low in Canada, the disease remains an important health problem, mainly among Aboriginal Peoples and immigrants.¹ In 2008, 1,600 TB cases (4.8 per 100,000) were reported to the Canadian Tuberculosis Reporting System, of whom 21% were Canadian-born Aboriginals and 62% foreign-born individuals. Pulmonary TB constituted 68% of all reported TB cases in Canada (based on pre-release results).¹

For many years, initial hospitalization followed by discharge with anti-TB medications have constituted the approach of choice for the great majority of patients with pulmonary TB in Canada.² Indications for hospitalization of TB patients include investigation and/or treatment of symptoms, establishment of an appropriate therapeutic regimen for patients with significant side effects to anti-TB medications and/or with known/suspected resistance to these agents, and provision of airborne isolation if this cannot be effectively provided as an outpatient.³ In fact, it has been argued that an initial period of hospitalization is important to achieve a reliable control of the infection in the community.³

Hospitalizing TB patients can be challenging, especially in areas with minimal health care resources or appropriate inpatient facilities. Moreover, hospitalization for TB is exceptionally costly.⁴⁻⁶ In Canada, the total cost per hospitalized TB patient has been estimated at \$19,157.⁶ Longer hospitalization for TB can also have detrimental effects on the psychosocial and economic well-being of the patients and their families.

The duration of hospitalization for patients with newly diagnosed pulmonary tuberculosis has decreased significantly over the years, and remains variable depending on the sputum smear, chest radiography, presence of other medical co-morbidities, patient's response to anti-TB medications and patient's unfavourable psychosocial status.^{2,7,8} According to the Canadian TB Standards (CTBS), for patients with smear-negative respiratory TB, airborne isolation may be discontinued after 2 weeks of appropriate multi-drug therapy, provided that the patient is improving clinically. On the other hand, for patients with smear-positive TB, the CTBS recommends that airborne isolation should continue until three consecutive sputum smears are negative, there is evidence of clinical improvement and the patient has shown adherence to at least 2 weeks of appropriate multi-drug therapy.³ TB patients initially smear-positive may be discharged home after 2 weeks of therapy, even if they remain-smear positive, provided that the discharge conditions ensure continued treatment and acceptable airborne iso-

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lation, while minimizing risk of close contact with vulnerable individuals.³

In Quebec, 57.3% of TB cases (annual cumulative incidence: 7.1 per 100,000 persons) were reported in Montreal region (population: 1,620,693) during the period 2004-2007.⁹ Concerns have been raised that the growing shortage of health care professionals, along with restructuring and the reduced capacity of institutionally-based health care services have been contributing to shortened hospital stays.¹⁰ Hence, we hypothesized that, as for other types of hospitalizations, hospital stays for pulmonary TB have likely become shorter through the years. This can be problematic because of continued infectivity of suboptimally treated patients after premature discharge.

METHODS

We used two data sources on TB hospitalizations in the region of Montreal from 1993-2007. One is the Quebec registry system for hospital discharge summary information (also called the *Système de maintenance et d'exploitation des données pour l'étude de la clientèle hospitalière* or Med-Echo registry). The Med-Echo data source is anonymous and does not include universal identity information such as name, date of birth or health insurance number. However, the cases in Med-Echo are distinguished by complex identifiers unique to the system. The data in Med-Echo contain demographic and hospitalization information including name of hospital, dates of patient's admission and discharge, and patient's principal and secondary diagnosis on admission, but not clinical information such as results of sputum smear or chest x-ray (CXR). In order to include such clinical information in our analysis, we also used the computerized reportable diseases central registry (also called the *Fichier des maladies à déclaration obligatoire* or MADO registry). This registry is used to manage and process surveillance data on all reportable diseases in Quebec. The MADO registry contains both demographic and clinical information including the type and results of sputum smear, culture, drug sensitivity test, and CXR. Of all reported TB cases in this registry, we selected those with a positive sputum culture (Figure 1).

From the Med-Echo data, we selected all registered hospitalizations for patients with a principal diagnosis of TB. The coding of diseases in Med-Echo is based on the 9th revision of the International Classification of Diseases (ICD) from April 1, 1992 to March 31, 2006, and thereafter on the 10th revision of the ICD. For patients with multiple TB hospitalizations, we only selected the first one.

We then linked all culture-positive pulmonary TB cases from the MADO registry with selected hospitalizations from the Med-Echo data (Figure 1). The linking criteria included the first 3 characters of postal code of residence, sex and age (plus or minus one year). For the linked cases, we calculated the difference between the date of notification of a TB case to the public health department (based on the MADO registry) from the date of patient's admission to a hospital for TB (based on Med-Echo registry). We accepted a difference of up to 150 days if hospitalization occurred before notification, and up to 120 days if hospitalization occurred after notification. We also eliminated patients who were linked more than once from the MADO registry to the Med-Echo registry, and those who stayed in long-term care hospitals or hospitals outside Montreal (Figure 1).

The data were analyzed using the Statistical Package for the Social Sciences, version 12.0 (SPSS Inc., Chicago, IL, USA). The median

Figure 1. Selection of hospitalized patients with culture-positive pulmonary TB in the Montreal region from 1993-2007

duration of hospitalization and the interquartile range (IQR) were calculated for the whole study period and for each separate year. Age, sex, and country of birth (Canada or outside of Canada), results of sputum smear, presence of radiological pulmonary cavity lesion(s), presence of resistance to anti-TB medication(s), and starting anti-TB medication regimen (i.e., whether the patient is started on the isoniazid (INH), rifampine (RMP), ethambutol (EMB) and pyrazinamide (PZA) combination or not), period of hospitalization (1993-97, 1998-2002, 2003-07), and hospital TB volume were examined as independent variables for patients' duration of hospitalization. For hospital TB volume, our final linked sample of patients was used to divide hospitals into two categories: lower volume, i.e., those with <2 TB patients per year, and higher volume, i.e., those with ≥2 TB patients per year, on average. Pearson's χ^2 test of significance was applied to calculate the p-value for cross-tabulated variables. Logistic regression was used to further test the association between the variables deemed significant in the bivariate analysis ($p < 0.05$). Odds ratios (OR) with 95% confidence intervals (CI) were calculated.

RESULTS

From 1993 to 2007, there were 1,697 TB hospitalizations of all types registered in Med-Echo for residents in the Montreal region. After linking the data from Med-Echo and MADO, we found 633 cases who were hospitalized (first episode) with culture-positive pulmonary TB. Upon eliminating those with more than one link, and those who stayed in long-term care hospitals or hospitals outside Montreal, we were left with 563 cases (Figure 1).

The study cases had a mean age of 46.5 (standard deviation = 21.8); 44.6% were hospitalized in 3 hospital centres in Montreal. In total, 18 acute care hospital centres had at least one hospitalized patient with culture-positive pulmonary TB. On admission, 48% of cases had positive sputum smears, and 38.4% had radiological evidence of pulmonary cavity lesion(s) (Table 1); 14.2% had a strain resistant to at least one anti-TB medication, and 2.3% had multi-drug resistant TB. INH/RMP/EMB/PZA was the starting anti-TB medication combination for 416 (73.9%) cases.

Median duration of hospitalization was 17.0 days (IQR: 10 to 28) for the whole study period. The minimum and maximum yearly

Table 1. Characteristics of Hospitalized Patients With Culture-positive Pulmonary TB and Factors Possibly Associated With Duration, Montreal, 1993-2007

Characteristics	n (%) [*]	Hospital Stay 1-13 Days [†] n (%)	Hospital Stay ≥14 Days [†] n (%)	p-value
Sex				
Male	341 (60.6)	75 (33.8)	147 (66.2)	0.365
Female	222 (39.4)	128 (37.5)	213 (62.5)	
Age groups (years)				
1-17	22 (3.9)	7 (31.8)	15 (68.2)	0.024
18-49	315 (56.0)	129 (41.0)	186 (59.0)	
≥50	226 (40.1)	67 (29.6)	159 (70.4)	
Country of birth [‡]				
Outside Canada	437 (77.6)	158 (36.2)	279 (63.8)	0.978
Canada	124 (22.0)	45 (36.3)	79 (63.7)	
Sputum smear				
AFB [§] positive	270 (48.0)	77 (28.5)	193 (71.5)	0.000
AFB negative/Unknown	293 (52.0)	126 (43.0)	167 (57.0)	
Chest X-ray [¶]				
With cavitory lesion(s)	216 (38.4)	73 (33.8)	143 (66.2)	0.434
No cavitory lesion	340 (61.6)	126 (37.1)	214 (62.9)	
Resistance to anti-TB medications				
No resistance	483 (85.8)	176 (36.4)	307 (63.6)	0.643
To ≥1 anti-TB medication	80 (14.2)	27 (33.8)	53 (66.3)	
Initial anti-TB medication regimen				
INH+RMP+EMB+PZA**	416 (73.9)	144 (34.6)	272 (65.4)	0.231
Not INH+RMP+EMB+PZA	147 (26.1)	59 (40.1)	88 (59.9)	
Year of hospitalization				
1993-1997	215 (38.2)	80 (37.2)	135 (62.8)	0.350
1998-2002	192 (34.1)	74 (38.5)	118 (61.5)	
2003-2007	156 (27.7)	49 (31.4)	107 (68.6)	
Hospital TB volume				
Lower volume	198 (35.2)	78 (39.4)	120 (60.6)	0.225
Higher volume	365 (64.8)	125 (34.2)	240 (65.8)	
Total	563 (100)	203 (36.1)	360 (63.9)	—

* column percent

† row percent

‡ Data are missing for 2 patients

§ AFB: Acid-fast bacilli

|| Includes patients with negative sputum AFB, patients with no sputum smears, and missing data

¶ Results not available or data missing for 7 patients

** INH: isoniazide; RMP: rifampine; EMB: ethambutol; PZA: pyrazinamide

medians for duration of hospitalization were 13.0 days (IQR: 7 to 19) and 22 days (IQR: 7 to 19) in 1993 and 2003, respectively. Among cases, 203 (36.1%) remained in hospital for less than 14 days. The duration of hospitalization was not significantly associated with the time period of hospitalization (Table 1). The age group of cases and the presence of smear-positive sputum were the only two independent variables associated with the duration of hospital stay. In a logistic regression model including these two variables, cases with a positive sputum smear were more likely to stay in hospital 14 days or more compared to those with no positive sputum smear (OR=1.90, 95% CI: 1.34-2.70). With respect to age, TB cases ≥50 years of age stayed in hospital longer than those between 18-49 years of age (OR=1.66, 95% CI: 1.15-2.40).

DISCUSSION

Our results indicate that the median hospital stay for cases with pulmonary TB in Montreal during their first episode of hospitalization was 17 days. The duration of hospital stay has not changed significantly over the years from 1993 to 2007. We observed that cases 50 years of age and older had generally longer hospital stays than those in the middle 18-49 age group. Furthermore, our data suggested that cases with positive sputum smear results were more likely to have longer stays.

Initial hospitalization of newly diagnosed TB patients, although not mandated in Canada, is a common practice. Hospitalization is an especially important consideration when the patient is highly infectious, since ensuring airborne isolation is often not feasible outside hospitals or other appropriate institutions. The challenge of

preventing outpatient secondary transmission of TB is further complicated in densely populated and multicultural urban centres, like Montreal, with many population subgroups at high risk for active and latent TB infection (LTBI).¹¹

With regard to duration of hospital stay, our results are comparable to those from other studies in Canada and the United States. In Canada, data supplied by the Canadian Institute for Health Information indicate that for the period 1996-2000, 50.2% of TB patients were hospitalized, and that the average duration of hospital stay for these patients was 20.6 days.⁶ Holmquist et al. report an average duration of 15 days for patients hospitalized in the US with a principal diagnosis of TB.⁵

CXR abnormalities (including involvement of both lungs, cavitation, pleural effusion and miliary pattern), positive sputum AFB results, body temperature and MDR status were shown to be significantly correlated with the duration of hospital stay and with hospitalization cost in previous studies.⁴ We did not find a significant association between radiological findings and hospital stay. However, we only considered the presence of any cavitory lesion, without further restricting the finding to more specific TB radiological findings involving both lungs. The number of MDR cases in the current study was too small to establish any meaningful association with the duration of hospital stay.

The linking formula used to identify hospitalized pulmonary TB patients was not perfect and may represent a limitation of the study. As indicated, Med-Echo, the hospitalization data source, is anonymous and does not include the case's name, health insurance number or any other unique case identifier that is in common

with MADO, the second data source. It is therefore possible that some patients were mis-linked between the two databases used. On the other hand, since the total number of patients hospitalized with pulmonary TB in Montreal per year is limited, the probability of mis-linking should be low. Hence, we believe that the number of mis-linked cases should not significantly affect our study conclusions. Moreover, our linking procedure left a significant number of TB patients unaccounted for. However, we compared the original data (n=1697) with our post-linking sample (n=563) with respect to demographic frequencies of sex and age groups, and the datasets were comparable. Therefore, we conclude that our post-linking sample, although significantly smaller in number, is likely a fair representation of all hospital cases.

Our study demonstrates that despite potential indications for longer hospital stays, 36% of patients with pulmonary TB were kept in hospital for less than the recommended 14-day period. However, the implications of this finding in the community are unclear. We recommend further research to investigate the association between premature discharge of patients with active pulmonary TB during their hospitalization and possible increased risk of TB transmission in the community.

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RÉSUMÉ

Objectifs : Évaluer la durée de séjour hospitalier des patients avec tuberculose pulmonaire à Montréal de 1993 à 2007.

Méthode : Dans le fichier des données hospitalières, nous avons sélectionné des patients hospitalisés pour la première fois pour une tuberculose pulmonaire et, du fichier des maladies à déclaration obligatoire, des patients avec résultat positif à la culture des expectorations. Nous avons relié les cas sélectionnés avec les trois premiers caractères du code postal de résidence, le sexe et l'âge. Parmi les cas reliés, nous avons gardé ceux dont la date d'admission (tirée du premier fichier) était similaire jusqu'à un certain point à la date de déclaration à la direction de santé publique (tirée du deuxième fichier).

Résultats : Parmi les 563 cas retenus, la durée médiane d'hospitalisation était 17,0 jours. La durée d'hospitalisation n'a pas diminué significativement durant la période étudiée. Les cas avec frottis des expectorations positif avaient plus de risque de rester à l'hôpital ≥ 14 jours que les cas avec frottis négatif (Ratio de cotes [RC]=1,90; Intervalle de confiance [IC] à 95% : 1,34-2,70). Les cas ≥ 50 ans avaient plus de risque de rester à l'hôpital longtemps que les cas âgés de 18 à 49 ans (RC=1,66; IC 95% : 1,15-2,40).

Conclusion : Pour 63,9 % (360) des cas étudiés, la durée d'hospitalisation était ≥ 14 jours et conforme avec la durée minimale recommandée au Canada pour les patients avec tuberculose pulmonaire. D'autres recherches sont nécessaires pour évaluer l'impact de donner congé de l'hôpital avant les 14 jours recommandés à des patients avec tuberculose pulmonaire sur le risque de transmission de la maladie dans la communauté.

Mots clés : tuberculose; hospitalisation; épidémiologie