Towards a "fourth 90": A population-based analysis of post-tuberculosis pulmonary function testing in British Columbia, Canada, 1985–2015

To the Editor:

Mounting evidence of chronic obstructive and restrictive lung disease among respiratory tuberculosis (TB) patients after treatment [1–4] raises questions about current practice in terms of linkage to care once pharmacologic treatment for TB has stopped. A systematic review of post-TB COPD showed pooled odds ratio of 3.05 (95% CI 2.42–3.85) for people with a history of TB compared to non-TB controls [3]. Another review reported a range of proportions of TB patients with airflow obstruction post-TB of 0.18–0.87 [1]. The development of a "fourth 90", in addition to the three objectives of the Stop TB Partnership's Global Plan to End TB, has been suggested: "Ensuring that 90% of all people successfully completing treatment for TB can have a good health-related quality of life" [5]. Post-TB sequelae may figure prominently in reductions in quality of life among TB patients [6], particularly those with severe forms of pulmonary TB [7]. International guidelines on TB treatment provide limited, if any, guidance for managing post-TB sequelae [8]. A logical first step towards managing post-TB lung disease (PTBLD) in well-resourced programmes may be to measure pulmonary function at the end of TB treatment. This may be performed at relatively low cost and with virtually no risk to the patient or public. The proportion of respiratory TB patients in high-resource settings who undergo pulmonary function testing during or after TB treatment is unknown. We hypothesised that a small proportion received this form of diagnostic testing in our well-resourced local setting (British Columbia (BC), Canada).

We used a large retrospective cohort of immigrants to BC, Canada, arriving from 1985–2012, which has been described elsewhere [9]. This linked administrative database contains health administrative data on all TB patients diagnosed and treated in BC during the period 1985–2015. This database was used to analyse the proportion of respiratory TB patients receiving pulmonary function testing in BC near the end of their TB treatment. For this analysis, we assembled all medical services plan (MSP) physician and technical fee-for-service claims related to components of pulmonary function testing from 1 January, 1985 to 31 December, 2015. We then assembled a retrospective cohort of people diagnosed with laboratory-confirmed respiratory TB who had successful treatment completion documented in the BC TB registry. Ethics approval was granted by the University of British Columbia (H16-00265).

Pulmonary function testing was defined as a minimum of one MSP billing claim within 90 days of TB treatment completion date (before or after) for any of the following services, including either the physician or technical fee claims: spirometry (with and without bronchodilators), flow volume loops and logs (with and without brochodilators), peak expiratory flow rate, lung volumes, diffusion studies, and detailed pulmonary function testing [10]. In addition to 90 days, we established two further indicator variables for pulmonary function testing at 180 days and 365 days (excluding pulmonary function tests prior to TB treatment initiation) to test the robustness of our main analysis measure to relaxation of the timing condition. We also calculated the mean, median and interquartile range (IQR) for days from TB treatment

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Post-tuberculosis lung disease is a growing concern globally. In a Canadian sample, only 3% of respiratory TB cases underwent pulmonary function testing within 90 days of treatment end. Benchmarks for post-TB pulmonary function testing are needed. https://bit.ly/2WX3tVf

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completion date to pulmonary function test date for those with pulmonary function testing anytime post-TB treatment initiation.

A total of 1376 respiratory TB patients with treatment completion, within our immigration cohort, were identified in the BC TB registry (table 1). For our primary measure of post-TB pulmonary function testing, we found that, within 90 days of the treatment completion date, only 2.9% of respiratory TB patients underwent testing. This percentage rose to 4.9% within 180 days, 7.0% within 365 days, and 14.2% at any time post-TB treatment initiation (table 1). Among the 14.2% with pulmonary function testing at any time post-TB treatment initiation, the mean difference in days between TB treatment completion date and pulmonary function testing date was 1810 days (~5 years), with a median of 1297 days (IQR 387–2623 days). Respiratory TB patients who were female, or had higher levels of comorbidity, or were at older age when treatment was initiated, each had higher likelihood of pulmonary function testing during or after TB treatment (table 1).

The results of this analysis suggest a large gap in post-TB respiratory care in Canada. It is unclear if the findings would be similar in other high-income jurisdictions. However, we note a lack of standards of care for lung function testing among TB patients and a lack of guidance from international guidelines [8]. Moreover, in low-resource regions, lung function testing is infrequently available in health centres where people receive TB treatment [11]. Benchmarks for PTBLD prevention, diagnosis, and care are needed to assess progress towards a "fourth 90" in various settings.

Results from the BOLD study show significant obstructive and restrictive sequelae among TB survivors [12]. Understanding the degree of pulmonary impairment in a TB survivor may lead to immediate benefits in terms of interventions and therapeutics. For example, pneumococcal vaccination may be appropriate for individuals with significant post-TB airway disease. Additionally, pulmonary rehabilitation has been associated with lung function improvement in people with post-TB pulmonary sequelae [13]. Using spirometry results as a marker of "lung age" may also serve as a motivational tool for TB survivors to quit smoking [14]. Meanwhile, pharmacological interventions, such as long-acting muscarinic antagonists or long-acting β-agonists, require further investigation in patients with post-TB airway disease given the likely difference in pathophysiology.

As the post-TB health agenda progresses [5, 15], TB programmes in high-resource settings may wish to conduct similar analyses to determine baseline service levels for PTBLD prevention, diagnosis, and care.

TABLE 1 Respiratory tuberculosis (TB) patients undergoing pulmonary function testing after TB treatment initiation: immigrants to British Columbia, Canada, 1985–2015

Group	Respiratory TB patients n	PFT within ±90 days of TB treatment completion % (n)	PFT within ±180 days of TB treatment completion % (n)	PFT within ±365 days of TB treatment completion % (n)	PFT any time post-TB treatment initiation % (n)
All respiratory TB	1376	2.9 (40)	4.9 (67)	7.0 (97)	14.2 (196)
Males	785	2.5 (20)	4.7 (39)	6.1 (48)	14.2 (112)
Females	591	3.4 (20)	5.1 (32)	8.3 (48)	14.3 (84)
Age <30 years	326	1.8 (60)	3.1 (10)	4.0 (13)	10.1 (33)
Age 30–60 years	566	2.6 (15)	4.4 (29)	7.2 (41)	14.5 (82)
Age ⩾60 years	483	3.9 (19)	6.6 (32)	8.9 (43)	16.8 (81)
Comorbidity score 0 to <1	762	1.4 (11)	2.7 (22)	4.3 (33)	13.3 (101)
Comorbidity score 1 to <2	340	3.5 (12)	5.6 (21)	8.8 (30)	15.3 (52)
Comorbidity score ⩾2	274	6.2 (17)	9.8 (28)	12.4 (34)	15.7 (43)

PFT: pulmonary function test. Data sources: 1) Immigration Refugees and Citizenship Canada (creator). Permanent resident database: Population Data BC (publisher), data extract, IRCC, www.popdata.bc.ca/data (published 2015). 2) BC Centre for Disease Control (creator). BC Provincial TB Registry (BCCDC-iPHIS): Population Data BC (publisher), data extract, BCCDC, www.popdata.bc.ca/data (2015; accessed 31 January, 2018). 3) BC Ministry of Health (creator). Consolidation File (MSP Registration and Premium Billing): Population Data BC (publisher), data extract, www.popdata.bc.ca/data (2018). 4) BC Ministry of Health (creator). Medical Services Plan (MSP) Payment Information File: Population Data BC (publisher), data extract, www.popdata.bc.ca/data (2018). 5) Population Data BC. www.popdata.bc.ca (published 2019; accessed 12 May, 2017). For comorbidity assessment, the weighted Charlson Comorbidity Index score was calculated from hospital discharge abstracts and physician billing claims data in the year prior to TB diagnosis. Age was calculated at the date of TB treatment initiation.

Health services research studies that integrate data from the broader health system with TB registry-type data are needed to understand patterns of health service use among TB patients post-TB treatment completion. In Canada, TB programmes may be able to access similar data to track post-TB pulmonary function testing, which may inform guideline development and performance targets for post-TB care [5]. Such studies may also seek to identify care trajectories before and after TB diagnosis that may elucidate points for prevention and intervention to reduce the burden of TB and lung disease among the TB survivors. Furthermore, economic valuations of TB prevention activities, including vaccine development, prophylactic testing and treatment, as well as earlier detection, may appear more appealing if post-TB pulmonary conditions are incorporated into economic and policy evaluation models [16]. Collaborations between TB programmes and primary care could provide valuable context for implementation of any new guidelines developed for post-TB lung function testing.

Towards the goal of increasing post-TB pulmonary function testing in BC, the authors plan to establish a Partnership for Post-TB Health. This partnership aims to create a focused knowledge exchange and models of care development network within the BC Centre for Disease Control that will monitor and generate evidence on post-TB health and interventions. We invite collaboration from other TB researchers, around Canada particularly, in this effort.

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