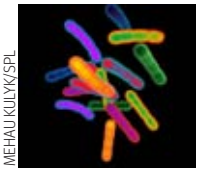
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Tuberculosis in the UK—time to regain control

Tuberculosis is increasing in incidence in many large cities in the UK. This contrasts with stable or declining rates in most western European countries. **Ibrahim Abubakar and colleagues** explain why and describe what needs to be done to regain control

Easy travel and migration have allowed tuberculosis to re-emerge as a public health problem in many European countries.[1] In the United Kingdom the number of reported cases is now at its highest since the 1970s. In 2009, 9040 cases of active tuberculosis were notified, which represents roughly a 75% increase over the past 20 years.[2] Most cases occur in large towns and cities (fig 1). We present an analysis of the size of the problem, factors driving the epidemic, weakness of our current control strategies, lessons to be learnt from other tuberculosis control programmes, and the actions required to achieve tuberculosis control in the UK.

Who has tuberculosis in the UK?

Most cases of tuberculosis (73% in 2009) in the UK occur in people born outside the country (fig 2, table 1).[3] The majority develop active symptomatic disease several years after arrival (in 2009, almost four fifths had lived in the UK for two or more years). DNA fingerprinting studies suggest that most cases arose from latent *Mycobacterium tuberculosis* infection acquired outside the UK.[4] This forms a reservoir of latent *M tuberculosis* infection from which future cases may arise.

M tuberculosis is spread by aerosol transmission and disproportionately affects marginalised urban populations who cluster geographically (for example, homeless people, drug misusers, and offenders[2]), present late to medical services, have poor adherence to prescribed regimens, and have low treatment completion rates.[5 6] Such people are often more infectious than other people with tuberculosis (as they have sputum smear positive pulmonary disease) and have high rates of drug resistance.[5-7] Social exclusion, therefore, affects current rates of tuberculosis.[7]

HIV, diabetes, chronic kidney disease, or the use of anti-tumour necrosis factor drugs, increase the risk of people with latent *M tuberculosis* infection progressing to active tuberculosis. HIV infection is more prevalent in the parts of the world from which most non-UK born tuberculosis arises (table 1), and 2-10% of tuberculosis cases in the UK are in people who have HIV coinfection.[8]

How does the UK compare with other countries?

Rates of tuberculosis in the UK now exceed those in all other Western countries except Spain and Portugal, where, in contrast to the UK, rates are falling (fig 3). The key difference is the geographical origin of migrants.[9] A greater proportion of UK migrants are from countries with a high prevalence of tuberculosis such as the Indian subcontinent and sub-Saharan Africa. The US also has higher rates of tuberculosis in foreign born residents. However, tuberculosis in both foreign and US born residents

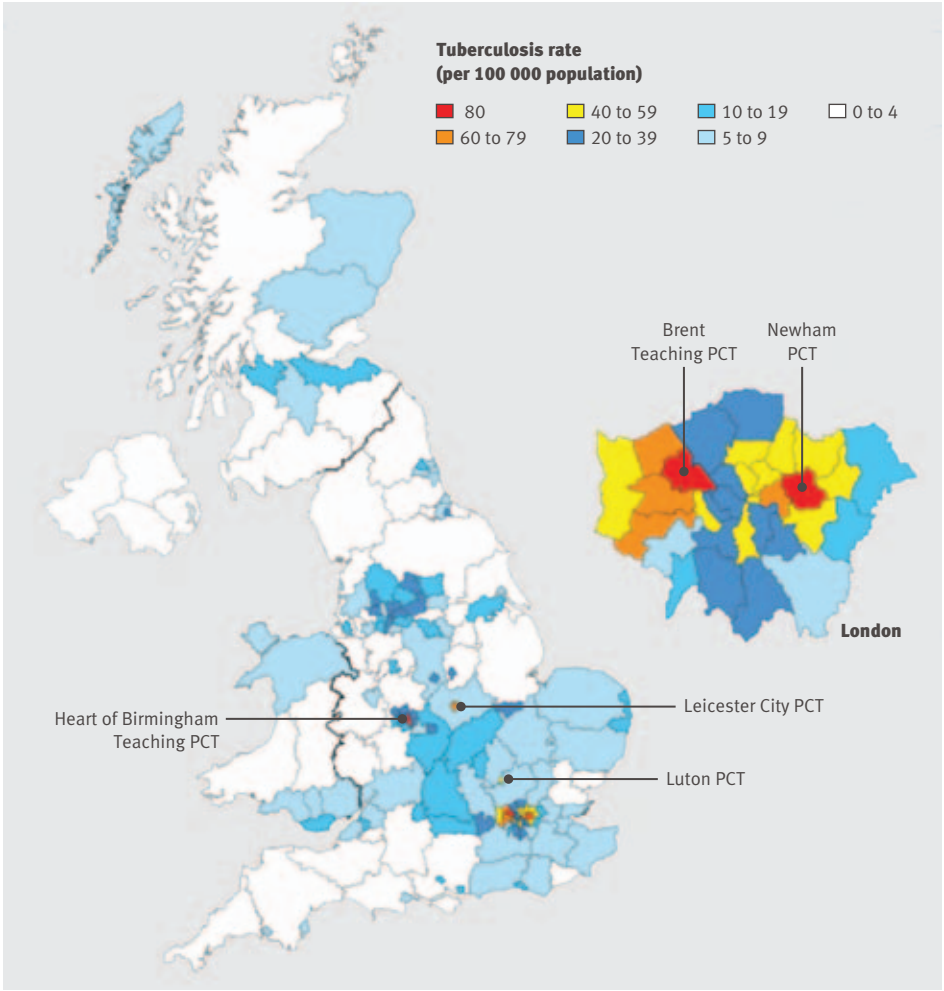

Fig 1 | Three year average tuberculosis case rates per 100 000 by primary care trust, 2007-9 (rates calculated using Office for National Statistics mid-year population estimates for 2008)

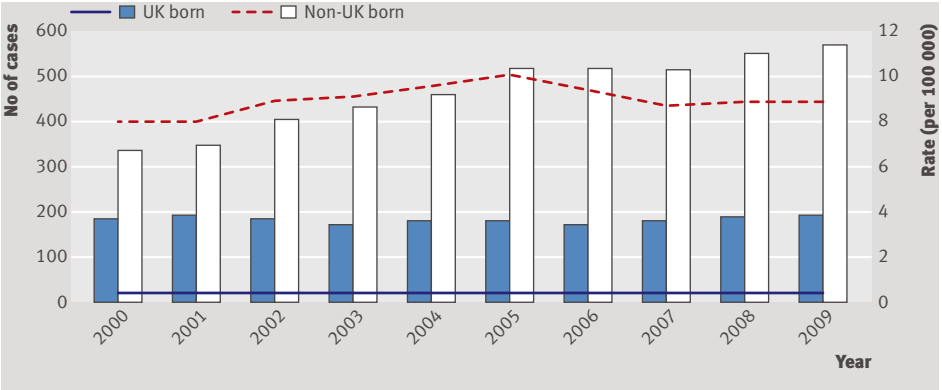

Fig 2 | Tuberculosis case reports and rates per 100 000 by place of birth, England, 2000-9[3]

Table 1 | Region of origin of non-UK born people reported with tuberculosis in UK, 2009[3]

World region of birth	No of cases*
South Asia	3167
Sub-Saharan Africa	1704
South East Asia	259
West Europe	136
Central Europe	126
South, Central America, and the Caribbean	115
East Asia	102
North Africa	60
East Mediterranean	54
East Europe	46
North America and Oceania	13
Total	5782

*Region of origin was not known for all cases.

has declined, whereas in the UK rates in the native born people are unchanged and those in non-UK born have increased.

UK control measures

About 10% of people with latent *M tuberculosis* infection will develop active disease at some point. Controlling tuberculosis requires prompt detection and effective treatment of people with active, symptomatic infectious disease and those with asymptomatic latent infection at risk of reactivation. Current measures to detect tuberculosis in people entering the UK include selective screening for active tuberculosis before the issuing of entry visas, chest x ray "screening" at Heathrow and Gatwick airports, and variable local follow-up of migrants referred from ports. Unfortunately, this strategy detects only a small number of cases.[11]

Previous reviews of tuberculosis services in the UK indicate both strengths and deficiencies in local screening.[12] For example, among the 112 English primary care trusts responding to a survey, nearly half reported not having a migrant screening programme and no tuberculosis lead to advise on control measures. About 40% of PCTs had no local arrangements to work with local authorities and social care services.

Across the country there is much variability in the methods used to diagnose active tuberculosis and latent *M tuberculosis* infection after entry. Indeed, UK regions with a high tuberculosis burden often undertake the least screening for latent infection—and that too, in a manner inconsistent with guidance from the National Institute for Health and Clinical Excellence (NICE).[13]

Mobile chest x ray screening of homeless people and other socially excluded populations for active tuberculosis has been used in London. A case-control study, plus economic modelling, suggest that this is effective in hard to reach groups, reducing diagnostic delay by up to two thirds compared with cases presenting passively.[14] However, many of those with chest x ray results suggesting tuberculosis never reached the healthcare service to which they had been referred.[14]

Treatment of tuberculosis is free for everyone in the UK, and migrant groups generally have treatment completion rates for active tuberculosis of about 83%,[2] though asylum seekers have poor access to health services.[15] The World Health Organization target is a minimum of 85% of cases completing treatment within 12 months of starting therapy. NICE guidance on managing latent *M tuberculosis* infection takes a pragmatic view, balancing the risk of progression to active disease against that of drug treatment.[16] National data on who is assessed, receives preventive therapy, or completes treatment are scanty, and the effectiveness of the UK approach is unclear.

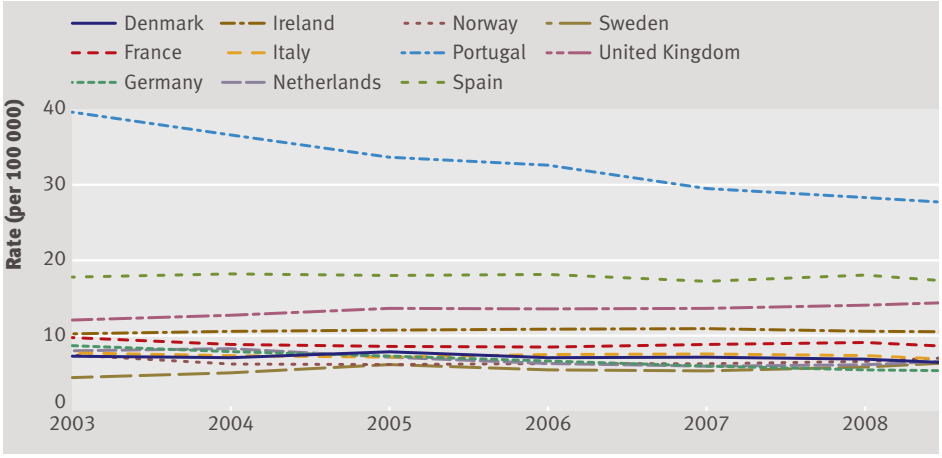

Fig 3 | Comparison of tuberculosis rates per 100 000 between European countries (2003 to 2009)[10]

What can the UK learn from other countries?

Most European data come from control programmes that have targeted tuberculosis arising from indigenous transmission, which explains only around 20% of UK cases.[17] However, the Netherlands and US have both reduced case rates in immigrants, and table 2 compares their control programmes with that in the UK. A Dutch observational study of screening for active tuberculosis among immigrants from countries with a high incidence of tuberculosis (>200/100 000) that used proactive follow-up detected over 270 active cases per 100 000 people screened, allowing prompt treatment.[18] To ensure good compliance, migrant screening is mandatory and explicitly linked to state benefits and immigration rights; screening is done by the municipal health service where the migrant lives. Migrants are also voluntarily reviewed for two years after entry. Although the Dutch have reduced the incidence of tuberculosis, a review of the control programme concluded that to approach elimination, it needed to intensify the diagnosis and treatment of latent infection among immigrants.[19]

The most cited example of a successful Western control programme is the reversal of the epidemic in New York. This had major political, legal, and financial backing. State tuberculosis programmes invested substantially in tuberculosis control and developed and applied a standardised manual of clinical policies and protocols.[20] This resulted in more aggressive control of recent transmission (which was considerably higher than current UK rates) and an improvement in treatment completion

Table 2 | Tuberculosis control services in the Netherlands, US, and UK

	Netherlands	US	UK
Model of care	TB control units based in local authorities target the social nature of TB by combining an outreach service with a one stop clinic for screening, diagnosis, contact investigation, and management of uncomplicated tuberculosis. Robust systems for screening immigrants, although loss to follow-up during subsequent voluntary screening is high	State programmes developed clinical pathways of care including a review of each "cohort" of new patients starting treatment and screening of immigrants. Household contact screening is done by local clinics with centrally managed larger contact screening exercises and immigrant screening	NICE guidelines outline detailed recommendations for the clinical and public health management of active latent TB. No model clinical pathway developed. Screening of immigrants recommended but variably implemented. Services largely dependent on local respiratory medicine or infectious diseases departments
Leadership	National leadership provided through the Dutch Royal TB Association (KNCV Tuberculosis Foundation)	State authorities with national leadership and guidance from the Centers for Disease Control	Some areas have local clinical leads, and the Health Protection Agency or local public health bodies often lead investigation of outbreaks, but no clear overall local leadership. National policy led by the Department of Health
Effect on tuberculosis	Rate of tuberculosis has declined significantly over the past century. Treatment completion rates are high	Nationally, rates are declining in both native and foreign born residents. Treatment completion rates are high	Increasing rates in most major cities with stable incidence in the UK born. Treatment completion in migrant groups reasonably high

from around 50% to 90%.[21] The falling rates in the US among native and foreign born residents are in part attributable to improved public health interventions,[22] pre-entry and post-entry screening of immigrants,[23] and better organised state tuberculosis control programmes. An observational study in a group of migrants to California showed that including mycobacterial cultures in the pre-entry screening programme decreased the occurrence of tuberculosis from 4.2% (86 cases) to 1.5% (22 cases, P<0.001), in the first six months after arrival.[23]

The way forward for UK tuberculosis control

The complexity of factors driving the tuberculosis epidemic in the UK requires a multifaceted locally tailored approach with a clear strategy. For example, in London, a detailed review of services has led to citywide recommendations.[24] Below we focus on the key points (box).

Tackling tuberculosis in immigrant populations

Because of the high incidence of tuberculosis in migrants from high burden countries NICE has recently lowered the threshold for screening for latent *M tuberculosis* infection to immigrants from countries with an incidence of active tuberculosis of 40/100 000.[16] A recent economic analysis suggests that a threshold of 150/100 000 may be more appropriate.[25] Use of this higher threshold would enable resources to be targeted at other neglected areas. The poor local follow-up of people at high risk highlights the need for improved information collection and exchange systems that link arrival data with local NHS and social services. This would enable local services to offer primary care registration and a health check to new arrivals in their area.

A cluster randomised controlled trial of an educational programme promoting evaluation for tuberculosis in people registering in primary care[26] in Hackney, London, improved identification of active tuberculosis 1.68-fold (95% confidence interval 1.05 to 2.68) and latent infection threefold (0.98 to 9.20); BCG coverage increased 9.52-fold (4.0 to 22.7). This shows the potential for locally tailored post-entry screening programmes to control tuberculosis. However, there are difficulties in organising such a system, especially for refugees.[27] Traditional approaches that rely on the port of entry and subsequent access to healthcare would not work with illegal immigrants.

Ideally migrants would be given information about their risk of developing active tuberculosis and encouraged to register with a general practitioner. Subsequent screening for latent infection and active disease should be undertaken as part of a general health assessment. This may require financial or other inducements, as used in the Netherlands.[18] Local health authorities, especially in areas with a high burden of tuberculosis, should have written standards for the management of those at risk, including a system for raising awareness of tuberculosis and HIV infection and a mechanism for audit. Pre-entry screening may also have a role[23] but requires further evaluation. The UK should also continue to support the global tuberculosis control effort, as this will reduce the number of immigrants with tuberculosis.

Hard to reach groups

The high loss to follow-up among hard to reach groups led the English Department of Health to fund a pilot "Find and Treat" programme. People with suspected tuberculosis identified by mobile chest radiography units were offered support to successfully negotiate the health and social care system, often with the help of non-profit organisations.[28] The simple measure of ensuring safe and secure housing for at least the duration of tuberculosis treatment in rough sleepers and those with unstable tenancy improves treatment outcome.[29]

Detection in prisons could also be improved. Generally only ad hoc symptom based tuberculosis assessment is undertaken, although some prisons are about to start chest x ray screening. Treatment completion in prisoners is currently about 50%[30] and could be improved by more coordinated planning of treatment before prisoners are released and by the restriction of transfers between prisons. New point of care tests that allow rapid diagnosis of tuberculosis and drug resistance may also have a role in this population.

No UK region exceeds the WHO 85% treatment completion levels for active tuberculosis.[2] This cannot continue. Approaches such as cohort review of patient care (where cases are formally discussed to ensure that the index case and their contacts' management are in line with expectations) plus greater use of directly observed therapy in groups with low adherence have improved completion rates in New York.[21] This is likely to be beneficial in UK cities.[31]

Organisation of healthcare

Neither the NICE guidelines nor the national toolkit for commissioning provide an efficient model of care.[16] The planned reforms of the NHS provide an opportunity to enhance public health, but must not impede the requirement of a coordinated service. Devolving commissioning to local providers may have a negative effect on tuberculosis control. For example, tuberculosis outbreaks are likely to be very infrequent within each clinical commissioning group's area or will cross several financial and administrative boundaries. It is therefore unlikely that any single commissioning group will have made provision for the resources required to handle an incident such as a school outbreak. Similarly, multidrug and extensively drug resistant tuberculosis are expensive to treat, and management would be better funded through a larger grouping. Furthermore, programmes such as the mobile radiography unit in London will be cost effective only when implemented across a wide area. Development of a strategy and commissioning of a comprehensive package across

Recommendations for change

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Tuberculosis in immigrants

- Screening for active and latent tuberculosis in immigrants from high burden countries with incidence above 150/100 000
- Migrants should be given information about their risk of developing active disease and encouraged to register with a general practitioner
- Locally tailored post entry screening programmes should be integrated within a general health assessment, where appropriate supported by financial or other inducements
- Local health authorities should have written standards for managing those at risk, which must include raising awareness of tuberculosis and HIV and a mechanism for audit

Tuberculosis in hard to reach groups

- Provide active case finding and case management support, where appropriate, through outreach programme
- Improve treatment completion in prisoners through coordinated planning before release of prisoners on treatment and restricting their transfer between prisons

Organisation of services

- A locally tailored evidence based strategy for an integrated and coordinated service should be implemented
- Enhanced links between health, social care, and non-profit organisations
- Commissioning of services should be across a wider area than covered by local commissioning groups

a wider geographical area, especially in high burden urban conurbations, is therefore the preferred approach for tuberculosis control in the UK. This may require commissioning to occur at a sub-national level through the NHS Commissioning Board and strong links with Public Health England.

Conclusion

Multiple factors are contributing to the rise of tuberculosis in the UK. There is no single intervention that will lead to control of tuberculosis in the UK, and a variety of strategies targeting different aspects of control are required. We are encouraged that the government's Public Health Outcomes Framework has provisionally included completion of tuberculosis treatment as one of its measures.

Ibrahim Abubakar consultant epidemiologist, Tuberculosis Section, Health Protection Services–Colindale, Health Protection Agency, London NW9 5EQ, UK and Norwich Medical School, University of East Anglia, Norwich, UK
Marc Lipman consultant physician, Centre for Respiratory Medicine, Royal Free Hospital, University College London Medical School, London, UK
Charlotte Anderson senior scientist, London Regional Epidemiology Unit, Health Protection Agency
Peter Davies consultant respiratory physician, TB Unit, Liverpool Heart and Chest Hospital, Liverpool, UK
Alimuddin Zumla professor of infectious diseases and international health, Division of Infection and Immunity, University College London Medical School

Correspondence to: I Abubakar, Tuberculosis Section, Health Protection Services—Colindale, Health Protection Agency, London **ibrahim.abubakar@hpa.org.uk**

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Contributors and sources: All authors work on TB in the UK. IA is a consultant epidemiologist/head of the TB section at the Health Protection Agency. ML is a member of the London tuberculosis clinical working group. PD leads the Liverpool tuberculosis service. AZ pioneered the London TB Link Project and leads international collaborations on research into several aspects of tuberculosis and HIV infection. AZ initiated this article. IA, ML, and AZ wrote the article with contributions from all authors. IA is guarantor.

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