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**Active and passive screening for tuberculosis in Vaud Canton,
Switzerland**

THESE

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Le dépistage actif et passif de la tuberculose dans le canton de Vaud, Suisse

Résumé

Même si l'incidence de la tuberculose est basse en Suisse, cette maladie reste un problème de santé publique en raison des migrations de populations provenant de pays où l'incidence de la tuberculose est élevée. Les immigrants, à leur arrivée en terre helvétique, doivent s'annoncer auprès d'un des cinq centres d'enregistrement pour les réfugiés (Vallorbe, Bâle, Kreuzlingen, Altstätten et Chiasso) et subir un contrôle médical qui comprend un test tuberculique et une radiographie du thorax afin de détecter des anomalies compatibles avec une tuberculose. Les requérants avec des signes de maladie sont immédiatement pris en charge dans le but d'éviter une dissémination du bacille de Koch.

Cette étude rétrospective compare la présentation bactériologique et clinique de la tuberculose ainsi que le résultat du traitement de cette maladie chez les immigrants diagnostiqués par dépistage actif (= immigrants venant d'être enregistrés comme requérants d'asile en Suisse) avec d'autres patients diagnostiqués par dépistage passif (= patients suisses, travailleurs étrangers résidents en Suisse ainsi que d'autres étrangers incluant les touristes, les étudiants, les immigrants illégaux ainsi que 11 requérants d'asile détectés tardivement et passivement après leur entrée en Suisse). Parmi les 179 patients, 78% sont des étrangers. La médiane d'âge de la population étrangère atteinte de tuberculose est de 29 ans contre 64 ans pour les Suisses. Le dépistage actif a été effectué auprès de 71 requérants d'asile chez lesquels 49.3% [CI : 37.4 – 61.2] n'avaient pas de symptômes contre 17.6% [CI : 10.3 – 24.9] chez les 108 passifs. La durée des symptômes était de 2 mois dans le groupe des actifs versus 2.5 mois chez les passifs (ns). L'analyse bactériologique est positive à l'examen direct ou à la culture chez 63.4% des actifs contre 70.4% des passifs (ns). La confirmation bactériologique de la tuberculose chez des patients asymptomatiques s'élevait à 42.2% [CI : 27.2-57.2] chez les actifs contre 13% [CI : 5.31-20.7] chez les passifs. Le plus grand danger de dissémination est couru par les patients avec un examen direct positif dont la proportion des asymptomatiques était de 22.2% ([CI : 9.6-34.8] dans le groupe des actifs contre 11.7% [CI : 4.4-19.0] dans le groupe des passifs. Le résultat du traitement, comprenant les patients guéris (avec confirmation bactériologique de guérison) ainsi que les patients ayant accompli le traitement jusqu'à la fin (mais sans confirmation bactériologique) est similaire dans les groupes des actifs et passifs. Le résultat différent selon le statut légal avec 88% pour les travailleurs étrangers, 85% pour les Suisses, 78% pour les autres étrangers et 83% pour les réfugiés. Ces chiffres sont proches des cibles de l'OMS (85%).

Le dépistage actif de la tuberculose permet la détection plus précoce des cas de tuberculose que le dépistage passif. Etant donné que les immigrants proviennent de régions où la prévalence de la tuberculose est supérieure à celle de la Suisse, ce dépistage à la frontière permet non seulement de diminuer la dissémination de cette maladie par la prise en charge immédiate des malades et de réduire la durée des symptômes mais encore de détecter des patients ne présentant aucun symptôme malgré une activité bactériologique positive. Les résultats du traitement ne satisfont pas entièrement aux exigences de l'OMS, ce qui peut être expliqué par le fait que la population de patients tuberculeux suisses étant plus âgés que celles des étrangers, le nombre de décès est plus nombreux (soit par la tuberculose, soit par les complications de maladies sous-jacentes) et que le suivi de patients étrangers est plus difficile car certains disparaissent durant le traitement et d'autres sont transférés ailleurs en Suisse ou retournent dans leur pays.

Active and passive screening for tuberculosis in Vaud Canton, Switzerland

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Summary

Aim: This retrospective study compared the bacteriological and clinical presentation of tuberculosis and the outcome of treatment in immigrants notified for TB after active screening by chest X-ray at the border with other patients detected by passive screening.

Design: Retrospective study of all patients notified for TB in Vaud Canton in 2001 and 2002.

Results: In Vaud Canton 78% of the 179 patients notified for TB were foreign-born. Among 71 asylum seekers actively screened at the border, 49.3% [CI 37.4–61.2] were symptom-free vs 17.6% [CI 10.3–24.9] among 108 passively screened patients. In the passively screened group, the proportion of asymptomatic patients was 15.4% for Swiss patients, 8.6% for foreign workers, and 29.4% for other foreigners. The average duration of symptoms before diagnosis among patients with complaints was 2 months in actively screened foreign-born, compared to 2.5 months in passively screened patients (no significant difference by Wilcoxon-Mann-Whitney test). The proportion of pulmonary TB cases with positive smear or culture was 63.4% in actively screened patients vs 70.4% in passively detected cases. Among actively

screened patients with bacteriological confirmation, 42.2% [CI 27.2–57.2] were asymptomatic compared to 13% [CI 5.31–20.7] for passively screened patients. Considering only smear positive patients, the proportion of symptom-free patients was 22.2% [CI 9.6–34.8] in 45 actively screened cases vs 11.7% [4.4–19.0] for 77 passive screening. Cure and treatment completion rate for new cases reached 88% for foreign workers, 83% for asylum seekers, 85% for Swiss patients, and 78% for other foreigners.

Conclusions: Actively screened patients were more frequently asymptomatic than passively detected cases, even when considering only patients with bacteriological confirmation. The active screening by chest X-ray of an immigrant population with a high prevalence of tuberculosis allows the early detection and treatment of tuberculosis. This may contribute to the protection of the resident population from infection. The outcome of treatment for tuberculosis was satisfactory in all population groups.

Key words: tuberculosis; screening; migrants; Switzerland

Introduction

Like in many other countries in Western Europe, where the incidence of tuberculosis is low, the disease is mainly observed in Switzerland among elderly persons in the native population and among the young in the foreign-born population. Despite the increasing proportion of foreign-born patients among TB cases, the total number of notifications is decreasing every year in Switzerland (1134 in 1991 and 611 in 2001). A temporary increase was observed in 2002, which reversed in 2003 [1].

Migration makes tuberculosis a public health problem. People move from high prevalence to low prevalence countries, where the illness is close to its elimination phase. Because of their origin, living or travelling conditions, immigrants are more likely to have active or latent tuberculosis. In

Switzerland, immigrants coming from countries other than the European Community, USA, Canada, Australia and New Zealand who register as asylum seekers in one of the five State registration centres at the border (Vallorbe, Basel, Kreuzlingen, Altstätten and Chiasso) undergo a health control, which includes a tuberculin skin test and a chest X-Ray (except for children younger than 15 years and for pregnant women), to detect any possible sign of pulmonary TB [2, 3]. Foreign workers from the same countries have to pass a Chest X-ray only. Patients with abnormal chest X-Rays are sent to a local hospital for further examination. Immigrants unable to speak French or English receive the assistance from translators. Patients with positive smears will be isolated and treated until the smear becomes negative to avoid any spread of

the illness. Most immigrants with tuberculosis detected at the border Centre of Vallorbe stayed in Vaud Canton for further treatment.

Foreign students, tourists and illegal immigrants are not screened as they enter Switzerland. In this group of foreigners, TB can only be identified if they seek medical attention, which means that for them the screening is passive, as for the Swiss population [4].

Studies have demonstrated that immigrants

with tuberculosis detected by active screening have shorter symptomatic and infectious periods and that an important proportion of actively screened patients with positive culture did not complain of symptoms [5].

This retrospective study compared the bacteriological and clinical presentation of tuberculosis and the outcome of treatment in immigrants notified for TB after active screening at the border with other patients detected by passive screening.

Methods

Data on tuberculosis patients notified in Vaud Canton were obtained from the Swiss Federal Office of Public Health. Vaud Canton, representing about 9% of the Swiss population, was selected because it is the main port of entry for immigrants in Switzerland, therefore allowing the constitution of a group of actively screened cases to be compared with the cases notified from the resident population. Information about demography, legal status, microbiology (smear and culture results), type of disease, duration of symptoms before treatment and outcome of treatment were searched for in hospital registers, especially the hospital at the border, university hospitals and in private medical practices. A questionnaire was sent to the physicians in charge of treatment. If the information was incomplete, an office visit was made. All cases were retrospectively analysed between May 2003 and February 2004, i.e. more than one year after notification in order to assess the outcome of treatment.

Information about the Swiss demography, immigration and epidemiology of tuberculosis in Switzerland, was found at the Swiss Federal Office for Statistics, at the Swiss Federal Office for Justice and at the Swiss Federal Office of Public Health.

This study compared the actively screened TB cases (new immigrants applying for asylum in Switzerland) with all other patients detected by passive screening (Swiss TB cases, resident foreign workers, and other foreigners including tourists, students, illegal immigrants as well as 11 asylum seekers detected by passive screening after entry in Switzerland). The interval between beginning of symptoms and initiation of treatment between actively and passively screened patients was compared, considering that all immigrants with positive smear and most of those with symptoms were started on treatment within a few days after entry in Switzerland.

Because many patients mentioned a prior treatment for TB but were unable to give any detail about drug therapy, in each screening group the proportion of new cases (never treated), of cases with undocumented (complete or incomplete) prior treatment, of cases with documented prior treatment and of cases without information about prior treatment were considered separately. Due to missing information about prior treatment prescribed, true relapses (i.e. recurrence of TB after complete cure) and progressive disease after incomplete treatment could not be differentiated. Therefore, these categories of patients were grouped under the single denomination of "retreatment".

Outcome of treatment was defined according to the WHO categories. "Cured" are patients with a documented conversion of culture. "Completed" are patients who completed treatment but have no documented culture conversion. "Death" applies to patients who died from any causes before the end of the treatment. "Failure" are patients with a persistently positive culture or a culture which becomes newly positive after 5 or more months of treatment. "Default" (abandon) relates to patients who stop taking medication for 2 or more consecutive months, those who fail to complete treatment within 9 months for a 6 month treatment regimen or within 12 months for a 9 months regimen, or those with a drug intake <80%. "Transferred" are patients referred to other clinicians for treatment where information on treatment outcome cannot be obtained. A "successful outcome" is the sum of cured and completely treated patients.

Data were analysed with the non-parametric Wilcoxon-Mann-Whitney test for the duration of symptoms between actively and passively screened populations and with descriptive statistics for the proportion of symptom-free patients in both groups.

Results

In 2001 and 2002, approximately 7 250 000 people lived in Switzerland. The incidence of TB was 8.4/100 000 in 2001 and 9/100 000 in 2002. The number of inhabitants in Vaud Canton in 2001 and 2002 was 620 300. The incidence of TB is higher than the Swiss average for these years, with 13/100 000 in 2001 and 16/100 000 in 2002. During both years, Vaud Canton reported 14% of Swiss TB cases. During this period, 15 519 immigrants were registered at the immigration centre in Vallorbe, of which 13 507 were actively screened

by Chest-X-ray. 2012 immigrants were not screened (children and pregnant women).

In 2001 and 2002, 179 patients were notified for tuberculosis in Vaud Canton (80 in 2001 and 99 in 2002). There were 114 male (63.7%). The distribution of groups is reported in figure 1. Among foreigners, 67 were from Africa (48%), 16 from Asia (11%), 37 from Eastern Europe (27%) and 20 from Western Europe and other countries (14%). The *median* age is lower for all groups of foreigners than for Swiss patients (fig. 2).

Figure 1
TB cases notified in Vaud Canton in 2001 and 2002, by screening procedure.

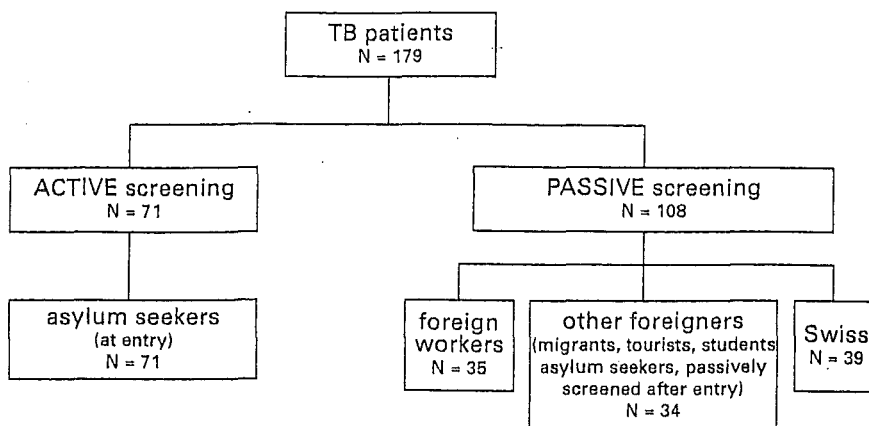


Figure 2
Age distribution of foreign and Swiss TB patients in 2001 and 2002 in Vaud (CH).

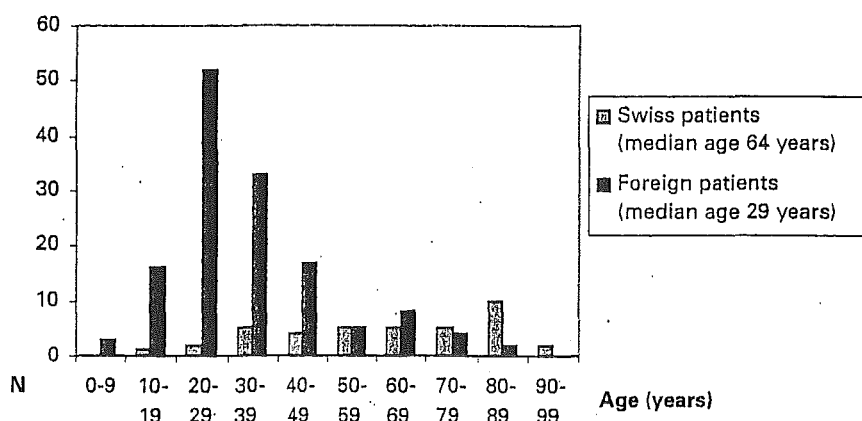


Table 1
Category of TB, by screening procedure. S: Sputum smear, C: sputum culture.

	active screening		passive screening	
	N	%	N	%
new Pulmonary TB (S+ / C±)	21	30	45	42
new Pulmonary TB (S- / C+)	14	20	16	15
new Pulmonary TB (S- / C-)	10	14	4	4
new Extra-pulmonary TB	6	8	16	15
undocumented prior treatment	14	20	20	19
retreatment after interruption	0	0	1	1
unknown prior history	6	8	6	6
total	71	100	108	100

There were 132 new cases (73%), 34 with a history of undocumented, complete or incomplete prior treatment (19%), 12 patients with unknown prior history of treatment (7%) and 1 treatment after interruption (table 1). Among the 132 new cases, there were 66 smear-positive pulmonary TB, 30 culture-positive pulmonary TB, 14 culture-negative pulmonary TB and 22 extra pulmonary TB (EPTB). Miliary TB was observed in 4 patients, urinary tract TB in 3 patients, peritoneal TB in 2 patients and there were single cases of bronchial, adrenal and hepatic TB. The proportion of bacteriologically proven cases (positive smear and/or culture) among new pulmonary TB cases was 77% in actively screened patients versus

94% in passively detected cases. Including retreatments, these proportions were 83% and 95%.

Tuberculosis was diagnosed by active screening at the border in 71 asylum seekers (40%) (525 cases for 100 000 examinations), in public hospitals for 32 patients (18%) and in the private medical sector for 76 patients (42%). The majority of Swiss patients (32) and an important number of foreign workers (20) were detected in the private medical sector, along with some asylum seekers where tuberculosis was discovered long after entry in Switzerland (11) and other foreigners (13).

In patients with complaints, the average duration of symptoms before notification and treatment was similar among immigrants actively

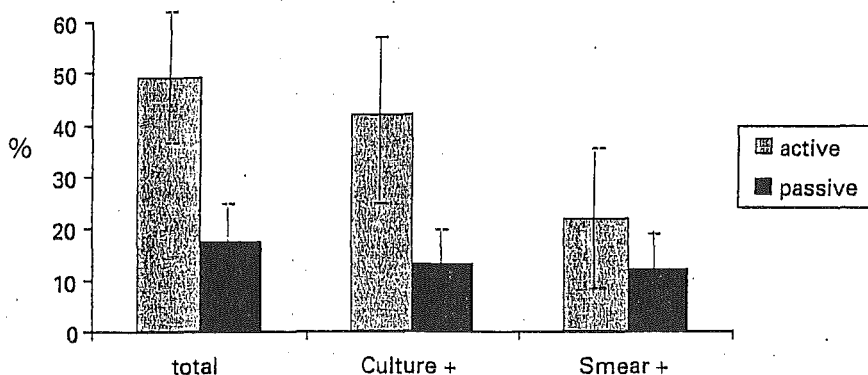
Table 2

Demographic data of TB cases, by legal status and screening procedure. AS: asylum seekers actively screened, FW: foreign workers, Other: illegal immigrants, students, tourists, asylum seekers passively screened, CH: Swiss patients.

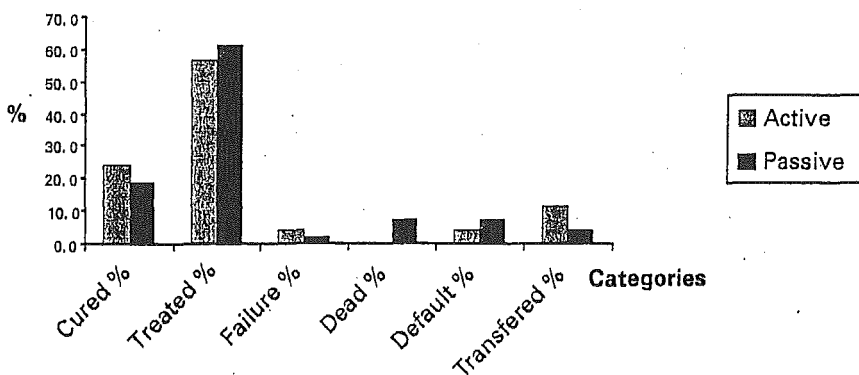
screening category	active AS	passive		
		FW	Other	CH
number	71	35	34	39
female %	21	37	56	46
median age (years)	26	34	31	64
symptomatic patients	51%	91%	71%	85%
infectious cases (S+ and/or C+ pulmonary TB)	63%	74%	65%	72%

Figure 3

Proportion of and asymptomatic patients, by bacteriological result, for the whole group, patients with culture-positive pulmonary TB and smear-positive pulmonary TB (mean with 95% confidence interval).

**Figure 4**

Outcome of treatment of TB, by screening procedure (all cases, including retreatment but excluding 12 cases with missing final information). "Cured": patient with bacteriological proof of negatization. "Completed": patients receiving a complete course of antituberculosis treatment, without bacteriological proof of negatization. The sum of "cured" and "Completed" is regarded as treatment success. "Failure" is the persistence of positive culture after 5 months of treatment. "Death" is the lethal issue from whatever cause during antituberculosis treatment. "Default" refers to patients missing 2 months of treatment before completion. "Transfers" are patients leaving the country during treatment, without available information on further treatment.



screened at the border (50.7% of the group), compared to passively screened patients (82.4%) (2 months vs 2.5 months). Anti-tuberculosis medication was started within a month of stay in Switzerland for 72% of actively screened TB patients. Table 2 reports the characteristics of all actively and passively screened TB cases.

Among actively screened patients, 49.3% [CI 37.4–61.2] were symptom-free vs 17.6% [CI 10.3–24.9] among passively screened patients. Among patients with pulmonary TB confirmed by culture, 42.2% [CI 27.2–57.2] of actively screened patients had no complaints compared to 13% [CI 5.31–20.7] for passively screened patients. Restricting to patients with positive smear, the pro-

portions were respectively 22.2% [CI 9.6–34.8] and 11.7% [CI 4.4–19.0]. The proportion of symptom-free patients was lower among Swiss patients (13%) and other foreigners (12%) and very low among foreign workers (3%) (fig. 3).

Overall, for the new and retreatment cases (excluding 12 cases with missing final information), the treatment was successful in 83% of the patients. The results were similar in the actively and passively screened group (fig. 4). Cure and treatment completion rate for new cases reached 88% for foreign workers, 83% for asylum seekers and 85% for Swiss patients, but only 78% for other foreigners. For patients in retreatment, the success rate was 82%.

Discussion

The incidence of TB in Vaud Canton was 1.5 times higher than the Swiss average rate in 2001 and 1.7 times higher in 2002, due to the presence of the registration centre at the border, where asylum seekers are screened. The rate was 13/100 000 in 2001 and 16/100 000 in 2002. Foreigners, approximately half of which were asylum seekers, represented 20% of the population living in Switzerland but 75% of the TB population. The Swiss population is much older than the foreign population. In our study, the majority of foreigners originated from Africa or Eastern European countries.

Active screening for tuberculosis has been extensively used in industrialized Countries since the middle of the 20th Century, mainly by mass miniature Chest X-ray screening, with the aim of discovering the infectious cases as early as possible and isolate them from the general population. Since the introduction of efficient antituberculous treatment, which has cured the majority of patients and shortened the infectious period, mass screening has been abandoned in most countries with a low or medium incidence rate. It is still used in some countries with high incidence rates, particularly in Eastern Europe, and in selected population groups, like immigrants from developing countries. A report by a European task force in 1994 highlighted the importance of a nationwide system for the screening and medical assessment of immigrants to avoid the transmission of tuberculosis to other immigrants and to the local population [6]. A Canadian study demonstrated that screening using chest X-rays and tuberculin skin tests are cost-effective methods for the detection of TB in population groups with high incidence, like new immigrants [7], although this position is currently questioned [8].

Active screening allows the detection of TB at an earlier stage than passive screening, before extensive destruction of lung parenchyma and the formation of cavities with a high bacterial content has occurred and give rise to obvious clinical symptoms. This is expected to shorten the duration of the period of possible transmission of infectious particles to healthy bystanders. It is therefore not surprising that a larger proportion of the patients are still symptom-free in the actively screened group (49.3%) than in the other groups (17.6%). Twenty-two percent of actively screened immigrants with positive smear are symptom-free, and 42.2% of those with positive culture. A prior Swiss study already demonstrated that a high proportion of patients with TB were asymptomatic [9]. For symptomatic patients, the duration of symptoms was similar in both groups. Immigrants detected after entry in Switzerland usually had a normal or unremarkable chest X-ray at the border and can be assumed to present a progression or reactivation of a latent infection which was inapparent at entry.

We cannot exclude that some cases among immigrants with a normal chest X-ray at entry may have been infected in Switzerland, but we have no documented evidence for it.

Contrary to the expectations, the proportion of bacteriological confirmation by smear or culture among new pulmonary TB and retreatment cases detected actively is high, and not significantly lower than among passively screened patients. This could mean that even actively screened patients had already reached a moderately advanced stage of disease and may have transmitted TB, if not detected. In a Dutch study, immigrants detected by active screening were less frequently bacteriologically active (OR 0.5), had less symptoms, were less frequently hospitalised (OR 0.2) and had probably less time and opportunity to transmit TB to other people than immigrants presenting spontaneously for examination [10]. The main difference is that in our study we compared immigrants screened at the border on the day of arrival in Switzerland with all other patients with TB, including Swiss and resident foreign workers and not only immigrants. In a recent study, TB cases detected actively among Canadian Plains Aborigines were younger, had less symptoms and were less infectious than cases detected passively [11]. The difference with our study is that the Canadian Aborigines were mainly detected actively during contact tracing or routine school examination and were therefore younger than adults presenting with symptoms. Due to age, a very limited proportion of them had bacteriologically confirmed pulmonary TB. In our study, the *median* age of asylum seekers, foreign workers and other foreigners is not different (26, 34 and 31 years). Only the Swiss TB patients are older (median age 64). Our study could therefore indicate that actively detected patients with tuberculosis may have a similar tendency to progression to extensive disease than passively detected patients and do not represent a group of cases with fibrotic lesions only or undergoing possible spontaneous regression.

The *overall* favourable outcome of treatment of tuberculosis is close to the WHO target of 85% but did not reach the expected target for industrialized countries. Among the reasons for this is the fact that Swiss patients are older than foreign patients and have therefore a higher death rate (from TB or with TB as a complication of an underlying illness). Of the 8 deaths that occurred during this study, 7 were Swiss patients, of whom 4 were in retreatment, but no case had multidrug-resistant TB. Another reason is that foreigners, especially asylum seekers and the "other" group, frequently disappeared during treatment by transfer to other parts of Switzerland or return to their country of origin. Similar results were observed in a survey of outcome of treatment in Switzerland in 1996, where the success rate (sum of patients cured and

completely treated) was satisfactory (79%) with a similar proportion of success for asylum seekers (81%), foreign workers (89%) and Swiss patients (80%) but lower for foreigners without a legal status (54%) [12]. Compared with the outcome of patients treated for TB in Vaud Canton between 1988 and 1992, the success rate increased in 2001 & 2002 [13]. This may partly be due to the wider use of directly observed therapy (DOT) [14].

This study has several limitations. First, it is a retrospective study relying on the medical records from hospitals and medical offices, without control on the accuracy of reporting of symptoms. As the data rely on information given by the patients, who frequently cannot express themselves in the local language or have another representation of health and disease, they may be unreliable. The fact that new immigrants usually have the assistance of a translator at entry in Switzerland gives some assurance. As we were able to study the records of all cases of TB notified during the period considered, we can exclude a selection bias. Second, recently infected immigrants may still have a negative tuberculin skin test and a normal chest X-Ray on examination at the border and develop tuberculosis at a later time. As the number of cases detected passively among immigrants over the years after entry is much lower than the number of immigrants detected with tuberculosis on entry at the border, we assumed that progression of disease after entry is an infrequent event. It is also known that some immigrants applying for asylum were already staying in Switzerland before being registered. The duration of stay in Switzerland is, therefore, probably underestimated. Finally, we did not perform a cost-effectiveness analysis of active versus passive

screening. It is possible that the yield of active screening is higher in immigrants groups with a very high incidence rate of tuberculosis and lower in groups with a moderate rate, but this remains to be demonstrated. For practical reasons, the screening programme at the border includes all immigrants, regardless of their origin.

Conclusion

The active screening of an immigrant population with a high prevalence of tuberculosis allows the early detection and treatment of tuberculosis, in a state where many patients still have no complaints, in spite of being bacteriologically active. This may contribute to the protection of the resident population from infection. The outcome of treatment for tuberculosis was satisfactory in all population groups.

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References

- Office fédéral de la santé publique. Déclaration des maladies infectieuses. Bull OFSP 2003;1/2:6.
- Office fédéral de la santé publique. Lutte contre la tuberculose dans la population étrangère en Suisse - proposition d'une stratégie d'optimisation et mesures. Rapport du groupe de travail «lutte contre la tuberculose dans la population étrangère en Suisse» de l'Office fédéral de la santé publique, 1 juin 1991. 1991.
- Office fédéral de la santé publique. L'examen sanitaire de frontière appliqué aux requérants d'asile. Bull Of fed santé publ 1995;4:3-5.
- Zellweger JP. La tuberculose chez les immigrants: dépistage et traitement. Swiss Medical Forum 2003; 24:556-7.
- 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;5:419-25.
- Rieder HL, Zellweger JP, Raviglione MC, Keizer ST, Migliori GB. Tuberculosis control in Europe and international migration. Eur Respir J 1994;7:1545-53.
- Schwartzman K, Menzies D. Tuberculosis screening of immigrants to low-prevalence countries. A cost-effectiveness analysis. Am J Respir Crit Care Med 2000;161:780-9.
- Coker R. Compulsory screening of immigrants for tuberculosis and HIV. BMJ 2004;328:298-300.
- Ravessoud M, Zellweger JP. Présentation clinique de la tuberculose chez les immigrants vus au Dispensaire Antituberculeux de Lausanne. Schweiz Med Wschr 1992;122:1037-43.
- 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;5:419-25.
- Ward HA, Marciniuk DD, Pahwa P, Hoepfner VH. Extent of pulmonary tuberculosis in patients diagnosed by active compared to passive case finding. Int J Tuberc Lung Dis 2004;8:593-7.
- Helbling P, Medinger C, Altpeter E, Raebler PA, Beeli D, Zellweger JP. Outcome of treatment of pulmonary tuberculosis in Switzerland. Swiss Medical Weekly 2002;132:517-22.
- Zellweger JP, Coulon P. Outcome of patients treated for tuberculosis in Vaud County, Switzerland. Int J Tuberc Lung Dis 1998;2:372-7.
- Déruaz J, Zellweger JP. Directly observed therapy for tuberculosis in a low prevalence region: first experience at the Tuberculosis Dispensary in Lausanne. Swiss Med Wkly 2004; 134:552-8.