Capture-recapture analysis for surveillance of tuberculosis
Dr. Rob van Hest, MD MSc PhD
Consultant Tuberculosis Control Physician/Epidemiologist
Department of Infectious Disease Control
Tuberculosis Control Section
Rotterdam Municipal Public Health Service
ROTTERDAM
The Netherlands
Capture-recapture Methods in Surveillance of Tuberculosis and Other Infectious Diseases

Rob van Hest
Surveillance

“The process of continuous and systematic collection, processing, analysis and interpretation of data regarding health which are important for planning, implementing and evaluating public health care, and reporting and distributing this information to all those who should know this”
“For all these reasons, it is impossible to obtain accurate data concerning the prevalence of tuberculous infection even during recent times.”

René and Jean Dubos
The White Plague; Tuberculosis, Man and Society
Surveillance is an indispensable part of infectious disease control and reliable information is essential.

A common method of infectious disease surveillance uses the notifications but not every patient is reported (incomplete reporting or under-notification).

Apart from the notifications other registers could exist containing information about infectious diseases, e.g. hospital admission registers or laboratory registers.
Record-linkage of various infectious disease registers improves case-ascertainment.

After record-linkage of various infectious disease registers, the completeness of the notification register can, under certain assumptions, be estimated by a technique called “capture-recapture analysis.”
Capture-recapture analysis is a technique originally developed within population biology for estimation of the size of animal populations.
Capture-recapture FOR DUMMIES

TSJA, JE MOET EVEN WETEN HOE HET WERKT
Capture
Assumption 1: unique identification
Assumption 2: only individuals from the study population should be caught
Assumption 2: no false-positive captures
Assumption 3: homogeneous distribution
Recapture
Assumption 4: the recapture should be independent of the (first) capture
Assumption 5: closed population
Assumption 6: perfect linkage between capture and recapture is possible
Recapture
Under these assumption this formula is valid:

Recapture \quad \approx \quad 1^{st} \text{ Capture}
Many years later capture-recapture analysis is also applied within epidemiology, e.g. to estimate the size of a group of persons with a certain disease.
For application of capture-recapture analysis within (infectious disease) epidemiology, being captured once, twice or three times is translated into being known to one, two, three or multiple (infectious disease) registers.
<table>
<thead>
<tr>
<th>1st capture</th>
<th>2nd capture</th>
<th>3rd capture</th>
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<td><img src="image32" alt="Image 32" /></td>
<td><img src="image33" alt="Image 33" /></td>
</tr>
</tbody>
</table>

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*GGD Rotterdam en omstreken*
For epidemiological applications of capture-recapture analysis, record-linkage of at least three registers is preferable.
Undetected burden of tuberculosis in a low-prevalence area

I. Baussano,* M. Bugiani,† D. Gregori,‡ R. van Hest,§ A. Borraccino,‡ R. Raso,‖ F. Merletti*

* Cancer Epidemiology Unit, S. Giovanni Battista Hospital and University of Turin, Centro di Prevenzione Oncologica (CPO) Piemonte, CeRMS, Turin, †Local Health Unit 4, Tuberculosis Prevention Service, Turin, ‡Department of Public Health and Microbiology, University of Turin, Turin, Italy; §Department of Tuberculosis Control, Municipal Health Service, Rotterdam, The Netherlands; ‖Epidemiology Unit, Local Health Unit 20, Alessandria, Italy
Capture recapture analysis and tuberculosis in resource-rich countries

Three sources: Notification – Laboratory - Hospital

After record-linkage completeness of case-ascertainment was 93.3%

A parsimonious capture-recapture model with only one interaction term was preferred

Overall estimated under-notification was was 79.1% (plausible).
Completeness of notification of tuberculosis in The Netherlands: how reliable is record-linkage and capture–recapture analysis?

N. A. H. Van Hest1,2*, F. Smit3,4, H. W. M. Baars1, G. de Vries1,2, P. E. W. De Haas5, P. J. Westenend6, N. J. D. Nagelkerke7 and J. H. Richardus1,2
Three Dutch tuberculosis registers were linked:

1. Notifications (IGZ)

2. National reference laboratory cultures (RIVM)

3. Hospital admissions (Prismant)
Capture recapture analysis and tuberculosis

Notifications

Laboratory

Hospital admissions
Remaining false-positives cases?

- Mycobacteria Other Than Tuberculosis? (MOTT) (not excluded)
- Other disease than tuberculosis? (not excluded)
• Are these patients real tuberculosis patients?

• Increase positive predictive value of the registers!!

CROSS-VALIDATION!!!
Capture recapture analysis and tuberculosis
Capture recapture analysis and tuberculosis

Notification (n = 1298)

Hospital (n = 610)

Laboratory (n = 1006)
Capture recapture analysis and tuberculosis

- Notification (n = 1298)
  - Laboratory (n = 1006)
  - Hospital (n = 610)

Counts:
- 78
- 510
- 30
- 388
- 93
- 301
- 99
The best-fitting log-linear capture-recapture model was the saturated model, i.e. including all pair-wise interactions and possibly three-source interaction.

The model estimates 2053 tuberculosis patients (95% CI 1871-2443), i.e. 554 unobserved tuberculosis cases!!

Estimated completeness of notification: 63.2% (95% CI 53.1-69.4)!!
The adjusted estimated completeness of notification of \textbf{36.8\%} is highly inconsistent with prior expectations!!
The best-fitting log-linear capture-recapture model on the adjusted data was a parsimonious model, containing two pair-wise interactions \([N*H]\) and \([N*L]\): \(G^2 = 0.053; \) D.F. = 2; \(P = 0.974;\) Akaike Information Criterion = –3.95)

The model estimates 1547 tuberculosis patients (95%CI 1513-1600), i.e. 106 unobserved tuberculosis cases!!

Estimated completeness of notification: **86.4%** (95% CI 83.5-88.3)!!
CONCLUSIONS

Even in a country with a well-organised system of tuberculosis control, record-linkage and cross-validation three source capture-recapture analysis can easily produce erroneous results and slight adjustment for possible misclassification of laboratory patients and remaining false-positive hospital cases had a considerable impact on the log-linear capture-recapture estimate.
Record-linkage and capture–recapture analysis to estimate the incidence and completeness of reporting of tuberculosis in England 1999–2002

N. A. H. VAN HEST¹,²*, A. STORY³, A. D. GRANT⁴, D. ANTOINE³, J. P. CROFTS³ and J. M. WATSON³
Capture recapture analysis and tuberculosis in resource-rich countries

Three sources: Notification – Laboratory - Hospital

High number of “TB” patients only recorded in hospital episode register: complex population-mixture model was required to estimate proportion of true TB patients

For all estimates the saturated log-linear model was preferred

Overall estimated under-notification was 43.8% (not plausible).
Capture-recapture Methods in Surveillance of Tuberculosis and Other Infectious Diseases

Rob van Hest
Completeness of notification of adult tuberculosis in Iasi County, Romania: a capture-recapture analysis

C. Cojocaru, * N. A. van Hest, † T. Mihaescu, * P. D. Davies ‡

* Pulmonary Disease Division, University of Medicine and Pharmacy ‘Gr T Popa’, Iasi, Romania; † Department of Tuberculosis Control, Municipal Public Health Service Rotterdam-Rijnmond, Rotterdam, The Netherlands; ‡ The Cardiothoracic Centre Liverpool National Health Service Trust, Liverpool, UK
Capture recapture analysis and tuberculosis in middle-income country

Notification

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<td></td>
<td>249</td>
<td>20</td>
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<tr>
<td></td>
<td>353</td>
<td>73</td>
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</tbody>
</table>

Laboratory

Medical prescriptions
Saturated model estimated completeness of notifications at 78%.

After internal validity analysis and use of alternative truncated population estimation models (truncated Poisson and truncated Poisson mixture models) we estimate completeness of the Notification register between 82%-85%
Estimating tuberculosis case detection rate in resource-limited countries: a capture-recapture study in Egypt

A. Bassili,* A. D. Grant,† E. El-Mohgazy,‡ A. Galal,‡ P. Glaziou,§ A. Seita,* I. Abubakar,† A. L. Bierrenbach,§ J. P. Crofts,† N. A. van Hest†

*Stop TB Unit, World Health Organization, Eastern Mediterranean Regional Office, Cairo, Egypt; †Centre for Infections, Health Protection Agency, London, UK; ‡National Tuberculosis Control Programme, Cairo, Egypt; §Stop TB Unit, World Health Organization, Geneva, Switzerland; †Tuberculosis Control Section, Department of Infectious Disease Control, Rotterdam Public Health Service, Rotterdam, The Netherlands
Capture recapture analysis and tuberculosis in resource-limited countries

- NTP ($n = 364$)
  - Public non-NTP ($n = 82$)
  - Private non-NTP ($n = 82$)

Venn diagram showing:
- 247 in NTP
- 76 in NTP and Public non-NTP
- 5 in NTP and Private non-NTP
- 1 in Public non-NTP and Private non-NTP
- 40 in NTP and Public non-NTP
- 0 in NTP and Private non-NTP
- 41 in Public non-NTP and Private non-NTP
The selected model (AIC: -1,873) contained two (expected) interactions (Public non-NTP referred to the NTP!) and estimated the CDR of the NTP surveillance at 55% (95% CI 45% - 68%) for all TB cases.

Internal validity analysis indicated similar relevant interactions as the log-linear model.

The estimated CDR of NTP surveillance for sputum smear-positive cases was 66%.
Estimating the tuberculosis burden in resource-limited countries: a capture-recapture study in Yemen

A. Bassili, A. Al-Hammadi, A. Al-Absi, P. Glaziou, A. Seita, I. Abubakar, A. L. Bierrenbach, N. A. van Hest

*Stop TB Unit, World Health Organization, Eastern Mediterranean Regional Office, Cairo, Egypt; †National Tuberculosis Control Programme, Sana’a, Yemen; ‡Stop TB Unit, World Health Organization, Geneva, Switzerland; £Centre for Infections, Health Protection Agency, London, UK; ¥Tuberculosis Control Department, Public Health Service Rotterdam-Rijnmond, Rotterdam, The Netherlands
Yemen 2010
<table>
<thead>
<tr>
<th>Governorate</th>
<th>Population n</th>
<th>Sputum smear TB notification rates n/100,000</th>
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</thead>
<tbody>
<tr>
<td>Raimah</td>
<td>395,076</td>
<td>9</td>
</tr>
<tr>
<td>Saylioun</td>
<td>467,172</td>
<td>6</td>
</tr>
<tr>
<td>Shabwah</td>
<td>466,889</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>1,329,137</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,247,516</td>
<td></td>
</tr>
<tr>
<td></td>
<td>59</td>
<td></td>
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<tr>
<td>Amran</td>
<td>872,789</td>
<td>11</td>
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<tr>
<td>Dhamar</td>
<td>1,339,229</td>
<td>14</td>
</tr>
<tr>
<td>Ibb</td>
<td>2,137,546</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>4,349,564</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6,129,357</td>
<td></td>
</tr>
<tr>
<td></td>
<td>71</td>
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<tr>
<td>Al-Mukalah</td>
<td>562,290</td>
<td>18</td>
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<tr>
<td>Hajjah</td>
<td>1,480,897</td>
<td>21</td>
</tr>
<tr>
<td>Sana’a City</td>
<td>1,747,627</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>3,790,814</td>
<td></td>
</tr>
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<td></td>
<td>6,920,586</td>
<td></td>
</tr>
<tr>
<td></td>
<td>55</td>
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<td>Abyan</td>
<td>438,656</td>
<td>33</td>
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<td>Al-Hodeida</td>
<td>2,161,379</td>
<td>31</td>
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<tr>
<td>Al-Mahra</td>
<td>89,093</td>
<td>34</td>
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<tr>
<td></td>
<td>2,689,128</td>
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<tr>
<td></td>
<td>3,279,541</td>
<td></td>
</tr>
<tr>
<td></td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Total population in selected governorates</td>
<td>12,158,643</td>
<td></td>
</tr>
<tr>
<td>Total population of strata</td>
<td>18,577,000</td>
<td></td>
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<tr>
<td>Average sampling fraction, %</td>
<td>65</td>
<td></td>
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</tbody>
</table>
Capture recapture analysis and tuberculosis in resource-limited countries

![Venn diagram showing distribution of observed number of TB cases](image)

**Figure 1** Distribution of observed number of TB cases (all forms) in 12 governorates in Yemen between 1 February and 1 May 2010. TB = tuberculosis; NTP = National Tuberculosis Programme.
Table 2 The eight possible three-source log-linear capture-recapture models with AIC and estimated number of TB cases in the 12 governorates in Yemen between 1 February and 1 May 2010, with 95%CI

<table>
<thead>
<tr>
<th>Model</th>
<th>AIC</th>
<th>$N_{est}$</th>
<th>95%CI</th>
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<tr>
<td>Independent model</td>
<td>47.9</td>
<td>1707</td>
<td>1607–1807</td>
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<tr>
<td>NTP $\times$ public non-NTP interaction</td>
<td>28.9</td>
<td>1646</td>
<td>1551–1741</td>
</tr>
<tr>
<td>NTP $\times$ private non-NTP interaction</td>
<td>18.5</td>
<td>2135</td>
<td>1855–2416</td>
</tr>
<tr>
<td>Public non-NTP $\times$ private non-NTP interaction</td>
<td>19.3</td>
<td>1692</td>
<td>1595–1790</td>
</tr>
<tr>
<td>NTP $\times$ public non-NTP interaction, NTP $\times$ private non-NTP interactions</td>
<td>2.1</td>
<td>2418</td>
<td>1069–3768</td>
</tr>
<tr>
<td>NTP $\times$ public non-NTP, public non-NTP $\times$ private non-NTP interactions</td>
<td>-2.0</td>
<td>1633</td>
<td>1541–1726</td>
</tr>
<tr>
<td>NTP $\times$ private non-NTP, public non-NTP $\times$ private non-NTP interactions</td>
<td>-0.4</td>
<td>1982</td>
<td>1758–2206</td>
</tr>
<tr>
<td>Saturated model</td>
<td>0</td>
<td>1636</td>
<td>1367–1905</td>
</tr>
<tr>
<td>Truncated binomial model*</td>
<td></td>
<td>2353</td>
<td>2206–2501</td>
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BACKGROUND: The lack of applicable population-based methods to measure tuberculosis (TB) incidence rates directly at country level emphasises the global need to generate robust TB surveillance data to ascertain trends in disease burden and to assess the performance of TB control programmes in the context of the United Nations Millenium Development Goals and World Health Organization targets for TB control.

OBJECTIVE: To estimate the incidence of TB cases (all forms) and sputum smear-positive disease, and the level of under-reporting of TB in Yemen in 2010.

METHODS: Record-linkage and three-source capture-recapture analysis of data collected through active prospective longitudinal surveillance within the public and private non-National Tuberculosis Programme sector in twelve Yemeni governorates, selected by stratified cluster random sampling.

RESULTS: For all TB cases, the estimated ratio of notified to incident cases and completeness of case ascertainment after record linkage, i.e., the ratio of detected to incident cases, was respectively 71% (95%CI 64–80) and 75% (95%CI 68–85). For sputum smear-positive TB cases, these ratios were respectively 67% (95%CI 58–75) and 76% (95%CI 66–84).

CONCLUSION: We estimate that there were 13,082 (95%CI 11,610–14,513) TB cases in Yemen in 2010. Under-reporting of TB in Yemen is estimated at 29% (95%CI 20–36).

KEY WORDS: tuberculosis; surveillance; record linkage; capture-recapture analysis; resource-limited
Estimating tuberculosis burden and reporting in resource-limited countries: a capture-recapture study in Iraq


*World Health Organization (WHO) Iraq Office, Amman, Jordan; †National Tuberculosis Control Programme, Baghdad, Iraq; ‡Centre for Infections, Health Protection Agency, London, United Kingdom; §Stop TB Unit, WHO, Eastern Mediterranean Regional Office, Cairo, Egypt; ‡Stop TB Department, WHO, Geneva, Switzerland; #Tuberculosis Control Department, Public Health Service Rotterdam-Rijnmond, Rotterdam, The Netherlands
Iraq 2011
Iraq 2011
Iraq 2011
Table 3  Overview of the number of public and private health providers in Iraq and the selected governorates (excluding psychiatrists, ophthalmologists, ENT specialists, dermatologists, obstetricians and some neurologists) and the number participating in the record-linkage and capture study

<table>
<thead>
<tr>
<th>Governorate</th>
<th>Public hospitals</th>
<th>Private hospitals</th>
<th>Private physician clinics</th>
<th>Prison</th>
<th>Private laboratories performing ZN stain</th>
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<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Participating</td>
<td>Total</td>
<td>Participating</td>
<td>Total</td>
</tr>
<tr>
<td>Baghdad</td>
<td>46</td>
<td>40</td>
<td>37</td>
<td>37</td>
<td>2196</td>
</tr>
<tr>
<td>Basra</td>
<td>13</td>
<td>12</td>
<td>5</td>
<td>4</td>
<td>631</td>
</tr>
<tr>
<td>Ninawa</td>
<td>14</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>772</td>
</tr>
<tr>
<td>Misan</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>105</td>
</tr>
<tr>
<td>Diwania</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>168</td>
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<tr>
<td>Diala</td>
<td>10</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>191</td>
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<tr>
<td>Anbar</td>
<td>11</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>261</td>
</tr>
<tr>
<td>Babil</td>
<td>14</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>375</td>
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<tr>
<td>Karbala</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>238</td>
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<tr>
<td>Kirkuk</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>283</td>
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<tr>
<td>Wasit</td>
<td>8</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>196</td>
</tr>
<tr>
<td>Thi Qar</td>
<td>9</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>196</td>
</tr>
<tr>
<td>Muthana</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>96</td>
</tr>
<tr>
<td>Salahelden</td>
<td>9</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>207</td>
</tr>
<tr>
<td>Najaf</td>
<td>7</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>376</td>
</tr>
<tr>
<td>Erbil</td>
<td>22</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>650</td>
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<tr>
<td>Duhok</td>
<td>9</td>
<td>8</td>
<td>3</td>
<td>3</td>
<td>162</td>
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<tr>
<td>Sulaymania</td>
<td>29</td>
<td>25</td>
<td>13</td>
<td>9</td>
<td>374</td>
</tr>
<tr>
<td>Total in Iraq</td>
<td>229</td>
<td>93</td>
<td>7477</td>
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<td></td>
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<tr>
<td>In study governorates</td>
<td>124</td>
<td>65</td>
<td>4208</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participating</td>
<td>110</td>
<td>60</td>
<td>3195</td>
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</table>

ENT = ear, nose, throat; ZN = Ziehl-Neelsen.
Table 2. The eight selected governorates, divided into four strata based on sputum smear-positive tuberculosis notification rates (very high, high, intermediate or low, according to the 75%, 50% and 25% percentiles for the country) and the two governorates (simple) randomly selected per stratum and sampling fraction per stratum.

<table>
<thead>
<tr>
<th>Governorates</th>
<th>Population n</th>
<th>Sputum smear TB notification rates n/100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basrah</td>
<td>2608601</td>
<td>24</td>
</tr>
<tr>
<td>Duhok</td>
<td>985402</td>
<td>22</td>
</tr>
<tr>
<td>Population in selected governorates</td>
<td>3594003</td>
<td></td>
</tr>
<tr>
<td>Population in stratum 1</td>
<td>9657794</td>
<td>37</td>
</tr>
<tr>
<td>Sampling fraction, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Misan</td>
<td>1030306</td>
<td>26</td>
</tr>
<tr>
<td>Najaf</td>
<td>1215937</td>
<td>26</td>
</tr>
<tr>
<td>Population in selected governorates</td>
<td>2246243</td>
<td></td>
</tr>
<tr>
<td>Population in stratum 2</td>
<td>4722959</td>
<td>48</td>
</tr>
<tr>
<td>Sampling fraction, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baghdad*</td>
<td>7341257</td>
<td>33</td>
</tr>
<tr>
<td>Sulaymania</td>
<td>1703062</td>
<td>32</td>
</tr>
<tr>
<td>Population in selected governorates</td>
<td>9044319</td>
<td></td>
</tr>
<tr>
<td>Population in stratum 3</td>
<td>10748922</td>
<td>84</td>
</tr>
<tr>
<td>Sampling fraction, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diwanyiah</td>
<td>1124516</td>
<td>39</td>
</tr>
<tr>
<td>Wasit</td>
<td>1155698</td>
<td>42</td>
</tr>
<tr>
<td>Population in selected governorates</td>
<td>2280214</td>
<td></td>
</tr>
<tr>
<td>Population in stratum 4</td>
<td>7164751</td>
<td>32</td>
</tr>
<tr>
<td>Sampling fraction, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total population in selected governorates</td>
<td>17164779</td>
<td></td>
</tr>
<tr>
<td>Total population of strata</td>
<td>32326011</td>
<td>53</td>
</tr>
<tr>
<td>Average sampling fraction, %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Baghdad has two sub-governorates: Rasafa (East Baghdad) and Al-Karkh (West Baghdad).
Table 4  The eight possible three-source log-linear capture recapture models with AIC and estimated number of tuberculosis cases in the eight governorates in Iraq between 1 May and 31 July 2011, with 95% CI (not adjusted for sample design)

<table>
<thead>
<tr>
<th>Model</th>
<th>AIC</th>
<th>(n_{est})</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent model</td>
<td>138.5</td>
<td>2508</td>
<td>2438–2590</td>
</tr>
<tr>
<td>NTP × public non-NTP interaction</td>
<td>135.2</td>
<td>2576</td>
<td>2481–2689</td>
</tr>
<tr>
<td>NTP × private non-NTP interaction</td>
<td>139.4</td>
<td>2563</td>
<td>2443–2715</td>
</tr>
<tr>
<td>Public non-NTP × private non-NTP interaction</td>
<td>58.1</td>
<td>2431</td>
<td>2370–2502</td>
</tr>
<tr>
<td>NTP × public non-NTP interaction, NTP × private non-NTP interactions</td>
<td>115.4</td>
<td>4196</td>
<td>3087–6420</td>
</tr>
<tr>
<td>NTP × public non-NTP; public non-NTP × private non-NTP interactions</td>
<td>58.7*</td>
<td>2460</td>
<td>2381–2553</td>
</tr>
<tr>
<td>NTP × private non-NTP; public non-NTP × private non-NTP interactions</td>
<td>59.2</td>
<td>2392</td>
<td>2305–2502</td>
</tr>
<tr>
<td>Saturated model</td>
<td>60.6</td>
<td>2502</td>
<td>2224–3208</td>
</tr>
</tbody>
</table>

*Selected model: positive NTP × public non-NTP interaction (non-significant); negative private non-NTP interaction × public non-NTP interaction (significant); goodness-of-fit \( P = 0.746 \).

AIC = Akaike Information Criterion; \( n_{est} \) = estimated total number of tuberculosis cases; CI = confidence interval; NTP = National TB Control Programme.
Iraq 2011

Total number of tuberculosis cases ($N = 1985$)

NTP
$(n = 1677)$

992

244

100

Public non-NTP
$(n = 378)$

416

25

9

Private non-NTP
$(n = 649)$

199

Figure Distribution of observed number of tuberculosis cases (all forms) in eight governorates in Iraq between 1 May and 31 July 2011. NTP = National TB Control Programme.
BACKGROUND: The global target for tuberculosis (TB) control set by the Millennium Development Goals is a decrease in TB incidence by 2015. Direct measurement of country-level TB incidence using population-based methods is impractical, emphasising the need for well-performing surveillance systems and, where these are not available, accurate quantification of incidence and under-reporting of TB.

OBJECTIVE: To estimate TB incidence and TB under-reporting in Iraq in 2011.

METHODS: Prospective longitudinal surveillance was established among all eligible public and private non-National TB Programme (NTP) providers in a random sample of eight of the 18 Iraqi governorates from May to July 2011. Record linkage with the NTP and three-source capture-recapture analysis of data were then conducted using log-linear modelling.

RESULTS: A total of 1985 TB cases were identified after record linkage. The NTP registered 1677 patients (observed completeness 84%). The estimated total number of TB cases was 2460 (95% CI 2381–2553), with identified TB cases representing 81% (95% CI 69–89) after adjusting for sampling design. The estimated ratio of notified to incident cases was 69% (95% CI 58–76).

CONCLUSIONS: We estimate 14500 TB cases in Iraq in 2011, of which 31% (95% CI 24–42) were unreported. TB surveillance needs to be strengthened to reduce under-reporting.

KEY WORDS: tuberculosis; surveillance; record linkage; capture-recapture analysis; resource-limited
Capture-recapture to estimate completeness of tuberculosis surveillance in two communities in South Africa


*Desmond Tutu TB Centre, Department of Paediatrics and Child Health, Faculty of Health Sciences, Stellenbosch University, Cape Town, South Africa; †Department of Tuberculosis Control, Municipal Public Health Service Rotterdam-Rijnmond, Rotterdam; ‡KNCV Tuberculosis Foundation, The Hague; §Centre for Infection and Immunity Amsterdam (CINIMA), Academic Medical Centre, University of Amsterdam, The Netherlands; ¶International Union Against Tuberculosis and Lung Disease, Paris, France; ∥Biostatistics Unit, Medical Research Council, Cape Town, **Division of Community Health, Stellenbosch University, Cape Town, South Africa
Capture recapture analysis and tuberculosis in resource-limited countries
Capture recapture analysis and tuberculosis in resource-limited countries
Capture recapture analysis and tuberculosis in resource-limited countries
Capture recapture analysis and tuberculosis in resource-limited countries

- TB treatment register: 243*
- Centralised laboratory: 263
- Hospital laboratory: 38

N = 306

208

15

12

16

8

2

45

*Includes 15 new patients
The log-linear model selected was a parsimonious model incorporating two interaction effects: the centralised laboratory and tuberculosis treatment register interaction and the centralised laboratory and hospital laboratory interaction.

The log-linear model estimated completeness of registration of bacteriologically confirmed pulmonary tuberculosis at 75%.

Extra problem: initial defaulting!
Capture recapture analysis and tuberculosis in resource-limited countries

SUMMARY

BACKGROUND: Reliable surveillance is essential for any tuberculosis (TB) control programme; however, under-registration of TB cases due to under-notification of patients on treatment or failure to initiate treatment has been well-documented internationally.

OBJECTIVE: To determine the contribution of capture-recapture methods in estimating the completeness of bacteriologically confirmed pulmonary TB registration in two high-incident communities in South Africa.

METHODS: Record linkage between the TB treatment register and two laboratory sputum TB result registers and three-source log-linear capture-recapture analysis.

RESULTS: The number of bacteriologically confirmed pulmonary TB cases in the TB treatment register was 243, with an additional 63 cases identified in the two laboratory databases, resulting in 306 TB cases. The observed completeness of the TB treatment register was 79%. The log-linear model estimated 326 (95% CI 314–355) TB cases, resulting in an estimated completeness of registration of 75% (95% CI 68–77).

CONCLUSION: Capture-recapture can be useful in evaluating the completeness of TB control surveillance and registration, including in resource-limited settings; however, methodology and results should be carefully assessed. Interventions are needed to increase the completeness of registration and to reduce the number of initial defaulters.

KEY WORDS: tuberculosis; case registration; initial defaulters; record linking; capture-recapture
Westbank 2013
Westbank 2013
Capture-recapture

NOT FOR DUMMIES

TSJA, JE MOET EVEN WETEN HOE HET WERKT
Thank you for your attention