Tuberculosis in London: the importance of homelessness, problem drug use and prison

A Story, S Murad, W Roberts, M Verheyen, A C Hayward, for the London Tuberculosis Nurses Network

In the developed world, tuberculosis (TB) is increasingly concentrated in subgroups of the population in large urban centres. TB is a major public health problem in London, where there was an 11% increase in new reported cases between 2004 and 2005 and now accounts for 45% of all cases reported in England. Rates of disease have doubled from 21.2 per 100 000 per year in 1987 to 47 per 100 000 per year in 2005. A large outbreak of drug resistant tuberculosis in London, with over 220 linked cases, has disproportionately involved problem drug users, prisoners and the homeless, highlighting weak control among these groups.

Tuberculosis control is based on early case detection and ensuring patients complete at least 6 months of regular treatment. Failure to do this can lead to increased disease transmission, the development of drug resistance and relapse. Poor adherence is a major barrier to successful treatment. In many countries this has led to directly observed therapy (DOT) becoming the accepted standard of care for TB. There is a lack of randomised controlled trial evidence to support universal DOT in low prevalence settings. In the UK, DOT is recommended for patients who have been or are likely to be poorly adherent; however, there are limited data on risk factors for poor adherence and on how DOT is used in practice in the UK.

Homelessness, problem drug use and imprisonment affect the ability of patients to access health care and to take treatment. TB is known to be common in the homeless, but the extent of the problem in prisoners and drug users and the effect of these social issues on adherence, loss to follow-up, infectiousness and drug resistance has not been adequately described. Levels of imprisonment, drug use and homelessness are high in London with an estimated 10 000 single homeless people living on the streets or in hostels, and over 5000 prisoners at any one time. We conducted a study including all patients with TB in London to describe the impact of homelessness, imprisonment and problem drug use on control of the disease.

METHODS
Study design
A cohort study was undertaken of all patients with TB in Greater London to determine the point prevalence of disease in different groups and to examine risk factors for smear positivity, drug resistance, treatment adherence, loss to follow-up and use of directly observed therapy (DOT).

Results: Data were collected on 97% (1941/1995) of eligible patients. The overall prevalence of TB was 27 per 100 000. An extremely high prevalence of TB was seen in homeless people (788/100 000), problem drug users (354/100 000) and prisoners (208/100 000). Multivariate analysis showed that problem drug use was associated with smear positive disease (OR 2.2, p<0.001), being part of a known outbreak of drug resistant TB (OR 3.5, p=0.001) and loss to follow-up (OR 2.7, p<0.001). Imprisonment was associated with being part of the outbreak (OR 10.3, p<0.001) and poor adherence (OR 3.9, p<0.001). Homelessness was associated with infectious TB (OR 1.6, p=0.05), multidrug resistance (OR 2.1, p=0.03), poor adherence (OR 2.5, p<0.001) and loss to follow-up (OR 3.8, p<0.001). In London, homeless people, prisoners and problem drug users collectively comprise 17% of TB cases, 44% of smear positive drug resistant cases, 38% of poorly compliant cases and 44% of cases lost to follow-up. 15% of these patients start treatment on DOT but 46% end up on DOT.

Conclusions: High levels of infectious and drug resistant disease, poor adherence and loss to follow-up care indicate that TB is not effectively controlled among homeless people, prisoners and problem drug users in London.
(RFLP) pattern) and isoniazid resistant strains that were not part of the outbreak. Smear positivity related to status at diagnosis. The main outcomes were poor adherence, loss to follow-up and management with DOT. DOT was defined as treatment being observed by a healthcare worker or other responsible adult. We measured adherence during the first 2 months of treatment because the risk of developing resistance is greatest when the bacterial load is high. Poorly adherent patients were defined as those who admitted poor adherence; had inconsistent pill counts; negative urine tests; or who were switched to DOT or admitted to hospital due to poor adherence. Loss to follow-up was defined as the patient being out of contact with services for at least 2 months without medication during the first 6 months of treatment.

We also collected data on age, sex, foreign birth, ethnicity, problem alcohol use, mental health problems and previous TB.

**Analysis of data**

Disease prevalence per 100 000 population on 1 July 2003 (and 95% confidence intervals based on the Poisson distribution) was calculated for homeless people, problem drug users and prisoners and compared with prevalence in different ethnic groups and in foreign born and UK born populations. Denominator data on the size of the populations at risk were obtained from published sources.

We assessed the relationships between variables using univariate and multivariate analyses. Logistic regression analysis was used to calculate univariate odds ratios (ORs), 95% confidence intervals and p values. Multiple logistic regression models (backwards elimination) were used to control for confounding using robust standard errors to account for clustering at the clinic level. All analyses were performed using STATA Version 9 (STATA Corp, College Station, Texas, USA).

**RESULTS**

There were 1995 eligible patients giving an overall point prevalence on 1 July 2003 of 27.1 per 100 000 (95% CI 25.9 to 28.3; table 1). Baseline data were collected for 97% (1941/1995) of eligible patients; follow-up data were available for 95% (1841/1941) of these. The prevalence of TB was 788 per 100 000 (95% CI 764 to 982) in the homeless, 354 per 100 000 (95% CI 624 to 982) in foreign born individuals and 148 per 100 000 (95% CI 131 to 165) in recent migrants with <1 year in the UK (table 1).

One hundred and ten patients (6%) were homeless. Of these, 42 (38%) had infectious TB, and 30 of 77 culture confirmed cases (39%) had drug resistant disease including five (6.5%) with multidrug resistant disease. Fifty (46%) were documented as being poorly adherent and 17 (15%) were lost to follow-up (table 2). Multivariate analysis showed that homelessness was associated with smear positive disease (OR 1.6, 95% CI 1.0 to 2.6, p = 0.05), poor adherence (OR 2.5, 95% CI 1.6 to 3.7 p < 0.001) and loss to follow-up (OR 3.8, 95% CI 2.0 to 7.4, p < 0.001). Current or previous homelessness (ever homeless) was associated with multidrug resistant TB (OR 2.1, 95% CI 1.1 to 4.1, p = 0.03; table 3).

Two hundred and forty-eight patients (13%) were problem drug users. Among these, 39% (97) were smear positive, 15% (27) were confirmed as part of the London outbreak, 47% (116) were documented as poorly adherent and 10% (25) were lost to follow-up (table 2). Multivariate analysis showed that problem drug use was associated with smear positive disease (OR 2.2, 95% CI 1.6 to 2.9, p < 0.001), being part of the London outbreak of isoniazid resistant TB (OR 3.5, 95% CI 1.6 to 7.7, p = 0.001) and loss to follow-up (OR 2.7, 95% CI 1.6 to 4.3, p < 0.001; table 3).

Seventy-four patients (4%) were prisoners at some time during treatment. Of these, 29 (39%) had smear positive disease, 19 (26%) were confirmed as part of the London outbreak, 44 (59%) were poorly adherent and 9 (12%) were lost to follow-up (table 2). Multivariate analysis showed that imprisonment was associated with being part of the London outbreak (OR 10.3, 95% CI 4.0 to 26.5, p < 0.001) and poor adherence (OR 3.9, 95% CI 2.5 to 6.1, p < 0.001; table 3).

Overall, 350 patients (18%) were non-adherent in the first 2 months of treatment. South Asians, females, recent migrants and foreign born individuals were most likely to adhere to treatment. Patients least likely to adhere to treatment were homeless people, problem drug users and prisoners. A total of 177 patients (91%) started their treatment on DOT with 492 (25.3%) eventually being treated with DOT. Relatively few homeless people, prisoners or drug users started their treatment (25.3%) eventually being treated with DOT. Relatively few homeless people, problem drug users and prisoners were confirmed as part of the London outbreak, 44% (97) were smear positive, 15% (27) were confirmed as part of the London outbreak, 47% (116) were documented as poorly adherent and 10% (25) were lost to follow-up (table 2).Multivariate analysis showed that problem drug use was associated with smear positive disease (OR 2.2, 95% CI 1.6 to 2.9, p < 0.001), being part of the London outbreak of isoniazid resistant TB (OR 3.5, 95% CI 1.6 to 7.7, p = 0.001) and loss to follow-up (OR 2.7, 95% CI 1.6 to 4.3, p < 0.001; table 3).

Two hundred and forty-eight patients (13%) were problem drug users. Among these, 39% (97) were smear positive, 15% (27) were confirmed as part of the London outbreak, 47% (116) were documented as poorly adherent and 10% (25) were lost to follow-up (table 2). Multivariate analysis showed that problem drug use was associated with smear positive disease (OR 2.2, 95% CI 1.6 to 2.9, p = 0.001), being part of the London outbreak of isoniazid resistant TB (OR 3.5, 95% CI 1.6 to 7.7, p = 0.001) and loss to follow-up (OR 2.7, 95% CI 1.6 to 4.3, p < 0.001; table 3).

Collectively, problem drug users, homeless people and prisoners made up 17% (321/1941) of TB cases, 38% (133/350) of non-adherent cases, 25% (47/184) of smear positive cases, 39% (97/248) of confirmed cases and 26% (61/235) of cases lost to follow-up (table 2). Multivariate analysis showed that homelessness was associated with smear positive disease (OR 3.9, 95% CI 2.5 to 6.1, p < 0.001; table 3).

**Table 1** Prevalence of TB in different population groups

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>Number of cases</th>
<th>Population denominator</th>
<th>Prevalence per 100 000 (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>1941</td>
<td>717209113</td>
<td>27.1 (25.9 to 28.3)</td>
</tr>
<tr>
<td>Age 0–14</td>
<td>92</td>
<td>1365377i</td>
<td>6.7 (5.4 to 8.3)</td>
</tr>
<tr>
<td>Age 15–29</td>
<td>718</td>
<td>16396312</td>
<td>43.8 (40.6 to 47.1)</td>
</tr>
<tr>
<td>Age 30–59</td>
<td>919</td>
<td>299230515</td>
<td>30.7 (28.8 to 33.8)</td>
</tr>
<tr>
<td>Age 60+</td>
<td>203</td>
<td>117444611</td>
<td>17.3 (15.0 to 19.8)</td>
</tr>
<tr>
<td>Male</td>
<td>1064</td>
<td>346879312</td>
<td>30.7 (28.9 to 32.6)</td>
</tr>
<tr>
<td>Female</td>
<td>847</td>
<td>370329811</td>
<td>22.9 (21.4 to 24.5)</td>
</tr>
<tr>
<td>Foreign born</td>
<td>1548</td>
<td>194290414</td>
<td>79.7 (75.8 to 83.7)</td>
</tr>
<tr>
<td>UK born</td>
<td>376</td>
<td>52291817</td>
<td>7.2 (6.5 to 8.0)</td>
</tr>
<tr>
<td>Recent migrant (arrived &lt; 1 year)</td>
<td>295</td>
<td>200000112</td>
<td>147.5 (131.2 to 165.3)</td>
</tr>
<tr>
<td>White</td>
<td>303</td>
<td>510320318</td>
<td>5.9 (5.3 to 6.7)</td>
</tr>
<tr>
<td>South Asian</td>
<td>450</td>
<td>73363512</td>
<td>88.6 (81.9 to 95.7)</td>
</tr>
<tr>
<td>Black African</td>
<td>748</td>
<td>37893312</td>
<td>197.4 (183.5 to 212.1)</td>
</tr>
<tr>
<td>Black Caribbean</td>
<td>92</td>
<td>34356711</td>
<td>27.9 (21.6 to 32.8)</td>
</tr>
<tr>
<td>Other</td>
<td>209</td>
<td>19323513</td>
<td>108.2 (94.0 to 123.9)</td>
</tr>
<tr>
<td>Problem drug users</td>
<td>248</td>
<td>7000013</td>
<td>354.3 (311.4 to 401.2)</td>
</tr>
<tr>
<td>Prison (on 1 July 2003)</td>
<td>11</td>
<td>527914</td>
<td>208.4 (104.1 to 372.9)</td>
</tr>
<tr>
<td>Living in hostel/on street (on 1 July 2003)</td>
<td>79</td>
<td>1002412</td>
<td>788.1 (624.0 to 982.2)</td>
</tr>
</tbody>
</table>

Table 1: Prevalence of TB in different population groups.
of poorly compliant cases, 44% (29/66) of cases lost to follow-up, 30% (146/492) of cases ever treated with DOT, 30% (350) of poorly compliant cases, 44% (29/66) of cases lost to follow-up. They form only 17% of all cases and problem drug users. These patients have a high prevalence of disease and are often infectious, drug resistant, poorly adherent and lost to follow-up. They form only 17% of all cases

### DISCUSSION

This study shows that TB is a major public health problem in London, and particularly among homeless people, prisoners and problem drug users. These patients have a high prevalence of disease and are often infectious, drug resistant, poorly adherent and lost to follow-up. They form only 17% of all cases.
but nearly half of all drug resistant smear positive patients, making a disproportionate impact on control.

Ascertainment of risk factors such as homelessness, drug use and prison history can be difficult. Although we provided clear case definitions, it is likely that we have underestimated the extent of these problems. Estimating the numbers of homeless people and problem drug users in London is also problematic. The reliability of prevalence estimates is also dependent on denominator data. We relied on published estimates of population sizes in London. Measuring poor adherence is notoriously difficult. We relied on hard measures and are therefore likely to have underascertained poor adherence.

We achieved a high level of completeness for baseline and follow-up data by working closely with patients’ case managers who were highly knowledgeable about their patients. This allowed detailed information on social circumstances that is not normally systematically recorded to be collected with a high degree of accuracy. Collection of data on multiple risk factors enabled confounding to be adequately controlled. The size and pan-London nature of the study are major strengths. Although the study was confined to London, similar issues are likely to be seen in any cities with large homeless, drug using and prison populations.

Previous studies in the United States have shown that homeless people, prisoners and drug users have high rates of infection, active disease, poor treatment outcomes and to be associated with recent transmission and outbreaks.20–23 These studies have also shown high levels of overlap between these populations. The contribution of homelessness, imprisonment and problem drug use to TB in the UK context has not been previously described. Data on these factors are not routinely collected. This study confirms these factors as being of major importance in London, quantifies the prevalence of disease in these populations, and shows that homelessness, prison and problem drug use are independent risk factors for drug resistance, smear positivity and poor adherence. Any of these factors either alone or in combination should raise the index of suspicion for TB, alert health professionals to the possibility of drug resistance and infectiousness and the need to instigate measures that will help patients to complete treatment.

Homeless people, problem drug users and prisoners commonly share overcrowded, poorly ventilated spaces leading to a high risk of transmission, as illustrated by the current large outbreak of drug resistant TB in London. In addition to large outbreaks, molecular epidemiological research in the Netherlands has shown intense transmission among drug addicts and homeless people by multiple sources.24 High levels of sputum smear positivity on diagnosis among homeless people, problem drug users and prisoners are likely to indicate delays in case detection. The duration of infectiousness is a key parameter for the transmission of any infectious disease.25 There is a need to evaluate measures to promote early case detection including raising awareness, improving access to services and active case finding measures such as mobile x ray screening.26

In the United States, 86% of homeless patients between 1994 and 2003 were treated with DOT. Those treated in this way had higher levels of treatment completion.19 In London, in 2003 only 12% of homeless patients started their treatment under direct observation but a further 47% were later switched to DOT after demonstrating poor adherence. Similar figures were seen for prisoners and problem drug users. This is despite national guidance in 199827 that “DOT is recommended for patients who are unlikely to comply” and, most recently, in 2006 the National Institute of Health and Clinical Excellence (NICE)
recommends that “all patients should have a risk assessment for adherence to treatment, and DOT should be considered for patients who have adverse factors on their risk assessment; in particular street- or shelter-dwelling homeless people and prisoners with active TB and patients with likely poor adherence and those who have a history of non-adherence”.6

Greater emphasis is needed on practical measures to identify early patients at risk of poor adherence to treatment and to provide additional support including DOT from the start of treatment, access to appropriate accommodation, and use of incentives.24–30 DOT is unlikely to lead to improved treatment outcomes unless initiated in conjunction with a package of supportive care tailored to patients’ needs.8 9 10

Most patients with TB pose a minimal transmission risk as they are smear negative on diagnosis, demonstrate good adherence to treatment and have high rates of treatment completion. By contrast, high levels of infectious and drug resistant disease, poor adherence and loss to follow-up indicate that TB is not effectively controlled among homeless people, prisoners and problem drug users in London.

ACKNOWLEDGEMENTS
The authors thank all TB nurses, allied professionals and administrative staff in London who contributed data; Dr John Watson, Professor Anne Johnson and Dr Rob van Hest for comments on the manuscript; and the London Infectious Disease Research Network for support with ethical applications and analysis.

Authors’ affiliations
A Story, Tuberculosis Section, Respiratory Diseases Department, Centre for Infections, Health Protection Agency, UK
S Murad, A C Hayward, UCL Centre for Infectious Disease Epidemiology, Department of Primary Care and Population Sciences, University College London/Camden Primary Care Trust, London, UK
W Roberts, North East London TB Network, London, UK
M Verheyen, Research Centre for Health Studies, Buckinghamshire Chilterns University College, Buckinghamshire, UK

Funding: Department of Health and the Health Protection Agency.
Competing interests: None.
Ethics approval: London Metropolitan Multi-centre Research Ethics Committee
Statement of independence from funders: Alistair Story is currently employed by the Health Protection Agency

REFERENCES
Tuberculosis in London: the importance of homelessness, problem drug use and prison

A Story, S Murad, W Roberts, M Verheyen and A C Hayward

Thorax 2007 62: 667-671 originally published online February 8, 2007
doi: 10.1136/thx.2006.065409

Updated information and services can be found at:
http://thorax.bmj.com/content/62/8/667

These include:

References
This article cites 21 articles, 3 of which you can access for free at:
http://thorax.bmj.com/content/62/8/667#BIBL

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Topic Collections
Articles on similar topics can be found in the following collections

Epidemiologic studies (1829)
Drugs: infectious diseases (968)

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/