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Tuberculosis screening in migrants in selected European countries shows wide disparities

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ABSTRACT: Well-established tuberculosis screening units in Western Europe were selectively sampled. Three screening units in Norway, two in the UK, one in the Netherlands and one in Switzerland were evaluated. The aim of this study was to describe a range of service models used at a number of individual tuberculosis units for the screening of new entrants into Europe.

Semi-structured interviews were conducted with clinicians, nurses and administrators from a selected sample of European tuberculosis screening units. An outline of key themes to be addressed was forwarded to units ahead of scheduled interviews. Themes included the history of the unit, structure, processes and outputs involved in screening new entrants for tuberculosis.

Considerable variation in screening services exists in the approaches studied. Units are sited in transit camps or as units within hospital facilities. Staff capacity and administration varies from one clinic per week with few dedicated staff to fully dedicated units. Only one site recorded symptoms; tuberculin testing was universal in children, but varied in adults; chest radiograph screening was universal except at one site where a positive tuberculin skin test or symptoms were required in those <35 yrs of age before ordering a radiograph. Few output data are routinely and systematically collected, which hinders comparison and determination of effectiveness and efficiency.

Service models for screening new immigrants for tuberculosis appear to vary in Western Europe. The systematic collection of data would make international comparisons between units easier and help draw conclusions that might usefully inform service development.

KEYWORDS: Europe, screening, tuberculosis

Communicable diseases have long captured the attention of public health policy makers challenged with the health consequences of population movements [1]. Tuberculosis is a disease associated with poverty and hardship and, because migration to and within Western Europe involves people moving from less to more economically developed regions, some countries are witnessing changes in the epidemiological profile of tuberculosis as a consequence. For example, whilst tuberculosis notification rates across Western Europe decreased by 3% yearly, overall between 1995 and 2000 increases in notification rates were seen in some countries, notably Denmark, Luxembourg, Norway and the UK. These increases were largely due to an increase in tuberculosis in foreign-born individuals. In 2000, tuberculosis amongst foreign-born persons or persons with a foreign citizenship accounted for 28% of all tuberculosis cases in Western Europe [2]. Thus, tuberculosis amongst new entrants entering Western Europe represents an important and increasing proportion of all tuberculosis cases reported.

It has been suggested that screening for tuberculosis and infection with *Mycobacterium tuberculosis* among groups of foreigners has the potential to yield a large number of persons who can benefit from curative and preventive interventions [3]. Moreover, whilst there is limited evidence to suggest that those entering host countries pose a threat to host communities, it has been suggested that they may pose a threat within their migrant communities [4–6]. Since many migrants are socially isolated and living in overcrowded conditions, these circumstances may both enhance the potential for spread of tuberculosis within these communities and challenge some individuals' effective and timely access to services. In 1994, a Task Force from the International

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Union Against Tuberculosis and Lung Disease (IUATLD) recommended that countries within Europe ''consider screening of high incidence and prevalence groups among the entering foreign population for tuberculosis and infection with *M. tuberculosis*'' [3].

This paper describes the service models of several units in Europe that screen immigrants for tuberculosis in order to inform and improve the delivery of such services.

METHODS

During the preliminary stages of an ongoing systematic literature review of new-entrant screening for tuberculosis, several sites in Western Europe were identified that had developed screening programmes for new entrants. Seven units were identified that appeared to offer a range of different approaches. These particular sites were purposely selected for sampling in order to acquire specific types of information [7]. All those approached agreed to participate.

Other than the unit in the Netherlands, all units were visited and face-to-face semi-structured interviews were carried out with the key professionals working there, including clinicians, nurses and managers. Interviewees were sent an outline of themes to be addressed (in which some specific questions were incorporated) ahead of scheduled interviews in order to identify appropriate respondents, and to give respondents time to prepare data and formulate responses. Further issues were explored in depth as they became apparent during interviews. Due to feasibility problems, the interview with the Dutch unit was conducted over the telephone.

An evaluation tool was developed by drawing upon an approach already developed for communicable disease programmes [8]. Where absolute quantitative data could not be provided, for example in staffing numbers, estimates are derived explicitly from available data.

RESULTS

Screening programmes for new entrants

All units were part of a national programme for screening new entrants for tuberculosis (table 1). Five of the seven were established after 1994, when the IUATLD recommended improved screening of immigrants coming into Europe from countries where tuberculosis is endemic [3].

In Switzerland, permanent entry into the country requires screening of all migrants for tuberculosis from countries other than the European Union (EU), European Free Trade Agreement countries not in the EU, North America, Australia and New Zealand, and the process is part of the transit camps' administrative function.

Transit camps are also used in Norway for all asylum seekers; others, such as family reunions and students intending to stay for >3 months, arrive directly at a municipality, where the police inform the health services about the new arrivals. The health services in Norway then have an obligation to carry out tuberculosis screening on those persons from countries with high tuberculosis prevalence (excluding Western Europe, USA, Canada, Australia, New Zealand and Japan). Screening therefore occurs within days of arrival, except in Norway unit 3, where the unit is specifically designed to screen new entrants who have missed the intended procedure.

In the UK, since 1971, the Port of Arrival scheme notifies the local Consultant for Communicable Disease Control (CCDC) of all new entrants who come from a country where the incidence of tuberculosis is >40 per 100,000 and who intend to stay for ⩾6 months. Those with symptoms may be offered a chest radiograph at the port of entry. The CCDC, in turn, notifies the local tuberculosis services so that the new entrant may be offered follow-up treatment. Approximately one in six of those invited to attend for screening in the UK do so. The two units in the UK were therefore given additional responsibility for addressing this low uptake in view of their high local incidence of tuberculosis. The Port of Arrival scheme was initiated in 1971; dates given in table 1 indicate when funding was allocated for this additional responsibility.

In the Netherlands, immigrants, foreign students and foreign workers from high-prevalence countries (>50 per 100,000, excluding EU countries, Switzerland, Israel, Surinam, USA, Canada, New Zealand, Australia and Japan) who intend to stay >3 months, are referred by the immigration office to the Municipal Health Service for screening. Compliance with this procedure is high (>80% within 3 months after arrival), because the residence permit is only issued if screening has been performed. Voluntary periodic screening (bi-annual) is offered to all immigrants >12 yrs of age, with a bacillus Calmette–Guérin (BCG) vaccination, for 2 yrs. Immigrants between 12 and 25 yrs without a BCG vaccination receive two tuberculin skin tests 2 months apart. If the skin test is positive, radiography follow-up screening (bi-annual) for 2 yrs is recommended; in selected cases, preventive therapy is offered. An element of coercion is present for all countries except the UK, where the police are not involved in the process of referral.

Structure and function

Two units were attached to the main transit camps for refugees and asylum seekers in Norway (Norway 1) and Switzerland, where entry is conditional upon screening. The remaining units were sited for ease of access to staff and radiography facilities at chest clinics, usually within a hospital setting or municipal health service. In the UK, access to radiography facilities was part of the general hospital use. The other units examined had dedicated equipment. Four had digital outputs resulting in a reduction in radiography exposure and offering the advantage that radiologists could interpret the data at a site distant from the screening unit. In the Netherlands, specially trained tuberculosis public health physicians read radiographs, and examine and treat patients at the municipal health service. All units have access to trained advocates in the languages of those screened; occasionally interpretation services *via* the telephone are used.

Where units had dedicated facilities, screening could be undertaken every day. Where facilities were shared, as in the UK, screening was largely confined to specific times, although informal arrangements meant that, in practice, new entrants with a high suspicion of active tuberculosis could be seen outside formal clinic times (table 2).

TABLE 1 Description of units engaged in new entrant screening

	Norway 1	Norway 2	Norway 3	UK 1	UK 2	The Netherlands	Switzerland
When established				1996	1998	Since the 1960s	1992
Where situated	Attached to the only transit camp	Hospital chest clinic	MHS	Hospital chest clinic	Hospital chest clinic	MHS	Refugee camp (registration centre at the border)
Purpose	Screening refugees	Screening for family reunions and for those missed in general processes	Screening for family reunions	High incidence of TB in new entrants	High incidence of TB in new entrants	Screening of new entrants from countries with high TB prevalence	Refugee national programme
Numbers invited per yr#	Practically identical to those attending	1953 in 2002	126	3068	857	NA	15000–25000
Attendees n·yr^{-1}#	15500	1553 in 2002	123	640	732	Total visits to TB department in 2002: immigration 39000; asylum seekers 9000; MHS 500; asylum seeker centres 850+	All immigrants applying for asylum
Staff wte							Five centres, each with 3–6 nurses
Nursing	4	6	1	0.5	0.4	5	
Medical	2	1.5	0.1	0.1	0.1	5	
Other	4	4	0	0.6	0.5	13f	
Estimated funding €	NA	NA	NA	50000	No additional dedicated funding§ for screening provided	NA (funding includes all costs)	NA
Staff per 1000 screened	NA	NA	NA	1.9	NA	NA	NA
Cost per person screened €	NA	NA	NA	78	NA	NA	250 (including immunisation)
TB cases identified yr^{-1}	27 in 2002 39 in 2003 23 in first 9 months of 2004	NA	NA	7	0.77	2002 TB cases in new immigrants 10 Active case finding 7## Incidence 185/100000 (6/3239 new immigrants)	100 to 140
Cost to treat one TB case €	NA	NA	NA	5250	NA	NA	NA
Potential savings¶ €	NA	NA	NA	73500	NA	NA	NA

MHS: Municipal Health Service; TB: tuberculosis; NA: not available; wte: whole time equivalent. #: results refer to 2003 unless stated otherwise; ##: six were identified at first screening; +: with a mobile radiography unit; f: for all activities including registration, contact investigation, *etc.*; ¶: assuming one patient identified by screening prevents three associated cases; §: dedicated funding; others are funded as part of an overall TB budget.

Process of screening

Initiation of the screening process depended on the site and source of referral. The prior risk of tuberculosis was estimated for new entrants to the UK, where screening was limited to those from areas where the incidence of tuberculosis was greater than 40 per 100,000. In this study, four units (Norway 1, UK 2, the Netherlands and Switzerland) specifically targeted asylum seekers and refugees, based on local epidemiological data of the incidence of tuberculosis in these groups. Where screening was not compulsory, units invited individuals to attend for screening by letter. Three units used the individual's own language, one of which provided a contact number so that literate friends could direct the individual to an advocate speaking the same language.

Immigration officials initiated screening, except in the UK where family doctors or a team working with refugees at UK 2 (including helpers at a day centre for asylum seekers and officials in the housing department of the local council) could also make referrals. Nurses began the process of excluding tuberculosis in all units except in the Netherlands. Six units interviewed new entrants for any symptoms that might suggest tuberculosis (cough, haemoptysis, fever, night sweats, weight loss, anorexia, malaise, and enlarged lymph glands). In the Netherlands and Switzerland, all immigrants are screened, whether or not they are symptomatic. Most units carry out tuberculin skin testing, order chest radiographs and order or perform blood tests. Nurses at most units interpreted the tuberculin skin tests. Referral to physicians was based on positive findings suggesting exposure to or active tuberculosis, with a view to diagnosis and treatment.

The criteria for tuberculin testing and chest radiographs differed among the sites. The three units in Norway took a uniform approach across the three units and all received a tuberculin skin test, as was the case in Switzerland. In the UK and the Netherlands, national guidelines state that tuberculin testing should be ''limited to those without prior BCG vaccination'' [9]. Neither UK unit followed this advice and, instead, for a positive response, required a larger tuberculin reaction in those with a BCG scar or a smaller reaction in those with concurrent HIV infection. UK 1 limited tuberculin testing to those <35 yrs of age, on the grounds that only such persons would be offered preventive treatment if a positive test was obtained and active tuberculosis excluded, and to limit radiographic screening. UK 2 and Netherlands 1 used screening for tuberculosis by chest radiography for those >25 yrs of age and adapted their tuberculin policy accordingly. Norway and Switzerland used the chest radiograph as screening for all those >15 yrs of age. Only one unit (UK 1) pursued sputum smear examination if the individual had a productive cough (though UK 2 also did this in selected cases). All units were able to offer further tests and treatment at the same site.

Outcomes

In the UK, the Port of Arrival form forwarded by the CCDC with the individual's address and country of origin has an outcome report on its reverse side for return to the Department of Public Health. Three units could provide data on the number of cases of tuberculosis identified by the screening process. In the Netherlands and Switzerland, results of screening are analysed locally at the Municipal Health Service and, nationally, data are collected and analysed to evaluate the screening policy of immigrants. In the UK, national enhanced surveillance can be used to enumerate tuberculosis occurring after the screening process, as long as either name and/or date of birth are consistently recorded.

DISCUSSION

Screening services for immigrants appear to vary considerably between Norway, Switzerland, the UK and the Netherlands. There are variations depending on the location of the unit, the administrative and financial autonomy of screening programmes, and the procedures undertaken. Five of the units examined were set up since the international Task Force (IUATLD) recommended improved screening of immigrants to Europe from areas of the world where tuberculosis has a high prevalence [3]. Each has addressed the problem of focusing resources by prior selection of a group of immigrants with an especially high incidence of tuberculosis. These have been variously defined as refugees (all units), asylum seekers (all units), family members of communities with a high risk of tuberculosis (Norway) or by the incidence or prevalence of tuberculosis in the country of origin (the UK, the Netherlands and Norway). In practice, this includes all countries except the countries of the European Union, Norway, Monaco, Switzerland, USA, Canada, Japan, Australia, New Zealand, Surinam and Israel.

The issue of mandatory *versus* cooperative engagement has, to date, been decided by the prevailing national culture. It was not possible to determine the impact of compulsion on the effectiveness of screening programmes. Concerns in all settings may persist regarding those who do not attend, and the degree of attention paid to, and resources expended on, nonattenders varies. One study has suggested that the incidence of tuberculosis in new entrants is the same in those who attend for screening as in those who do not [10]; and the costs associated with compulsory screening may be significantly and disproportionately greater. A qualitative study of asylum seekers in London has shown no resentment towards an offer of screening for tuberculosis, and suggests that a requirement for screening for tuberculosis would not be considered discriminatory by many new entrants themselves [11].

The criteria used to determine who might be subjected to screening vary across units. Whilst in terms of feasibility, screening refugees and asylum seekers may be relatively straightforward, limiting the scope of screening in this way may mean that many individuals at risk of tuberculosis remain unscreened [12]. Yet, expanding the scope of screening to wider populations, at potentially lower risk of tuberculosis, may reduce the positive predictive value of screening and hence the programme's effectiveness [12]. The advantage of using a criterion for screening based on incidence in the country of origin might permit screening for those individuals coming from countries that have recently acceded to the European Union, but where tuberculosis remains more prevalent. However, political imperatives, such as ensuring the free movement of people through the Schengen agreement, might make such a scheme politically unattractive and unworkable [13].

All units were in agreement that chest radiography should be used for those with a positive tuberculin skin test and for screening for adults >35 yrs of age, although one unit (UK 1) would only perform a chest radiograph in those with symptoms. Screening those who are symptomatic may increase yield. Indeed, recent research (in support of older influential research findings) [14] shows that substantial inter- and intra-observer variability occurs in the interpretation of radiographs and a as a test for tuberculosis, a chest radiograph has poor sensitivity and specificity [15]. Furthermore, in England and Wales, >50% of pulmonary tuberculosis occurring in those born abroad may develop within a year of a normal radiograph, supporting the notion that radiographic screening on entry may lack predictive value [12]. In Switzerland, in

TABLE 2 Process of screening of new entrants

	Norway 1	Norway 2	Norway 3	UK 1	UK 2	Netherlands	Switzerland
Availability	Monday–Friday 08:00–15:30 h	Monday–Friday 08:00–15:30 h	Monday and Thursday 08:00–10:00	Thursday 09:00–13:00 Open access clinic Tuesday 09.00–13.30	Three mornings and one evening per month	Four days per week 08:30–15:00 h	Monday–Friday 09:00–17:00 h
Source of referral	Police, camp staff on arrival	Police and centre for asylum seekers	Hospital chest clinic GP	1. Port of Arrival scheme, Heathrow Airport: referral to local CCDC to local hospital 2. Registration with family doctor (GP)	1. Port of Arrival scheme, Heathrow Airport: referral to local CCDC to local hospital 2. Homeless and Refugee team 3. Family doctors (GPs)	Immigration office	Border control (Swiss Federal Office for refugees)
Invitation	Compulsory Information given on arrival	Letter in own language with appointment	Letter Visit	1. Letter from local hospital with own language contact 2. GP referral	1. Letter in own language from local hospital 2. Direct referral from Homeless and Refugee team	Compulsory	Compulsory
Timing	On entry	On entry (within some weeks)	When referral received (usually 0–4 months)	When referral received (usually 0–3 months)	1–3 months from entry	Within 2 weeks	On entry (1–2 days)
Symptoms screening	All asked about symptoms	If abnormal radiograph	No	Yes		No, only if abnormal radiograph or positive TST	Yes, if abnormal radiograph
Tuberculin skin testing	All >6 months BCG scar noted and positivity adjusted accordingly Repeat at 6 weeks if negative	All >6 months BCG scar noted and positivity adjusted accordingly Repeat at 6 weeks if negative	All >6 months BCG scar noted and positivity adjusted accordingly Repeat at 6–8 weeks if negative	All <35 yrs BCG scar noted and positivity adjusted accordingly	All <25 yrs BCG scar noted and positivity adjusted accordingly	All <26 yrs if no BCG scar Repeat at 2 months if negative	All BCG scar noted and positivity adjusted accordingly
CXR	Age >15 yrs	Age >15 yrs	Age >15 yrs	1. At Port of Entry for symptoms 2. If PPD+ 3. If symptoms and aged >35 yrs 4. If from high-incidence area and aged >35 yrs	1. At Port of Entry for symptoms 2. If PPD+ 3. Age >25 yrs 4. Any age if symptoms present	1. Age <26 yrs and BCG scar 2. Age >25 yrs 3. PPD+	1. If PPD+ 2. Age >15 yrs
Sputum examination	If irregularities found on radiograph	If irregularities found on radiograph	No	If sputum produced	If sputum produced	At MHS if abnormal radiograph	At local hospital if abnormal radiograph
Blood tests	Done at the local hospital when needed.	Occasionally	No	If PPD+ or CXR+ Inflammatory markers Offer of HIV and hepatitis screening	If symptoms, abnormal CXR, or prior to chemoprophylaxis	Basic laboratory at MHS	At local hospital if needed
Outcomes							
1. TB treated	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Preventive treatment	Not until later at camp	Sometimes	Yes	Yes, if aged <35 yrs	Yes, if aged <16 yrs. Also considered for those 16–25 yrs	Yes (or radiographic follow-up)	Yes, if indicated
3. BCG vaccination	Yes	Yes	Yes	Yes, PPD-	Yes, aged <30 yrs	Yes, if <12 yrs of age and twice a negative TST	Yes for children aged <1 yr
Outcomes recorded and accessible for audit	NA	NA	Yes	Yes	NA	Yes	Yes
Audit against local policy	No	No	No	Annual	Audited at 1 and 4 yrs from start of programme	Annual	Intermittent

CCDC: Consultant in Communicable Disease Control; GP: general practitioner; TST: tuberculin skin test; BCG: bacillus Calmette–Guérin; PPD: purified protein derivative; MHS: Municipal Health Service; CXR: chest radiograph.

contrast, <10% of tuberculosis cases arising in migrants are notified to the Swiss Federal Office of Public Health >6 months after entry and screening (J.-P. Zellweger, Swiss Lung Association, Berne, Switzerland, unpublished data). Broadly, these apparently conflicting findings suggest that undue reliance on a normal chest radiograph alone may be an insufficient component in a screening programme in some settings and that the populations being screened (and subsequent population mixing patterns) are also likely to be important. Moreover, relying on symptoms alone may lack both sensitivity and specificity. A recent study from the Netherlands, for example, reports that a large proportion of patients with tuberculosis, even when smear positive, may have no complaints [16], findings supported by unpublished Swiss data (J.-P. Zellweger, Swiss Lung Association, Berne, Switzerland, unpublished data). The unit variations in service configurations described here seem to underline programmatic challenges resulting from the lack of robust sensitive and specific tests for tuberculosis, as well as variations in patterns of migration.

The evidence base suggests that in areas where tuberculosis is endemic, a positive tuberculin response is present in the majority of the population >15 yrs of age [17]. This is the basis for the assumption that a third of the world has been infected with the tubercle bacillus bacterium. In the UK, there is greater concern that a positive tuberculin skin test indicates an increased likelihood of later development of tuberculosis and with estimates varying from 1.68% within 2 yrs to a lifetime risk of 12% [18–20]. Given that the side effects of chemoprophylaxis for tuberculosis increase with age, with benefits outweighing risk only until the age of 35 yrs [21], units adhere to the position that tuberculin testing is valuable for children, but some variations in practice exist for young adults between the ages of 15 and 35 yrs.

This paper is limited in a number of ways. In specifically selecting a number of recognised screening units, this paper clearly cannot provide a picture of service approaches to screening that is generalisable. It seems likely that these units offer examples of the most robust services where staff are highly committed; however, in the present author's literature review and through discussion with key international experts, these service models were highlighted as examples of ''good'' practice from which to draw lessons. It seems reasonable to assume that the differences exemplified by the service models described here are likely to be reproduced or extended in other, less prominent, settings.

Collaboration in the field of communicable disease control in Europe, particularly in the European Union, is now well established. However, most emphasis has focused upon strengthening surveillance capacity, for example, through online EuroSurveillance journals, and networks including the 'Council for European State Epidemiologists for Communicable Disease' (CESE) [22]. However, despite their many successes, these structures have yet to resolve a range of important policy issues, in particular security of funding, definition of organisational responsibilities, common preparedness planning and commonality of control measures [23]. Whilst most efforts in recent years have focused on improving surveillance, supporting coherent approaches to control beyond this has received considerably less attention. The findings presented here highlight this in screening services for tuberculosis.

Coherent policies and robust evidence should inform rational service development. In the area of tuberculosis screening of new immigrants this coherence and an evidence-base underlying it, may be lacking. With the changing geopolitical configuration of Europe, shifts in population migration patterns and unpredictable global trends in tuberculosis (including HIV-associated tuberculosis and drug-resistant strains), those charged with protecting domestic public health may come under greater pressure to ensure that screening services to detect immigrant-associated tuberculosis are effective. To date, the effectiveness of such service models in the European setting has been difficult to prove.

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REFERENCES

1 Kraut AM. Silent travellers: germs, genes, and the ''immigrant menace''. Baltimore, MD, Johns Hopkins University Press, 1994.
2 (InVS/KNCV) and the national coordinators for tuberculosis surveillance in the WHO European Region. Surveillance of tuberculosis in Europe. Report on tuberculosis cases notified in 2002. *EuroTB* 2005: 1–120.
3 Rieder HL, Zellweger JP, Raviglione MC, Keizer ST, Migliori GB. Tuberculosis control in Europe and international migration. *Eur Respir J* 1994; 7: 1395–1396.
4 Maguire H, Dale JW, McHugh TD, *et al.* Molecular epidemiology of tuberculosis in London 1995–7 showing low rate of active transmission. *Thorax* 2002; 57: 617–622.
5 Lillebaek T, Andersen AB, Bauer J, *et al.* Risk of *Mycobacterium tuberculoisis* transmission in a low-incidence country due to immigration from high-incidence areas. *J Clin Microbiol* 2001; 39: 855–861.
6 Borgdorff MW, Nagelkerke N, van Soolingen D, de haas PEW, Veen J, Van Embden JD. Analysis of tuberculosis transmission between nationalities in the Netherlands in the period 1993–1995 using DNA fingerprinting. *Am J Epidemiol* 1998; 147: 187–195.
7 Handwerker WP. Sample design. *In*: Kempf-Leonard K, ed. Encylopedia of Social Measurement. San Diego, CA, Academic Press, 2003.
8 Atun R, Lennox-Chugani N, Drobniewski F, Samyshkin Y, Coker RJ. A framework and toolkit for capturing the communicable disease programmes within health systems: tuberculosis control as an illustrative example. *Eur J Public Health* 2004; 14: 267–273.
9 Joint Tuberculosis Committee of the British Thoracic Society. Control and prevention of tuberculosis in the United Kingdom: code of practice. *Thorax* 2000; 55: 887–901.

10 Bothamley GH, Rowan JP, *et al.* Screening for tuberculosis: the port arrival scheme compared with screening in general practice and the homeless. *Thorax* 2002; 57: 45–49.

11 Brewin P, Jones A, Griffiths CJ, *et al.* Acceptability of screening for tuberculosis: a qualitative study. *Int J Tuberc Lung Dis* 2003; 7: Suppl. 2, 252–253.

12 Coker R. Migration, public health and compulsory screening for TB and HIV. Asylum and Migration Working Paper 1. London, Institute of Public Policy Research, 2003.

13 Maclehose L, Coker R, McKee M. Communicable disease control: detecting and managing communicable disease outbreaks across borders. *In*: McKee M, Maclehose L, Nolte E, editors. Health policy and European Union enlargement. Maidenhead, Open University Press, 2004.

14 Toman K. Tuberculosis case-finding and chemotherapy: questions and answers. Geneva, Switzerland, World Health Organization, 1979.

15 Balabanova Y, Coker R, Fedorin I, *et al.* Variability in interpretation of chest radiographs among Russian clinicians and implications for screening programmes: observational study. *BMJ* 2005; 331: 379–82.

16 Verver S, Bwire R, Borgdorff MW. Screening for pulmonary tuberculosis among immigrants: estimated effect on severity of disease and duration of infectiousness. *Int J Tuberc Lung Dis* 2001; 5: 419–425.

17 Palmer CE, Edwards LB, Hopwood L, Edwards PQ. Experimental and epidemiologic basis for the interpretation of tuberculin sensitivity. *J Pediatrics* 1959; 55: 413–429.

18 Smieja MJ, Marchetti CA, Cook DJ, Smaill FM. Isoniazid for preventing tuberculosis in non-HIV infected persons. *Cochrane Database Syst Rev* 2000; 2: CD001363.

19 Vynnycky E, Fine PEM. Life time risks, incubation period, and serial interval of tuberculosis. *Am J Epidemiol* 2000; 152: 247–263.

20 Comstock GW, Livesay VT, Woolpert SF. The prognosis of a positive tuberculin reaction in childhood and adolescence. *Am J Epidemiol* 1974; 99: 131–138.

21 Ferebee SH. Controlled chemoprophylaxis trials in tuberculosis. A general review. *Adv Tuberc Res* 1970; 17: 28–106.

22 Hoile E. New chair of the Council for European State Epidemiologists outlines some immediate changes. *Euro Surveill* 2002; 6: 1–2.

23 Maclehose L, McKee M, Weinberg J. Responding to the challenge of communicable disease in Europe. *Science* 2002; 295: 2047–2050.