Virtual Clinic Models for Managing Remote Care

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Declaration of Conflict of Interest

I, Richard Long declare that in the past 3 years:

I have received manufacturer funding from the following companies*:

No

I have done consulting work for the following companies*:

No

I have done speaking engagements for the following companies*:

None

I or my family hold individual shares in the following*:

None

*pharmaceutical or medical/dental equipment
The concept of a “tuberculosis dispensary” was originally developed by Sir Robert Philip in Edinburgh in 1897 in response to the limitations of mainstream medical management.*

In 1964 Canadians called for urgent improvement and extension of chest clinic services, as well as a sharply increased awareness of the many pitfalls of prolonged self medication.†

*Keers RY. Pulmonary Tuberculosis: A Journey Down the Centuries
† Can J Public Health 1964; 55; 323-33
Contemporary TB Programming in Canada faces five acknowledged challenges

1. The disease is less common but often more difficult to treat (HIV/AIDS; drug resistance).
2. The disease is concentrated in two minority groups – foreign-born and Indigenous peoples.
3. The disease, while geographically focal in its spread, can occur anywhere at any time.
4. The management of the disease is a highly collaborative enterprise involving many stakeholders.
5. The management of the disease is presupposed to be equitable.
In 2007-2008, 131/157 (83.4%) of the on-reserve Registered First Nations and in-settlement Métis pulmonary cases on the prairies resided north of the 53\textsuperscript{rd} parallel.
Frequency distribution of on-reserve Registered First Nations pulmonary tuberculosis cases on the prairies, 2007-2008
In Canada, with the exception of the First Nations and Inuit Health Branch, or FNIHB, there is no national TB program. Instead each province and territory has its own public health legislation and TB prevention and care program.
TB Prevention and Care Program of Alberta

- Alberta Health PHO (legislation)
- AH/AHS Communicable Disease Control Committee
- Provincial Laboratory for Public Health
- Federal Ministries: PHAC, CIC, FNIHB
- TB Program Evaluation & Research Unit (Department of Medicine and Department of Public Health Sciences, University of Alberta)

Central TB Clinic

- TB Control Committee of Alberta
- TB Registry
- Central Drug Depot
- TB Prevention & Care Manual of AB
- Biennial TB Symposium

AHS

- Calgary TB Clinic
- Edmonton TB Clinic

AHS

- Calgary Health Centres
- Edmonton Health Centres

Calgary

- Rural Alberta

Edmonton

- Public Health Centres
- FNIHB Health Centres

In-patient Unit, Univ. of Alberta Hospital
Area: 661 848 km²

Population: 3, 645, 257
(Statistics Canada, 2011)
The “Virtual Clinic” is a colloquialism in the TB program in Alberta; it refers to a clinic that does not actually see patients face-to-face. Rather it receives from community health nurses in reserve communities or public health nurses in Rural Health Zones, referrals in the form of a medical record and chest radiograph(s) sent either electronically or by courier.

Public health nurses and a small group of community-based pulmonary and infectious disease physicians staff all three clinics.
The establishment of the virtual clinic in 1999 united the separate rural components of the program by providing centralized expertise to sparsely populated areas, especially important as case load falls, and enabling ‘management-in-place’ of on-reserve First Nations.
In addition to recognizing the negative history attached to the removal of First Nations to distant sanatoria, it resembles the neighbourhood clinics described by Curry, serving patients who are often at a lower socioeconomic level, less well educated and living in overcrowded substandard housing.
1. Are there pulmonary symptoms +/- constitutional symptoms?

2. Is there a relative absence of dyspnea?

3. Are symptoms subacute or chronic?

4. Has there been a failure to respond to broad spectrum antibiotics?

5. Is there an epidemiologic risk?

6. Is there a high risk medical condition?

7. Is there an upper lung zone infiltrate is the on CXR; is WBC normal; is there anemia?
Fig 1. A posterior-anterior chest radiograph in a patient with typical adult-type smear-positive pulmonary tuberculosis. The major features are: (1) upper lung zone distribution; (2) cavitation; (3) volume loss; (4) acinar shadows.
Area under ROC curve = 0.9549

<table>
<thead>
<tr>
<th>Obs</th>
<th>ROC Area</th>
<th>Std. Err.</th>
<th>95% Conf. Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>318</td>
<td>0.9549</td>
<td>0.0114</td>
<td>0.93245 0.97733</td>
</tr>
</tbody>
</table>
### Table 1 Age- and sex-adjusted TB case rates in Alberta, by population group and time period

<table>
<thead>
<tr>
<th>Population group</th>
<th>Time period</th>
<th>Cases*</th>
<th>Crude rate</th>
<th>Adjusted rate</th>
<th>95%CI</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Indian</td>
<td>1989–1998</td>
<td>7.0</td>
<td>278</td>
<td>39.9</td>
<td>35.4–44.9</td>
<td>63.8</td>
</tr>
<tr>
<td></td>
<td>1999–2008</td>
<td>9.3</td>
<td>163</td>
<td>17.5</td>
<td>15.0–20.4</td>
<td>26.4</td>
</tr>
<tr>
<td>Canadian-born ‘other’</td>
<td>1989–1998</td>
<td>209.3</td>
<td>400</td>
<td>1.9</td>
<td>1.7–2.1</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>1999–2008</td>
<td>252.1</td>
<td>212</td>
<td>0.8</td>
<td>0.7–1.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Foreign-born</td>
<td>1989–1998</td>
<td>41.2</td>
<td>898</td>
<td>21.8</td>
<td>20.4–23.3</td>
<td>18.5</td>
</tr>
<tr>
<td></td>
<td>1999–2008</td>
<td>51.7</td>
<td>920</td>
<td>17.8</td>
<td>16.7–19.0</td>
<td>16.7</td>
</tr>
<tr>
<td>All population groups</td>
<td>1989–1998</td>
<td>257.5</td>
<td>1576</td>
<td>6.1</td>
<td>5.8–6.4</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>1999–2008</td>
<td>313.1</td>
<td>1295</td>
<td>4.1</td>
<td>3.9–4.4</td>
<td>4.0</td>
</tr>
</tbody>
</table>

*Case numbers in 1989–1998 differ slightly from those reported previously, mainly on account of having applied, in the interim and retrospectively, a strict case definition for pediatric TB.

TB = tuberculosis; py = person-years; CI = confidence interval.
Table 2: Age- and sex-adjusted tuberculosis case rates in Status Indians, by place of residence

<table>
<thead>
<tr>
<th>Place of residence</th>
<th>Time period</th>
<th>py /100000</th>
<th>Cases n</th>
<th>Crude rate /100000 py</th>
<th>95%CI</th>
<th>Adjusted rate /100000 py</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Indians*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-reserve</td>
<td>1989–1998</td>
<td>4.6</td>
<td>200</td>
<td>43.4</td>
<td>37.6–49.9</td>
<td>75.1</td>
<td>67.2–83.0</td>
</tr>
<tr>
<td></td>
<td>1999–2008</td>
<td>6.0</td>
<td>122</td>
<td>20.2</td>
<td>16.8–24.1</td>
<td>34.4</td>
<td>29.7–39.1</td>
</tr>
<tr>
<td>Off-reserve</td>
<td>1989–1998</td>
<td>2.4</td>
<td>75</td>
<td>31.8</td>
<td>25.0–39.9</td>
<td>39.3</td>
<td>31.3–47.3</td>
</tr>
<tr>
<td></td>
<td>1999–2008</td>
<td>3.2</td>
<td>41</td>
<td>12.6</td>
<td>9.1–17.1</td>
<td>15.5</td>
<td>11.2–19.8</td>
</tr>
</tbody>
</table>

*The reserve status of three Status Indians and the region of birth of one foreign-born person were unknown.

py = person-years; CI = confidence interval.
Table 3 Treatment outcomes, associated pediatric cases and close contact evaluations of culture-positive pulmonary TB on-reserve adult cases aged ≥ 15 years, 1989-1998 and 1999-2008

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PTB cases</td>
<td>106 (100.0)</td>
<td>76 (100.0)</td>
<td></td>
</tr>
<tr>
<td>Incident pediatric cases†</td>
<td>36</td>
<td>8</td>
<td>0.0003</td>
</tr>
<tr>
<td>Pediatric cases/PTB case</td>
<td>0.34</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>Close contacts of PTB cases‡</td>
<td>1699</td>
<td>1664</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Number of subjects assessed</td>
<td>1348 (79.3)</td>
<td>1486 (89.9)</td>
<td></td>
</tr>
<tr>
<td>Close contacts of PTB cases who were recommended</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTBI treatment</td>
<td>428</td>
<td>359</td>
<td></td>
</tr>
<tr>
<td>Total number who accepted LTBI treatment</td>
<td>313 (73.1)</td>
<td>229 (63.8)</td>
<td>0.005</td>
</tr>
<tr>
<td>Number of subjects who completed LTBI treatment</td>
<td>202 (64.5)</td>
<td>195 (85.2)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Non-adherent/lost to follow-up subjects</td>
<td>51 (16.3)</td>
<td>19 (8.3)</td>
<td>0.006</td>
</tr>
</tbody>
</table>

†A uniform case definition was applied to pediatric cases. \(^{16}\)
‡The same data abstraction tool was applied in each decennial; see Appendix.
PTB = pulmonary tuberculosis; DOT = directly observed therapy; LTBI = latent tuberculosis infection.
AGE AND SEX ADJUSTED INCIDENCE OF TUBERCULOSIS IN ALBERTA, 1989-2013
In 2008-2012, TB cases in Alberta were grouped according to clinic type and performance indicators were grouped according to objective category

- **TB case management** (10 indicators)
- **TB treatment outcome** (6 indicators)
- **TB contact management** (12 indicators; 6 indicators in two age groups were assessed in close contacts of two different random samples of smear-positive pulmonary TB cases)
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Clinic Site of Care</th>
<th></th>
<th></th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Clinics n (%)</td>
<td>Virtual Clinic n (%)</td>
<td>Outpatient Clinics n (%)</td>
<td></td>
</tr>
<tr>
<td>No. Assessed</td>
<td>841</td>
<td>150 (18)</td>
<td>691 (82)</td>
<td>NA</td>
</tr>
<tr>
<td>Population Group</td>
<td></td>
<td></td>
<td></td>
<td>0.0001</td>
</tr>
<tr>
<td>CB Indigenous</td>
<td>100 (12)</td>
<td>70 (47)</td>
<td>30 (4)</td>
<td></td>
</tr>
<tr>
<td>CB Other</td>
<td>81 (10)</td>
<td>19 (13)</td>
<td>62 (9)</td>
<td></td>
</tr>
<tr>
<td>Foreign-Born</td>
<td>660 (78)</td>
<td>61 (41)</td>
<td>599 (87)</td>
<td></td>
</tr>
</tbody>
</table>

CB: Canadian-Born

Table 3 Tuberculosis Treatment Outcome Indicators by Clinic Site of Care, Alberta, 2008-2012

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Target (%)</th>
<th>All Clinics n (%)</th>
<th>Virtual Clinic n (%)</th>
<th>Outpatient Clinics n (%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TB cases</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number Tx with DOT†</td>
<td>100</td>
<td>789 (96)</td>
<td>145 (100)</td>
<td>644 (95)</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[15]</td>
<td>[5]</td>
<td>[10]</td>
<td></td>
</tr>
<tr>
<td><strong>Culture-positive TB cases</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number relapsed within 2 years‡</td>
<td>&lt;3</td>
<td>3 (&lt;1)</td>
<td>0 (0)</td>
<td>3 (1)</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[68]</td>
<td>[13]</td>
<td>[55]</td>
<td></td>
</tr>
<tr>
<td>Number with TB-related death§</td>
<td>&lt;5</td>
<td>24 (4)</td>
<td>8 (6)</td>
<td>16 (3)</td>
<td>0.063</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[4]</td>
<td>[5]</td>
<td>[19]</td>
<td></td>
</tr>
<tr>
<td><strong>CB culture-positive TB cases</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number with initial drug resistance</td>
<td>&lt;4</td>
<td>3 (2)</td>
<td>2 (3)</td>
<td>1 (2)</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0]</td>
<td>[0]</td>
<td>[0]</td>
<td></td>
</tr>
<tr>
<td><strong>Smear-positive PTB cases</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number Tx within 72 hr. of PCR†</td>
<td>&gt;90</td>
<td>206 (88)</td>
<td>41 (85)</td>
<td>165 (89)</td>
<td>0.32</td>
</tr>
<tr>
<td>Number completing Tx within 12 mo.‡</td>
<td>≥95</td>
<td>199 (95)</td>
<td>39 (93)</td>
<td>160 (96)</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[28]</td>
<td>[8]</td>
<td>[20]</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: TB tuberculosis; Tx treatment; DOT Directly-Observed Therapy; CB Canadian-born; PTB pulmonary tuberculosis; PCR Polymerase Chain Reaction
* See text for definition of clinic type
† Those who died without treatment are listed in square brackets beneath the indicator result and excluded from the denominator
‡ Those who were TB deaths or transferred out are listed in square brackets beneath the indicator result and excluded from the denominator
§ Those who died without treatment or transferred out are listed in square brackets beneath the indicator result and excluded from the denominator
Results

Individually and together both types of clinics met most performance targets. Compared to outpatient clinics, virtual clinic performance was comparable, superior and inferior in 22, 3, and 3 indicators, respectively.

There was no difference in the performance of the “virtual clinic” in cases reported to be “on” versus “off” reserve at the time of diagnosis.
Conclusion

Outpatient and virtual public health TB clinics perform equally well. In low-incidence settings a combination of the two clinic types has the potential to address issues around equitable service delivery and declining expertise.
Limitation: The outbreak or high-incidence community

On the Prairies in 2007-2008 there were 249 Indigenous communities and 120 “potential TB transmitters” with pediatric contacts:

- 249 First Nations Reserves and Métis Settlements on the Prairies
  (199 FN Reserves; 50 Métis Settlement)

  - 11 High Incidence Communities
    (10 FN Reserves; 1 Métis Settlement)
    - 73 Aboriginal PTBs w/ Pediatric Contacts from High Incidence Communities
    - 646 Pediatric Contacts
      (27 Secondary cases; 119 LTBI Infections)

  - 238 Low Incidence Communities
    (189 FN Reserves; 49 Métis Settlement)
    - 47 Aboriginal PTBs w/ Pediatric Contacts from Low Incidence Communities
    - 434 Pediatric Contacts
      (21 Secondary cases; 102 LTBI infections)
Figure The main variables that contribute to the prevalence of TB in adults and by extrapolation the burden of childhood TB. TB = tuberculosis; HIV = human immunodeficiency virus.
Outbreak and High-Incidence Communities

TB Prevention & Care

Community Engagement
- Health Director
- CHN
- CHR
- Elders x2
- FNIHB
- Province
- Service Provider

Compulsive Application of Good Programming

Surveillance

Addictions and Mental Health

Education

Stable Staffing
Acknowledgements

• The staff & students of the TB Program Evaluation and Research Unit, University of Alberta
• University of Alberta Hospital Foundation

Questions?