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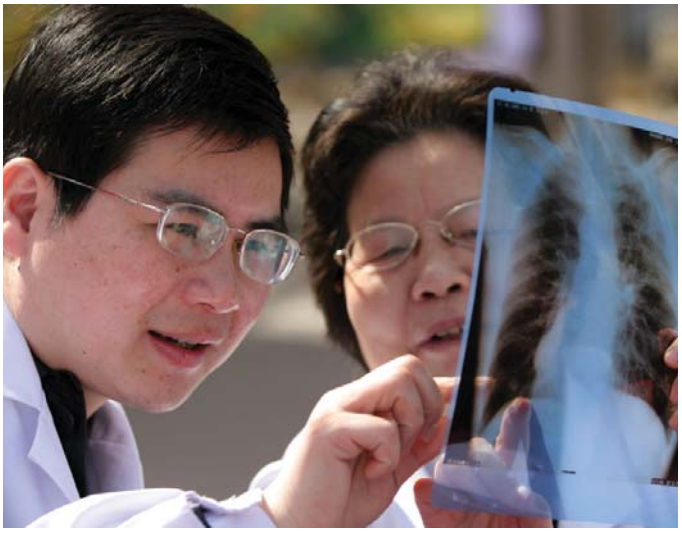

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Using tuberculosis surveillance data for informed programmatic decision-making

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Public health surveillance, through the ongoing and systematic collection, analysis, interpretation and dissemination of health information, plays a critical role in informed decision-making and appropriate public health action.[1] Different surveillance systems are required to meet disease-specific public health objectives, and some systems have been expanded through the collection of risk factor, behaviour and health practice information.

Tuberculosis (TB) control programmes are widely known as successful public health programmes that effectively collect and use surveillance data in a standardized manner at both the global and national levels. Surveillance was one of the five core components in the original World Health Organization (WHO) *Framework for Effective Tuberculosis Control* (the WHO DOTS strategy) established in 1994. The strategy recommended a case-based registry and cohort monitoring of treatment outcomes using highly standardized, paper-based recording and reporting forms. Once an individual was recorded on the TB register, heath workers monitored and recorded the person's treatment until completion. Thus the recording and reporting system of TB programmes, as well as being a surveillance tool, also served as a patient support tool.

In addition to monitoring individual patient outcomes, there are several other uses of surveillance data for informed programmatic decision-making (**Box 1**). These include measurement of disease burden, detection of potential outbreaks, definition of high-risk groups and monitoring and evaluation of programme performance.[2] Further analysis of surveillance data can help identify programmatic gaps, prioritize interventions and research topics and allocate resources for subsequent action.

Assessing disease burden and epidemiological trends

TB surveillance data have been the globally recognized, fundamental data source for assessing the disease burden and epidemiological trends of TB.[3] WHO's policy for measuring TB disease burden emphasizes the importance of quality surveillance towards the ultimate goal of measuring TB incidence directly from TB notifications.[4] Annually, WHO collects TB surveillance data from more than 200 countries and publishes the epidemiological situation of TB at the country, regional and global levels. WHO also promotes in-depth analysis of national surveillance data through various workshops and trainings.

Box 1. Uses of TB surveillance data for programmatic decision-making

- To assess disease burden and epidemiological trends
- To monitor unusual occurrences and phenomena for potential response actions
- To evaluate programmatic impacts
- To identify high risk, vulnerable or underserved populations for programmatic targeting
- To investigate epidemiological processes, especially in the context of contact investigation using genotyping technology

Monitoring unusual occurrences and phenomena for potential response actions

Another fundamental function of a surveillance system is to detect unusual occurrences of a disease including outbreaks, such as the outbreaks of multidrug-resistant TB in the Federated States of Micronesia.[5] TB surveillance data can also be combined with other data sources, such as genotyping and geospatial data, to determine possible transmission chains of TB cases and to identify clusters.[6] In the same study, routinely reported data were used to formulate an outbreak prediction algorithm for the automatic generation of outbreak alerts, identification of high-risk clusters and potential candidates for intensified contact investigation.

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Evaluating of programmatic impact

Data from a reliable TB surveillance system with reasonable coverage can be used to evaluate TB programmes. This is a great advantage for TB programmes, as the evaluation components of pilot or programmatic operational research can be assessed using routinely collected TB surveillance data. Three examples of such evaluation are published in this issue of WPSAR. By using TB surveillance data, Shimouchi et al. demonstrated that appropriate patient support significantly improved treatment outcome and reduced the drug resistance rate in Osaka city between 2001 and 2008.[7] Similarly, Ngamvithayapong-Yanai et al. used TB surveillance data to assess the programmatic impact of social mobilization activities in Thailand.[8] By comparing TB surveillance data in project and non-project districts, Lu et al. demonstrated improved treatment outcome among internal migrants with TB who received subsidiary support in Shanghai.[9]

Identifying high-risk, vulnerable or underserved populations

In-depth analysis of surveillance data can reveal high-risk groups who are vulnerable to the disease. Yanjindulam P et al. analysed TB surveillance data and reported a substantial burden of TB among prisoners in Mongolia.[10] Improved TB management in the prison sector achieved significant reduction in TB notification over a decade.[10] Foreign-born individuals are among the most vulnerable populations in many countries with a low TB incidence.[11] The epidemiology of TB among foreign-born persons is often investigated, especially in countries with high immigration and low TB burden with the use of surveillance data.[11] In this issue of WPSAR, Uchimura et al. analysed Japan's routine TB surveillance data to examine different high-risk groups including those with human immunodeficiency virus (HIV) infection, diabetes mellitus patients, contact cases, homeless people, foreigners, health care workers and the elderly. They found that the risk groups in Japan were quite different from other high-income countries with a low TB burden.[12]

Analysis of TB surveillance data can be further enhanced by linking with socioeconomic variables from other data sources. In this issue of WPSAR, Wong et al. combined TB surveillance data with data from poverty surveys and demographic health surveys in Cambodia to assess the relationship between TB diagnosis and poverty.[13] The recent advancement in geographical information system technologies provides unlimited potential for geographical linkage between surveillance and other data, including census data. While recognizing methodological limitations (such as ecological fallacy), this type of analysis improves our understanding of the role of social determinants in TB epidemiology, potentially facilitates targeted interventions and should be explored further.

Since the 1994 WHO DOTS strategy, TB surveillance systems have evolved due to social, demographic, technological and epidemiological changes. Standardized recording and reporting forms have been revised and capture newly identified programme components such as TB/HIV activities and the management of multidrug-resistant TB. The introduction of electronic and/or web-based surveillance systems have greatly improved the accessibility and timeliness of TB surveillance data,[2] further contributing to the widespread utilization of TB surveillance data in parallel with the development of innovative analysis approaches. However, as for all surveillance systems, TB surveillance data carry inherent limitations when it comes to scientific rigorousness, and TB notifications may not be considered a direct measure or close proxy of TB incidence. Continued efforts are needed to improve the quality of surveillance data, and careful assessment of the accuracy, completeness and comprehensiveness is required when interpreting the result of the analysis.

Despite these limitations, TB surveillance continues to serve as the fundamental data source for TB programme management and decision-making. Basic skills and knowledge on methodologies to analyse surveillance data should be widely disseminated through practical hands-on capacity building activities at the national and subnational levels. Technical advances in infectious disease epidemiology, geo-spatial analysis and molecular epidemiology should be actively applied for analysing TB surveillance data to improve our understanding of TB epidemiology. The sharing of such experiences among countries will further stimulate ideas and encourage a culture of evidence-based programme management and policy formulation. In this regard, WPSAR is one venue for this communication.

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Strengthened tuberculosis control programme and trend of multidrug resistant tuberculosis rate in Osaka City, Japan

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Osaka City has the highest tuberculosis (TB) notification rates in Japan. In the period 1999–2003, the TB control programme was strengthened, and the Stop TB Strategy was implemented to reduce the number of notified cases. The objective of this study was to assess the effect of these control activities in Osaka City, including the implementation of directly observed treatment (DOT), by analysing TB surveillance and routinely collected data. We reviewed the surveillance data of all sputum smear-positive pulmonary tuberculosis (PTB) cases registered in the Osaka City Public Health Office from 2001 to 2008 and data collected from the routine TB programme. The DOT implementation rate increased from 0% in 2001 to 68% in 2008 for smear-positive PTB cases of the general public and to 61% for all PTB cases of the homeless. The proportion of smear-positive PTB cases that had treatment failure and default combined, declined from 8.0% (52 of 650) in 2001 to 3.6% (20 of 548) in 2006. The proportion of cases among the homeless with previous treatment declined from 28% in 2001 to 15% in 2008. The proportion of cases with multidrug resistant-TB (MDR-TB) among those without previous treatment declined from 1.7% in 2001 to 0.9% in 2008. It is logical that reduction in the failure and default rate would lead to the reduction of cases with previous treatment and TB transmission, including resistant TB, therefore to the reduction of MDR-TB rates.

Osaka City is the third largest city (population of 2.6 million in 2005) and has the highest tuberculosis (TB) notification rate in Japan. The TB notification rate in Osaka City decreased during the 1970s, but this decline slowed substantially and has stagnated since 1983.[1] During this period, the notification rate of Osaka City was two to three times higher than the national rate. This stagnation of decline occurred in only a few wards (districts) where unemployment rates were high among the middle-aged. In 1998, a cohort analysis in an inner city ward, Naniwa, showed that 30% of TB cases defaulted from their treatment.[2] In 1997, 42.9% of homeless TB cases registered in Osaka City had been previously treated. This declined to 27.4% in 2001.[3]

During the period 1999–2003, to strengthen the TB control programme, the Osaka City Government implemented the following:

- Osaka City Public Health Office (OCPHO) was newly established in 1999, and the 24 ward-level TB Diagnostic Committees (TBDC) were integrated into one as part of OCPHO;
- OCPHO became responsible for the integrated TB programme for homeless cases in the city;
- from the year 2000, public health nurses were allowed to visit TB cases outside of Osaka City routinely (previously they were not allowed due to budget constraints);
- the STOP TB Strategy, 10-Year Plan of Tuberculosis Control in Osaka City 2001–2010[4] was launched in 2001; and
- eight public health nurse positions were created at OCPHO for directly observed treatment (DOT) and programme implementation for the homeless in 2003.

The target of the "STOP TB Strategy" was to halve the TB notification rate in Osaka City to 50 per 100 000 population by 2010.[4] The main strategies to do this

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included the promotion of the standard treatment regimen containing pyrazinamide (PZA), treatment support by using DOT in hospitals and the community and monitoring and evaluating case management. The treatment regimen was to be approved by the TBDC as required by law,[5] and any changes to the regimen were to be advised to clinicians by the TBDC as necessary.

In Japan, smear-positive pulmonary TB (PTB) cases are legally required to be isolated in hospitals until their smears or cultures are negative.[5] During this hospitalization, most cases are treated with DOT by nurses. After discharge from hospital, treatment support can be provided by DOT nurses through weekly visits to the cases' houses or cases visiting a pharmacy weekly. For all PTB cases of the homeless, daily DOT is provided at the DOT clinic of a semi-governmental hospital located in a poor area of 0.6 km^2 where 21 000 of the 30 000 total population are daily-paid laborers and homeless people living in small hostels, shelters, parks or on roads.[6]

For monitoring and evaluation of case management, cohort analysis meetings are held at all 24 ward public health offices and OCPHO. Information such as treatment regimen, drug susceptibility testing (DST) results and type of case support were obtained. One case was to be discussed twice during the treatment so that any necessary change of regimen or case support could be undertaken.

Notification of TB cases is mandatory in Japan,[5] with every case of diagnosed TB reported by a clinician to the local public health office. Individual data are recorded on a case management card by public health nurses of the 24 ward public health offices and OCPHO. Data included on the card are name, date of birth, sex, occupation, co-morbidities, diagnosis, results of bacteriological examination, chest X-ray findings, regimen and treatment outcome. This data are further entered into the computerized surveillance system. DST results were not systematically collected before 2001.

The objective of this study was to assess the effect of the TB control programme, including DOT, in Osaka City by assessing TB surveillance and routinely collected data from the programme, including the rate of multidrug resistant-TB (MDR-TB) between 2001 and 2008.

METHODS

This is a descriptive and observational study using TB surveillance and routinely collected data by the TB control programme. All smear-positive PTB cases registered in Osaka City from 2001 to 2008 were included for DST results.

The indicators used included the proportion of all PTB cases using PZA, DOT implementation rate for all smear-positive PTB cases of the general public and for all PTB cases of the homeless, previous treatment case rate of all PTB cases for the general public and the homeless and treatment outcome of smear-positive PTB cases. MDR-TB cases and remainders were assessed by previous treatment status and other factors for smear-positive PTB cases.

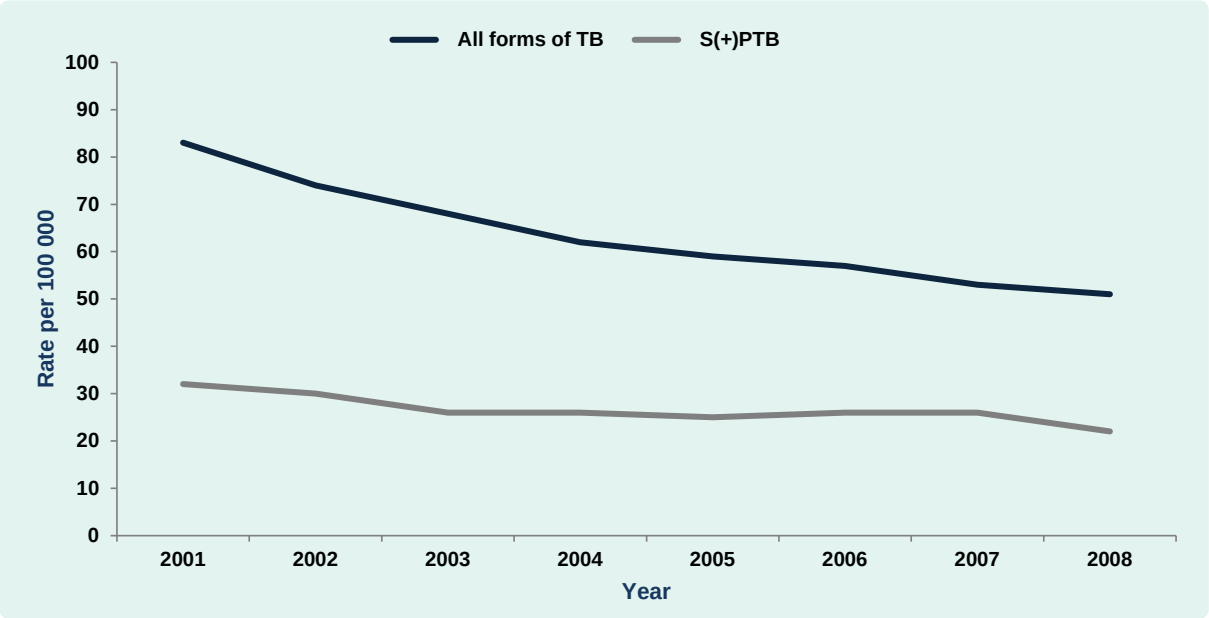
The homeless are defined in this study as people who live in parks, on river banks, roads, stations or other facilities without permission.[7] The treatment outcomes are defined as follows: failure – positive culture result five to 12 months after the start of treatment; default – treatment is interrupted for more than two months in total or treatment ended in less than standard duration;[8] and case previously treated – a case treated with anti-TB medicine for at least one month and at least two months before current treatment. MDR-TB was defined as a case resistant to both Isoniazid (INH) and rifampicin (RFP).

DSTs are conducted according to the guidelines in Japan[9] in three public hospitals and four private hospitals in Osaka Prefecture and at the national TB reference hospital. Quality assurance programmes of DST have showed reliable results for RFP and INH.[10]

Aggregated data and the electronic database of registered cases without name and date of birth were used and analysed. The χ^2 test was used for trend analysis of categorical data using Epi Info, and *P*-values were used for judging statistical significance.

A multivariate analysis was constructed using logistic regression models in SPSS to compare MDR-TB cases with the remainder. Data were only available at the individual level for age, sex, previous treatment and residence; therefore, these were used in the model. Only cases with all these fields completed were included. The step-wise maximum likelihood estimation

Figure 1. **Notification rate of all TB and smear-positive pulmonary TB, Osaka City, Japan, 2001 to 2008**



TB – tuberculosis; S(+)PTB – smear-positive pulmonary tuberculosis

with a significance level of <0.2 was used to select the variables for the logistic regression models.

As the data used in this study were collected through routine surveillance mechanisms by public health authorities and did not contain any identifying data, the office for ethical issues in Osaka City Government deemed it not necessary to obtain the ethical clearance.

RESULTS

There were 5589 new smear-positive PTB cases registered between 2001 and 2008; the number declined from 821 in 2001 to 569 in 2008. DST results were available for 5030 (90%) of these cases. The notification rate of all TB and smear-positive TB cases declined from 2001 to 2008 (**Figure 1**).

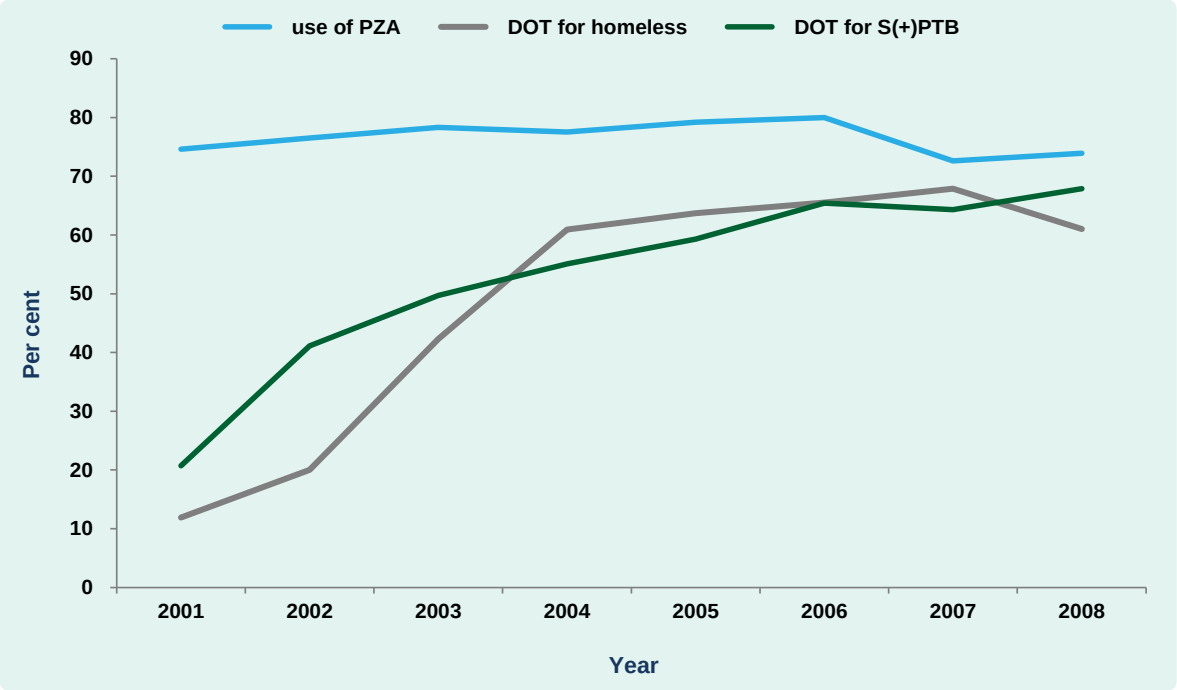
From 2001 to 2008, the proportion of all PTB cases treated with a regimen containing PZA was maintained at more than 70% each year. DOT implementation rates for smear-positive PTB cases of the general public increased from 0% in 2001 to 68% in 2008 (321 of 473) and increased from 0% to 61% (114 of 187) for all PTB cases of the homeless during the same period (**Figure 2**).

The proportion of all PTB cases with previous treatment in the general public was stable over the study period and was 13.5% overall (1931 of 14 292). For homeless cases, the proportion with previous treatment declined from 27.4% (97 of 354) in 2001 to 15.1% (22 of 146) in 2008 (**Figure 3**). The proportion of all smear-positive PTB cases that had treatment failure and default combined declined from 8.0% (52 of 650) in 2001 to 3.6% (20 of 548) in 2006.

For all smear-positive PTB cases, the proportion of cases with resistance to INH significantly declined from 9.3% (63 of 681) in 2001 to 5.3% (27 of 505) in 2008 ($P = 0.016$). Similarly, the proportion of cases with resistance to RFP significantly declined from 3.4% (23 of 681) in 2001 to 2.2% (11 of 505) in 2008 ($P = 0.015$). The proportion of cases with MDR-TB also significantly declined from 2.6% (18 of 681) in 2001 to 1.8% (nine of 505) in 2008 ($P = 0.017$) (**Table 1**).

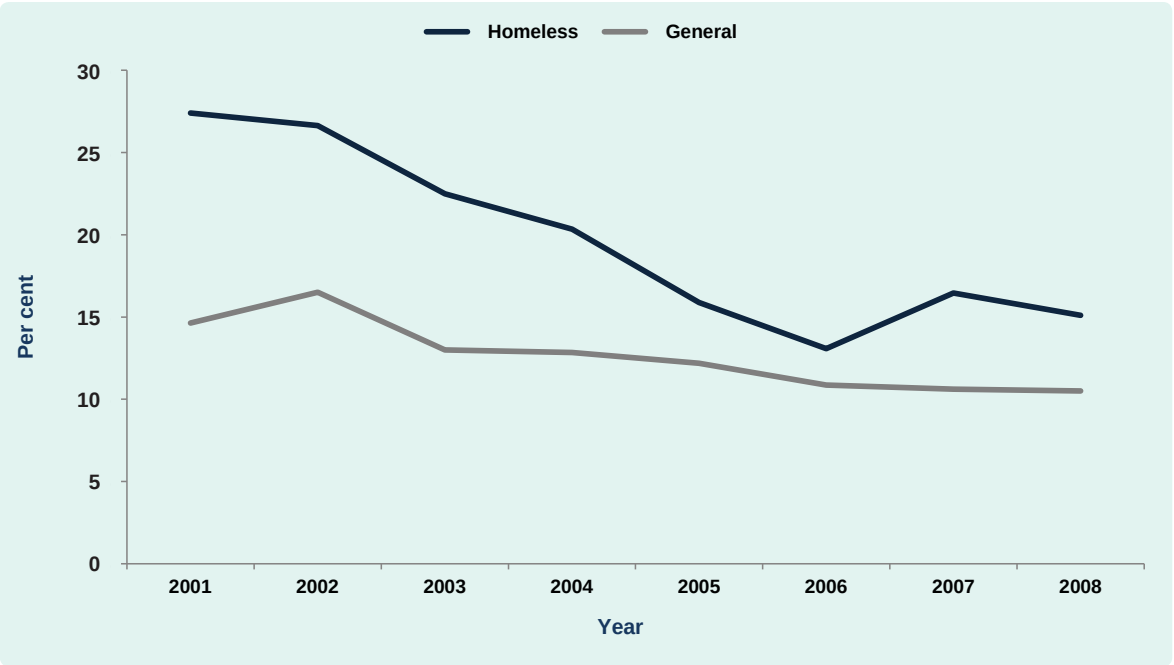
The proportion of cases without previous TB treatment with resistance to INH declined from 6.4% (37 of 579) in 2001 to 4.0% (18 of 446) in 2008, although this was not statistically significant ($P = 0.212$). There was also a decline from 2.4% (14 of 579) in 2001 to 1.1% (5 of 446) in 2008 for resistance to RFP in these cases, and this was statistically significant (p-value = 0.002). MDR-TB also significantly declined from 1.7% (10 of 579) in 2001 to 0.9% (4 of 446) in 2008 ($P = 0.0173$) for those cases without previous TB treatment (**Table 1**).

Figure 2. **Proportion of TB cases using PZA and DOT and the proportion of homeless cases using DOT, Osaka City, Japan, 2001 to 2008**



TB – tuberculosis; PZA – pyrazinamide; DOT – directly observed treatment; S(+)PTB – smear-positive pulmonary tuberculosis

Figure 3. **Proportion of TB cases with previous treatment in the general public and for the homeless, Osaka City, Japan, 2001 to 2008**



For those cases that had previous treatment, the proportion of resistance to INH, or RFP or MDR-TB did not show any significant reduction from 2001 to 2008 (**Table 1**).

When comparing MDR-TB cases (n = 81) with the remainder of cases (n = 4 609) in the multivariate model, having MDR-TB was significantly associated with having had previous treatment (crude OR: 7.89;

Table 1. **Number and proportion of smear-positive pulmonary TB cases with drug resistance to isoniazid and/or rifampicin by treatment status, Osaka City, Japan, 2001 to 2008**

Year	Combined							Without previous treatment							With previous treatment						
	All cases*	any H		any R		any RH		All cases*	any H		any R		any RH		All cases*	any H		any R		any RH	
		n	%	*n*	%	*n*	%		*n*	%	*n*	%	*n*	%		*n*	%	*n*	%	*n*	%
2001	681	63	9.3	23	3.4	18	2.6	579	37	6.4	14	2.4	10	1.7	102	26	25.5	9	8.8	8	7.8
2002	664	50	7.5	27	4.1	17	2.6	546	29	5.3	15	2.7	6	1.1	118	21	17.8	12	10.2	11	9.3
2003	651	37	5.7	19	2.9	16	2.5	568	33	5.8	16	2.8	13	2.3	83	4	4.8	3	3.6	3	3.6
2004	633	36	5.7	11	1.7	7	1.1	541	32	5.9	7	1.3	4	0.7	92	4	4.3	4	4.3	3	3.3
2005	632	26	4.1	10	1.6	5	0.8	555	19	3.4	4	0.7	2	0.4	77	7	9.1	6	7.8	3	3.9
2006	644	38	5.9	9	1.4	4	0.6	571	28	4.9	6	1.1	2	0.4	73	10	13.7	3	4.1	2	2.7
2007	620	45	7.3	18	2.9	12	1.9	548	35	6.4	7	1.3	5	0.9	72	10	13.9	11	15.3	7	9.7
2008	505	27	5.3	11	2.2	9	1.8	446	18	4.0	5	1.1	4	0.9	59	9	15.3	6	10.2	5	8.5

H – isoniazid; R – rifampicin

* All smear positive pulmonary tuberculosis cases that drug susceptibility result is available.

Table 2. **Comparison between multidrug resistant TB cases and all other positive pulmonary TB cases, Osaka City, Japan, 2001 to 2008**

Multidrug resistance		Yes	No	Crude OR	95% CI	*P* value	Adjusted OR*	95%CI	*P* value
Age	Less than 40	16	3562	1.00	0.70–2.21	0.462	-	-	-
	40 and above	16	1047	1.24					
Sex	Female	15	856	1.00	0.38–1.28	0.249	-	-	-
	Male	66	3753	0.70					
Treatment	Without previous treatment	40	4141	1.00	4.96–11.57	< 0.001	7.57	4.78–11.98	< 0.001
	With previous treatment	41	509	7.89					
Residence	Any ward except Nishinari	46	3307	1.00	1.07–2.81	0.0027	1.58	0.99–2.52	0.053
	Homeless, Nishinari Ward	35	1348	1.73					

Crude OR – crude odds ratio; Adjusted OR – adjusted odds ratio; CI – confidence interval.

* Logistic regression adjusted for the four variables in this table.

95%CI: 4.96–11.57; $P < 0.001$, adjusted OR: 7.57; 95%CI: 4.78–11.98; $P < 0.001$) and being a resident of Nishinari ward or homeless (crude OR: 1.73; 95%CI: 1.07–2.81, adjusted OR: 1.58; 95%CI: 0.99–2.52; $P = 0.053$). Having MDR-TB was not associated with sex or age group (**Table 2**).

DISCUSSION

Since the strengthening of the TB control programme in Osaka City and the implementation of the STOP TB Strategy, all TB indicators have improved. The goal of the Stop TB Strategy to reduce the TB notification rate to 50 per 100 000 by 2010[4] was almost reached in 2008 with a notification rate of 51 per 100 000. Improvements in TB indicators included increases in the proportion of cases using PZA in their treatment regimen and the implementation rate of DOT, reductions in the proportion of cases with treatment failure and default, and reductions in the proportion of previous treatment of the homeless and the proportion of cases with drug resistance, including

MDR-TB. The proportion of homeless cases with previous treatment declined before DOT started in 1997 because PZA was introduced in 1996 in Japan, and PZA usage rates had already reached 56% before DOT started. As all PTB homeless cases including resistant TB were targeted for daily DOT, the treatment outcome of resistant TB cases should also be improved. Thus it would be logical that the reduction of the failure and default rate would lead to the reduction of the previous treatment rate and to the reduction of TB transmission, including resistant TB, in the community.

The homeless are a high-risk group for TB infection in Osaka City; this has also been reported in the United States of America where drug-resistant TB is also significantly higher in homeless individuals,[11] and in London where homelessness was associated with the risk of multidrug resistance, poor adherence to treatment and loss to follow-up.[12] DOT for homeless cases has been introduced in urban areas of Japan such as Tokyo, Yokohama, Kawasaki and Nagoya since 1997 and has resulted in improved treatment success rates.[13,14] In Shinjuku, Tokyo, after the introduction of DOT for the homeless and foreigners from 2000 to 2006, the re-treatment rates decreased from 19.4% to 10.0% ($P < 0.001$) and MDR-TB rates from 1.6% to 0.2% ($P = 0.042$).[15] The same findings were observed with this study, suggesting that strengthening control activities for this high-risk group, including the use of DOT, can be effective.

The main limitation of this report is that only smear-positive PTB cases were studied as these are the only cases for which drug resistance is recorded. Based on surveillance data for 2008,[16] our sample potentially missed an additional 40% of cases that were bacteriologically confirmed but smear-negative. As a result of this study, the drug resistance of all bacteriologically positive TB cases are now being recorded. Another limitation for our multivariate analysis is that the individual case data did not contain occupation, education, use of PZA, type of DOT and other factors, and therefore these could not be included in the model. Lastly, as the data are from routine systems, the entering rate might have varied among different ward public health offices.

Despite these limitations, this analysis of TB surveillance and routinely collected data from the programme showed a statistically significant reduction in the proportion of TB cases with drug resistance from 2001 to 2008. This most likely resulted from the improvements in treatment outcome which were made possible by strengthening TB control activities, including DOT implementation for homeless cases, in Osaka city.

Conflicts of interest

None declared.

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Characteristics and treatment outcomes of tuberculosis cases by risk groups, Japan, 2007–2010

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Introduction: We studied the characteristics and treatment outcomes of the following risk groups for tuberculosis (TB): those with HIV and diabetes mellitus (DM), contact cases, the homeless, foreigners, health care workers (HCW) and the elderly.

Method: A descriptive cross-sectional study was conducted by analysing the Japanese tuberculosis surveillance data of all cases registered between 2007 and 2010 (n = 96 689).

Results: The annual proportion of TB cases by risk group was stable over the study period, although there was a slight but significant increase observed for foreigners and elderly cases. Homeless and elderly TB cases had the highest DM co-morbidity (16.6% and 15.3%). HIV co-infection was low in all TB cases (0.2%) yet highest in foreigners (1.3%). HIV status of 45% of TB cases was unknown. The proportion of multi drug resistant (MDR) TB was similar among all risk groups (0.0–0.9%) except foreigners, at 3.4%. Males in most risk groups had higher mortality than females; the mortality of all TB cases in all age groups for both males and females were 3.6–24 times higher than the general population.

Discussion: Reasons for the high proportion of "HIV status unknown" should be investigated and improved. Contact tracing among foreign cases with MDR-TB should be a priority. Homeless persons should be screened for DM together with TB. Programs to enhance health and nutrition status may benefit tuberculosis prevention among the elderly. Tuberculosis screening and TB education are important for HCW.

Globally, it is well documented that certain populations have a higher risk for tuberculosis (TB) due to biological, social or environmental factors.[1,2] Identifying populations at risk for TB has important implications for guiding TB control and public health measures. Japan is a high-income country with a middle level of TB burden. Of the 128 million population, the 2011 TB surveillance reported 22 681 new TB cases with a notification rate of 18 per 100 000 population.[3]

Japan started the first nationwide computerized tuberculosis surveillance system in 1987 that underwent revisions in 1992, 1998 and 2007. Reporting of TB is mandatory under Japan's infectious diseases control law.[4] Every public and private hospital is required to report TB cases to a local public health centre where a public health nurse in TB control enters the data into a central computerized surveillance system (**Table 1**). The data is updated every month. Treatment outcome is automatically coded by the surveillance programme based on the data on treatment regimen and smear results entered. Mechanisms to ensure data quality include automatic verification by the surveillance software on some variables, exchange of information at Directly Observed Treatment meetings at the hospitals, cohort analysis meetings at the health centres and periodic refresher training for public health nurses.

In this paper, we analyse the TB surveillance data and report the characteristics and tuberculosis treatment outcomes of populations identified as high risk for TB by Japanese and international literature including those co-infected with HIV, co-morbidity with diabetes mellitus (DM), cases detected through contact tracing of TB cases (contact cases), the homeless, foreigners, health care workers (HCW) and the elderly.

METHODS

A descriptive cross-sectional study was performed by analysing data of all new TB cases registered in the Japanese TB surveillance system between

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Table 1. **Data items included in the tuberculosis surveillance system, Japan**

Information of identification and status until treatment	Record under the registration
Address	Kinds of organ
Public health centre	Diabetes
Patient identification number	HIV infection
Sex	X-ray
Age	Smear result
Date of registration	Culture result
Nationality	Drug sensitivity test result
Occupation	Hospitalized/out-patient
Homeless	Length of hospitalization
Transferred in/out	Treatment regimen
New/retreatment/latent tuberculosis infection	Health insurance
Previous treatment regimen	Type of medical fee subsidy
Mode of case detection	Treatment outcome by cohort analysis methods
Symptoms	Smear result in each month
Date of diagnosis	Treatment status in each month
Patient's delay	Type of DOTS in each month
Doctor's delay	Length of treatment interruption
Bacillus Calmette–Guérin (BCG)	Length of pyrazinamide use
Date of treatment end	Continuity of isoniazid use
Reason for treatment end	Continuity of rifampicin use
Length of retreatment	Treatment exceeded 12 months
Date of cancellation	Treatment outcome
Reason for cancellation	

1 January 2007 and 31 December 2010 (n = 96 689). The number of TB cases and the proportion of risk groups over time were evaluated by the test for regression slope and the Cochran-Armitage test for trend. STATA12 (Stata Corp LP, College Station, Tx, USA) was used to analyse the frequencies and measures of central tendency and to produce cross-tabulations by risk group. Treatment outcome was included for smear-positive pulmonary tuberculosis (PTB) cases only; the category of "not evaluated for treatment outcome" was excluded from this analysis. Age- and sex-stratified mortality data from national vital statistics was compared with the mortality of the TB cases by risk group. Mortality of TB cases was defined as deaths from any causes during TB treatment course.

Ethical research clearance was not required as the Japanese TB surveillance data does not include case identifiers.

RESULTS

The number of annual TB cases significantly decreased over the study period (P = 0.001) from 25 184 in 2007 to 23 155 in 2010 (**Table 2**). Among the seven risk groups, the elderly accounted for the largest proportion of TB cases in Japan (57.3%), followed by TB cases with DM (13.1%). The risk group with the smallest proportion was cases with HIV (0.2%) and 2.8% were detected through contact investigation (**Table 2**). The annual proportion of each risk group was stable over the study period except for foreigners ($P < 0.001$) and elderly cases ($P < 0.001$), which show significant increases (**Table 2**).

The risk groups with the highest male to female ratio were the homeless and cases with HIV and DM, respectively, while the groups with the lowest male to female ratios were HCW and foreigners. The median age of HCW, foreigners and cases with HIV was between 28–40 years younger than all TB cases (**Table 3**). More than a half of the cases with HIV, and homeless patients were found in metropolitan cities. The proportion of cases having DM testing was relatively high among all risk groups (88–93%) with the highest proportion of DM co-morbidity among homeless and elderly cases. Almost half (45%) of the cases' HIV status was unknown (**Table 3**); this also

Table 2. **Total number of tuberculosis cases and proportion by risk group, Japan, 2007 – 2010**

Risk group	Proportion (%)*				
	2007	2008	2009	2010	Total
HIV positive	0.3	0.3	0.2	0.2	0.2
Diabetes mellitus	13.1	13.1	13.0	13.1	13.1
Contact cases	2.9	3.0	2.7	2.9	2.8
Homeless	1.3	1.4	1.7	1.4	1.4
Foreigner	3.4	3.9	3.9	4.2	3.8
Health care worker	2.5	2.4	2.6	2.4	2.5
Elderly (65 years old and above)	55.7	56.7	57.8	59.1	57.3
Total number of TB cases	**25 184**	**24 571**	**23 779**	**23 155**	**96 689**

Table 3. **Demographic and clinical characteristics of tuberculosis cases by risk group, Japan, 2007–2010**

Characteristics		Proportion of cases by risk group							
		All TB patients	HIV positive	Diabetes mellitus	Contact cases	Homeless	Foreigner	Health care worker	Elderly
Total number of cases		**96 689**	**240**	**12 694**	**2 753**	**1 384**	**3 704**	**2 400**	**55 384**
Sex (%)	Male	63.2	88.3	73.6	50.5	94.7	43.8	24.1	62.4
Age (%)	0–14	0.4	0.4	0.0	6.2	0.1	0.8	0.0	-
	15–64	42.4	92.1	33.1	73.3	70.2	94.6	93.1	-
	65 and above	57.3	7.5	66.9	20.5	29.8	4.6	6.9	-
	Median (years)	69	41	71	43	59	29	38	79
Residence (%)	Metropolitan city (> 1 million population)	30.9	55.0	32.8	31.3	67.3	36.4	25.6	26.5
Nationality (%)	Japanese	93.7	75.0	96.4	93.0	97.5	-	96.8	97.5
Type of TB (%)	Pulmonary	78.6	61.7	80.0	94.4	91.3	79.3	83.8	75.6
	Extra-pulmonary	21.4	38.3	20.0	5.6	8.7	20.7	16.2	24.4
Diabetes mellitus (%)	Yes	13.1	4.6	-	5.7	16.6	3.4	3.8	15.3
	No	78.6	83.8	-	87.1	71.7	85.0	90.1	76.3
	Unknown	8.3	11.7	-	7.2	11.6	11.6	6.1	8.4
HIV (%)	Positive	0.2	-	0.1	0.1	0.7	1.3	0.1	0.0
	Negative	54.7	-	54.4	55.7	53.0	53.5	58.0	54.4
	Unknown	45.0	-	44.2	44.2	46.3	37.1	41.8	45.6
Chest x-ray (%)	Have cavity	26.7	16.3	36.9	14.8	48.9	26.9	16.3	23.6
Pulmonary cases, 2007–2010		**76 004**	**148**	**10 149**	**2 598**	**1 264**	**2 939**	**2 011**	**41 847**
Smear positive (%)		50.9	52.7	62.3	16.4	64.1	41.2	29.6	56.5
Culture positive PTB cases, 2007–2010		**46 575**	**92**	**6 820**	**921**	**745**	**1 513**	**963**	**27 197**
Culture positive (%)		61.3	62.2	67.2	58.9	58.9	51.5	47.9	65.0
Multi-drug resistance TB (%)		0.6	0.0	0.6	0.9	0.7	3.4	0.5	0.4

applied to the reproductive-age TB cases (data not shown).

The proportion of cases with HIV among foreigner TB cases was 6.5 times higher than all TB cases. Cavities in the lung on chest x-ray were most frequently observed in homeless cases followed by cases with DM. Within the HCW group, the proportion of smear positive cases amongst nurses/public health nurses with PTB (n=1 035) was 26%, compared with 37% for all females aged 20-59 years (n=9 875). MDR-TB in foreigners was four to nine times higher

Table 4. **Treatment outcome of smear-positive pulmonary tuberculosis cases by risk group and gender, Japan, 2007–2010 (n=33 699)***

Risk group by gender		Total (*n*)	Treatment outcome (%)					
			Treatment success	Default (loss to follow up > 2 months)	Failure	Still on treatments (after 12 months)	Transfer out	Death
All patients	Male	23 037	54.0	4.2	1.3	13.2	3.6	23.7
	Female	10 662	59.3	5.0	0.8	12.9	3.1	18.9
HIV positive	Male	55	38.2	7.3	1.8	29.1	14.5	9.1
	Female	8	25.0	0.0	12.5	50.0	0.0	12.5
Diabetes mellitus	Male	4 396	51.9	2.8	1.7	19.3	3.2	21.1
	Female	1 226	50.3	3.5	1.1	21.2	2.2	21.6
Contact cases	Male	246	69.9	4.1	1.2	14.2	6.1	4.5
	Female	117	70.9	11.1	1.7	6.0	3.4	6.8
Homeless	Male	640	53.9	2.7	1.6	9.8	14.5	17.5
	Female	21	57.1	0.0	0.0	19.0	19.0	4.8
Foreigners	Male	450	59.1	4.9	1.3	9.6	18.9	6.2
	Female	559	4.3	4.3	1.3	11.1	14.5	1.4
Health care workers	Male	145	71.7	5.5	0.7	9.7	4.8	7.6
	Female	400	80.5	6.0	1.0	9.0	3.3	0.3
Elderly	Male	13 520	44.5	4.5	1.1	12.9	1.5	35.6
	Female	6 910	50.1	5.3	0.7	14.1	2.0	27.9

* This total does not include those cases not evaluated for treatment outcome (*n*=4989).

than the other risk groups and 5.7 times higher than all TB cases.

Treatment outcome

There were 33 699 smear positive PTB cases with data recorded on treatment outcome. Compared to other risk groups and all TB cases, male and female HCW achieved the highest treatment success, followed by contact cases and foreigners. Contact cases had the highest proportion of default, followed by HCW. Female cases had higher proportions of default than male cases in most risk groups, except cases with HIV, the homeless and foreigners. The proportion of those "still on treatment" was high for all TB cases, especially for both male and female cases with HIV and DM (**Table 4**).

Mortality

For all TB cases and in most risk groups, males had higher mortality compared with females. Mortality for all TB cases in all age groups for both males and females were 3.6 to 24 times higher than that of the general population. Mortality for TB cases aged less than 45 years in most risk groups, except HCW and contact cases, was higher than all TB cases. However, the mortality of older cases for every risk group was similar to those of all TB cases. Remarkably, mortality among male homeless TB cases aged 35–44, was five and 119 times higher than all TB cases and the general population respectively. There were no deaths for female cases with HIV aged 0–74, lower than for all TB cases, however the number of cases in this group was small (**Table 5**).

DISCUSSION

Most international literature reports that the risk groups for TB, such as those with HIV,[5] DM,[6] migrants[7] and homeless,[8] have higher mortality or poorer treatment outcome. Although Japan started TB surveillance more than two decades ago, data on risk groups such as cases with HIV and DM and the homeless were only available from 2007. To assess whether these groups also have a higher risk for TB in Japan, routine surveillance data was used for this study. This is the first descriptive report of the general situation of several TB risk groups in Japan.

Table 5. **Mortality of Japan population and of tuberculosis cases by risk group, gender and age group, Japan, 2007–2010**

		Age group								
Male by risk group		**0–14**	**15–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65–74**	**75–84**	**>85**
General population in Japan	Population (per 1000)*	8 673	6 571	8 136	9 025	7 760	9 172	7 066	4 085	972
	Mortality (%)**	0.0	0.0	0.1	0.1	0.3	0.8	1.9	5.2	14.8
Smear positive PTB	Cases	3	490	1 219	1 653	2 183	3 969	4 350	6 164	3 006
	Proportion of death (%)	0.0	0.6	0.6	2.4	6.4	11.4	21.5	36.8	53.4
HIV positive	Cases	0	3	10	17	14	6	5	0	0
	Proportion of death (%)	-	0.0	0.0	5.9	7.1	0.0	60.0	-	-
Diabetes mellitus	Cases	0	4	40	239	529	1 103	1 021	1 128	331
	Proportion of death (%)	-	25.0	5.0	1.7	5.1	9.7	18.7	37.7	51.1
Contact cases	Cases	1	20	30	26	43	61	37	18	10
	Proportion of death (%)	0.0	0.0	0.0	0.0	7.0	1.6	2.7	27.8	10.0
Homeless	Cases	0	3	14	67	134	252	133	30	7
	Proportion of death (%)	-	0.0	0.0	11.9	9.7	19.8	19.5	40.0	42.9
Foreigners	Cases	0	103	156	55	57	28	25	17	9
	Proportion of death (%)	-	0.0	1.3	1.8	5.3	7.1	24.0	52.9	55.6
Health care workers	Cases	0	6	27	28	21	20	9	30	4
	Proportion of death (%)	-	0.0	0.0	0.0	0.0	0.0	22.2	23.3	50.0
Female by risk group										
General population in Japan	Population (per 1000)*	8 254	6 224	7 842	8 792	7 714	9 471	7947	5 783	2 570
	Mortality (%)**	0.0	0.0	0.0	0.1	0.2	0.3	0.8	2.6	10.4
Smear positive PTB	Cases	11	411	1 053	843	615	819	1 423	3 117	2 370
	Proportion of death (%)	0.0	0.2	0.6	1.1	2.3	6.8	14.6	23.4	41.8
HIV positive	Cases	0	0	3	3	0	1	0	1	0
	Proportion of death (%)	-	-	0.0	0.0	-	0.0	-	100.0	-
Diabetes mellitus	Cases	0	2	10	41	60	151	271	440	251
	Proportion of death (%)	-	0.0	0.0	0.0	5.0	9.9	15.5	22.2	42.2
Contact cases	Cases	3	7	22	14	10	16	18	18	9
	Proportion of death (%)	0.0	0.0	0.0	0.0	10.0	0.0	11.1	11.1	33.3
Homeless	Cases	0	0	4	2	1	2	5	4	3
	Proportion of death (%)	-	-	0.0	0.0	0.0	0.0	0.0	0.0	33.3
Foreigners	Cases	0	137	236	103	52	13	3	12	3
	Proportion of death (%)	-	0.0	0.4	1.9	1.9	7.7	0.0	16.7	33.3
Health care workers	Cases	0	21	140	113	78	34	10	3	1
	Proportion of death (%)	-	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0

* Average of 2007–2010

** Vital statistics of Japan, 2007–2010

The magnitude and context of risk groups in Japan were quite different from other high-income and low TB burden countries, which may be related to differences in the prevalence of the risk groups in the general population. Compared with the United Kingdom and the United States of America, Japan has a significantly larger elderly population (23% compared with 16% and 12%, respectively), but lower prevalence of several risk groups. For example the prevalence of DM was 5.1% in Japan, compared with 5.6% in the United Kingdom and 9.4% in the United States of America; the HIV prevalence was < 0.1%, 0.2% and 0.6%, and the proportion of immigrants were < 2%, 9% and 12.8%, respectively. As a result of the different size of the risk groups, the characteristics and treatment outcomes of TB also differed.

A majority (60%) of TB cases in Japan are elderly, whereas in the United Kingdom and the United States of America the majority (60–80%) of cases are migrants or foreign-born . In Japan, most elderly cases were infected when they were young yet developed active TB disease when older due to co-morbidity and age-related immuno-suppression, malnutrition and other risk behaviours such as smoking and drinking.[9,10] Therefore there is no direct intervention to prevent active TB among the elderly. Nevertheless, general health interventions such as alcohol and tobacco cessation programs or programs to promote balanced nutrition and appropriate physical exercise may indirectly reduce the risk of TB.[11] Tuberculosis infection control measures and TB screening for staff and clients in institutions caring for the elderly are recommended. The high proportion of those still on treatment for all TB cases (13.2% in male, 12.9% in female) may be because the majority of TB cases in Japan are elderly and it is quite common to extend the standard treatment regimen according to the individual patient's clinical condition. Moreover, the Japanese national TB treatment guidelines do not recommend Pyrazinamide for patients aged over 80 years, which lengthens the regimen. A three-month extension of treatment is also recommended for patients with a co-morbidity such as DM.

In line with the World Health Organization (WHO) recommendation,[5] DM testing was completed for more than 90% of TB cases in Japan. This may be attributable to the practice of routine blood glucose testing among TB cases in Japan. According to a systematic review,[11] cases of TB co-morbidity with DM have a risk ratio for the combined outcome of treatment failure and death of 1.7 (95% CI: 1.4 to 2.1). Our study showed higher mortality for TB cases with a DM co-morbidity for males of younger ages (< 35) but similar mortality for older age groups with a DM co-morbidity, compared with all smear positive PTB cases of same age group.

The status of HIV testing among TB cases in Japan is quite alarming. Regardless of a country's HIV prevalence, WHO and the international standard of TB care recommend HIV testing for all TB cases.[5] The proportion of TB cases with unknown HIV status was above 40% for all age groups. Reasons for low HIV testing, especially among reproductive age patients, should be investigated.

Unlike the United States of America or the United Kingdom,[8] TB control among the homeless in Japan is not complicated by issues such as drug use and HIV infection. Nevertheless, our study reports high mortality and DM co-morbidity among homeless young adults and needs to be addressed. Current active case-finding for homeless TB cases should also simultaneously screen for DM.[6] Persons with DM have about a three times higher risk of developing TB and therefore may require a different TB screening strategy.

Tuberculosis among foreigners in Japan has continued to be less than 5%. Although TB with HIV co-infection is higher among foreigners than other risk groups, this proportion was only 1.3%. The mortality of foreigner cases was much lower than Japanese cases, probably because they are younger and have four times less co-morbidity with DM than for all TB cases. However, a higher proportion of MDR-TB among foreigner TB cases points to the importance of effective contact investigation among this group. The final treatment outcome for foreigners who transferred out (18.9% in male, 14.5% in female) was unknown, and it is possible that these have ultimately defaulted.

In low and middle income countries, the attributable risk for TB disease in HCW compared to the risk in the general population, ranged from 25 to 5361 per 100 000 populations per year.[12] That the proportion of smear-positive cases among PTB in nurses/public health nurses in this study was lower compared with female cases aged 20-59, and smear positive cases are an indicator of late diagnosis, suggests that TB cases

may be detected earlier in nurses/public health nurses. This may be due to HCWs seeking treatment promptly or that routine medical checks of HCW are being conducted. Despite this, overall TB infection and TB disease among HCW is higher than the general population[13] with TB incidence in nurses aged 30–49 being 3.4–4.7 times higher than same-age females in the general population. One of the main reasons for the high TB incidence of HCW is that elderly hospitalized patients infected with TB were causing nosocomial infection to medical staff prior to their diagnosis with TB. Prevention of such nosocomial infection requires earlier TB diagnosis of elderly hospitalized patients.

The final risk group in this study was contact cases. In high-income countries, 2.3% of adults and 4.7% of children in contact with TB cases develop active TB.[14] As household size in Japan is becoming smaller, with 32% being one-person households, the number of household contacts is potentially small. However, household and other contacts remain a priority risk group for TB control[15] with almost 3% of cases in this study being contact cases. The current surveillance system does not report the total number of household and other types of contacts. Therefore, the coverage of contact investigation is unknown. Future research should investigate the acceptability of and barriers to contact investigation.

Despite mandatory TB reporting in Japan, anecdotal evidence indicates that underreporting of TB cases may be possible. The magnitude of underreporting is now under a systematic investigation by other researchers. This study is a descriptive analysis using routine surveillance data; therefore analysis using relative risks was not possible due to the lack of reliable denominators of several risk groups such as those with HIV, DM and the homeless. Also access to vital registration data in Japan is limited. The Japanese TB surveillance system is quite advanced in terms of technology and design, yet the system nevertheless may limit our study findings. The high proportion of treatment outcomes "not evaluated" (~12%) may affect the study findings. The current surveillance programme only codes treatment outcomes for those cases receiving the standard treatment regimen. However, this problem has now been recognized and the additional manual coding of treatment outcomes by public health nurses started in 2012. Although the national surveillance system does not include identifiers, double entering of the same case from different health facilities is unlikely because the data is identifiable at the local level and surveillance staff from the health centres regularly communicate with each other about transferring patients. Recognizing the limitations of the TB surveillance system in Japan will guide its further improvements.

Conflicts of interest

None declared.

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Do transportation subsidies and living allowances improve tuberculosis control outcomes among internal migrants in urban Shanghai, China?

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Introduction: Tuberculosis (TB) in internal migrants is one of three threats for TB control in China. To address this threat, a project was launched in eight of the 19 districts of Shanghai in 2007 to provide transportation subsidies and living allowances for all migrant TB cases. This study aims to determine if this project contributed to improved TB control outcomes among migrants in urban Shanghai.

Methods: This was a community intervention study. The data were derived from the TB Management Information System in three project districts and three non-project districts in Shanghai between 2006 and 2010. The impact of the project was estimated in a difference-in–difference (DID) analysis framework, and a multivariable binary logistic regression analysis.

Results: A total of 1872 pulmonary TB (PTB) cases in internal migrants were included in the study. The treatment success rate (TSR) for migrant smear-positive cases in project districts increased from 59.9% in 2006 to 87.6% in 2010 ($P < 0.001$). The crude DID improvement of TSR was 18.9%. There was an increased probability of TSR in the project group before and after the project intervention period (coefficient = 1.156, odds ratio = 3.178, 95% confidence interval: 1.305–7.736, $P = 0.011$).

Conclusion: The study showed the project could improve treatment success in migrant PTB cases. This was a short-term programme using special financial subsidies for all migrant PTB cases. It is recommended that project funds be continuously invested by governments with particular focus on the more vulnerable PTB cases among migrants.

China is one of the 22 highest tuberculosis (TB) burden countries in the world[1] with an estimated 0.9–1.2 million TB cases in 2010.[2] There is a large amount of rural-to-urban migration in China with over 200 million people relocating to seek better incomes and living conditions. TB in the large internal migrant population (about 221 million in 2010) has been demonstrated as one of the major threats to TB control in China.[3] Many studies have found that internal migrants have lower incomes compared to the local residents, have poor access to health and social security systems, are highly mobile and are therefore more vulnerable to TB. These factors result in a lower proportion of suspected TB cases completing diagnostic evaluation and an even lower proportion of successful treatment in internal migrants.[4–10] Information from the China TB Information Management System (TB-IMS) in 2005 showed a higher proportion of migrants among notified TB cases in big cities, ranging from 40%–80%, and a treatment completion rate among migrants of around 60% compared with over 85% among local residents.[11]

Shanghai is the largest city by population in China (over 23 million in 2010), and 39% of the population are internal migrants.[12,13] Compared with local registered residents, migrants have restricted access to TB control services and social protection.[14–17] To improve TB control for migrants, a five-year financing project of transportation subsidies and living allowances for patients was launched in eight of 19 districts in Shanghai (one district in 2006 and seven districts in 2007). This study aims to determine if the transportation subsidies and living allowances contributed to improved

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TB treatment outcomes among internal migrants in Shanghai.

METHODS

Study setting

There were eight project districts in Shanghai. The project provided transportation subsidies and living allowances of US$14.63 and US$4.39 a month, respectively, for all migrant TB cases (non-local official household registered resident TB cases) in the project districts. The services they received were the same as those in non-project districts. In 2010, there were 2439 migrant pulmonary TB (PTB) cases receiving the subsidies.

Three project and three non-project districts were compared. Sample size calculations estimated samples of 108 for project groups and 484 for non-project groups (a = 0.05, b = 0.10). It was estimated there are 600 migrant TB cases in three districts a year. Three project and three non-project districts in Shanghai were selected by geographic location: one central urban district (A district), one suburb district (B district) and one district between A district and B district (C district) for both the project and non-project groups.

Project B district initiated the project on 1 October 2006; in order to minimize the effect of this bias, the cases from October to December 2006 in B district were eliminated along with a quarter of the population.

Study design

This was a community intervention study; quantitative methods were used to evaluate the effect of the project. The data of PTB cases were obtained from the China TB-IMS for 2006 and 2010.

Treatment success rate (TSR) was defined as the proportion of a cohort of TB cases registered in the TB-IMS as being treated under directly observed treatment, short-course (DOTS) in a given year whom successfully completed treatment. Treatment success included those with bacteriologic evidence of success ("cured") or without bacteriologic evidence ("treatment completed").[18] TSR was used to determine the success of the project between smear-positive PTB and smear-negative PTB cases.[19]

Data analysis

Descriptive statistics were used to summarize the characteristics of the TB cases from the surveillance data. For dichotomous data, the differences between TB treatment outcomes of project and non-project districts were tested using chi-squared tests. To assess the project intervention effect on migrant smear-positive PTB cases, a difference-in-difference (DID)estimation framework was used. To determine the impact of the intervention, a crude double difference of TSR was calculated: $([TSR_{proj,2010}–TSR_{proj,2006}]–[TSR_{non\text{-}proj,2010}–TSR_{non\text{-}proj,2006}])$. This assumed that the change of TSR in the non-project districts reflects what would happen in the project districts in the absence of the project.

A multivariate logistic regression model was then performed to estimate the association among the probability of being successfully treated ($P[Y = 1]$) and the DID impact estimator (the interaction on being a project recipient and year of registration) and some other independent variables. Here the dependent variable Y indicated "treatment success or not" (using value one for treatment success, zero for otherwise).The independent variables were basic personal information available in TB-IMS, including year of patient registration (2006 or 2010), patient site (non-project and project), two-way interactions between patient site and year of registration, sex, age, job (professional, managerial, skilled or partially skilled, housekeeper or unemployed, children or youth, retired and others) and TB type (initial or re-treated cases). Analyses were conducted using SPSS version 20.0 and STATA version 12.

RESULTS

Migrant PTB notifications

There were a total of 909 and 963 migrant PTB cases reported in TB-IMS in 2006 and 2010, respectively. Among these, 42%–45% were smear-positive cases. The case notification rate for smear-positive PTB in migrants was more than two times that of local residents in 2006 (27.1 per 100 000 compared with 12.1 per 100 000) and 1.3 times higher in 2010 (16.2 per 100 000 compared with 11.9 per 100 000).

The migrant groups in project districts had a smear-positive notification rate of 26.8 per 100 000 in 2006, lower than for migrants in non-project districts at

Table 1. **Characteristics of migrant PTB cases by project and non-project districts, Shanghai, China, 2006 and 2010**

Variable	2006					2010				
	Project districts (n = 691)	%	Non-project (n = 281)	%	P-value*	Project districts (n = 734)	%	Non-project (n = 229)	%	P-value*
Diagnosis										
Smear-positive	312	45.2	93	42.7	0.519	330	45.0	75	32.8	0.001
Smear-negative	379	54.8	125	57.3		404	55.0	154	67.2	
Therapy										
Initially treated	608	88.0	194	89.0	0.689	656	89.4	202	88.2	0.622
Re-treated	83	12.0	24	11.0		78	10.6	27	11.8	
Sex										
Male	419	60.6	131	60.1	0.886	462	62.9	135	59.0	0.277
Female	272	39.4	87	39.9		272	37.1	94	41.0	
Age										
below 15	4	0.6	1	0.5	0.324	7	1.0	1	0.4	0.081
15–24	193	27.9	54	24.8		246	33.5	92	40.2	
25–34	249	36.0	81	37.2		249	33.9	66	28.8	
35–44	134	19.4	42	19.3		107	14.6	38	16.6	
45–54	53	7.7	11	5.0		57	7.8	15	6.6	
55–64	35	5.1	20	9.2		49	6.7	7	3.1	
65 and above	23	3.3	9	4.1		19	2.6	10	4.4	
Occupation										
Professional	7	1.0	3	1.4	< 0.001	9	1.2	7	3.1	< 0.001
Managerial	28	4.1	26	11.9		43	5.9	13	5.7	
Skilled or partially skilled	282	40.8	71	32.6		330	45.0	72	31.4	
Housekeeper or unemployed	226	32.7	40	18.3		179	24.4	48	21.0	
Children and youth	26	3.8	7	3.2		24	3.3	15	6.6	
Retired	25	3.6	20	9.2		25	3.4	9	3.9	
Others	97	14.0	51	23.4		124	16.9	65	28.4	

* P-values are for chi-squared tests of association between district type (project versus non-project) and characteristics factors.

28.2 per 100 000. In 2010, this rate decreased by 33.3% in the project districts to 17.9 per 10 000. In contrast, it decreased by 58.9% in non-project districts to 11.6 per 100 000.

In both 2006 and 2010, nearly 90% of new PTB cases in migrants were diagnosed and treated for the first time, compared with about 85% in local resident groups.

Characteristics of migrant PTB cases

Among the migrant PTB patients, 515 (27.5%), 1009 (53.9%) and 348 (18.6%) cases were registered in A, B and C districts, respectively. Some characteristics of the 1872 migrant PTB cases were similar in both project and non-project districts in both 2006 and 2010. About 60% of all four groups were male with just over 65% cases aged 15–34 years (**Table 1**). Approximately 40% of migrant PTB cases in all groups combined were skilled or partially skilled employees (e.g. worker, farmer, service personnel), 25% were housekeepers or unemployed migrants and 4% were children, youth and retired people. However, job structure comparison between project and non-project districts showed that there was a significant difference both in 2006 and 2010 ($P < 0.001$ for both).

Treatment outcomes of migrant PTB cases

In 2006, TSR of smear-positive cases in project districts was 59.9%, lower than in non-project districts at 73.1% and significantly different ($P = 0.021$). In 2010, TSR in project districts rose to 87.6%, significantly higher than in 2006 ($P < 0.001$) and was appreciably higher than non-project districts in 2010 at 81.9%, although this was not significantly different ($P = 0.205$; **Figure 1**).

In 2006, TSR of smear-negative PTB cases in project districts was 73.1%, lower than that in non-project districts at 78.4%. In 2010, TSR in project districts increased to 89.8%, higher than that in non-project districts at 85.6%, but this was not significantly different ($P = 0.165$; **Figure 2**).

The crude average double difference of TSR was 18.9% (**Figure 1**). In the logistic regression model, the predictor of interaction on being a project recipient and year of registration was significantly associated with a higher probability of TSR (odds ratio [OR] = 3.178; 95% confidence interval (CI): 1.305–7.736; $P = 0.011$) after adjustment for all other variables. The odds, the

Figure 1. **Treatment success rates for smear-positive migrant PTB cases, Shanghai, China, 2006 and 2010**

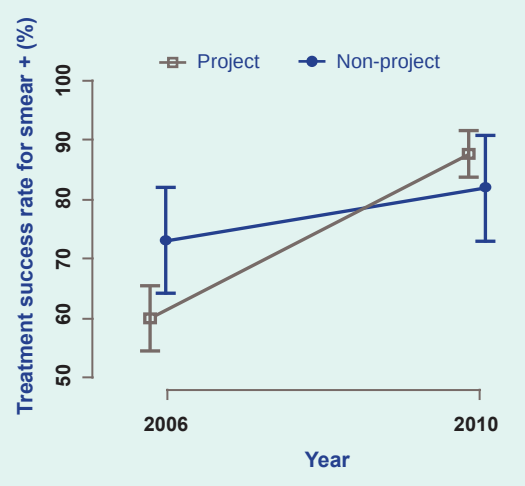

Figure 2. **Treatment success rates for smear-negative migrant PTB cases, Shanghai, China, 2006 and 2010**

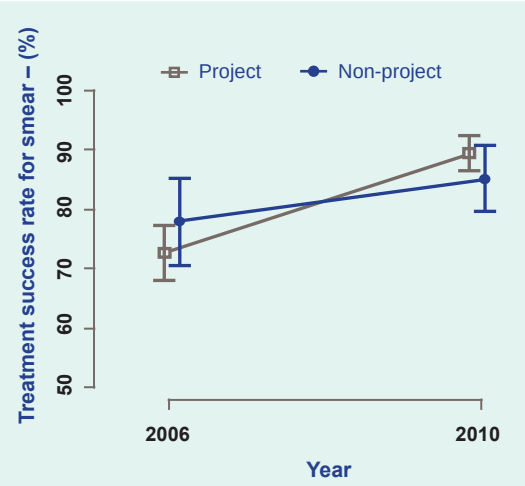

Table 2. **Multivariable logistic regression analysis on the treatment success rates for migrant smear-positive cases by confounding factors, Shanghai, China, 2006 and 2010**

Variables	β	Wald	P-value	OR	95% CI
Patient site (non-project = 0)	–0.725	–2.63	0.009	0.484	(0.282–0.831)
Patient site * year (year, 2006 = 0)	1.156	2.55	0.011	3.178	(1.305–7.736)
Sex (female = 0)	–0.403	–2.13	0.033	0.668	(0.461–0.969)
Patient type(new cases = 0)	–0.588	–2.59	0.010	0.555	(0.356–0.867)
$Occupation_{retired}$ * (skilled or partly skilled = 0)	–1.040	–2.63	0.009	0.354	(0.163–0.768)
Constant	2.026				

[a] Occupation is used as dummy variables in regression analysis. All other occupation fields are not included in the regression model.

CI – confidence interval; OR – odds ratio.

Table 3. **Difference-in-difference estimates for the contribution of the project on the treatment success rates for smear-positive migrant PTB cases, Shanghai, China, 2006 and 2010**

	Xtime = 0	Xtime = 1	X([time = 1] – [time = 0])	*P*-value
$X_{project} = 0$	X_n[a]	X_n[a]	0	1
$X_{project} = 1$	$–0.725+X_n$[a]	$–0.725+1.156+X_n$[a]	1.156	0.011

[a] X_n is the part of the estimation model ($Logit[Y_{TSR}]$): $2.026–0.403x_{sex}–0.588x_{therapy}–1.040x_{jobretired.}$

relative possibility of PTB treatment success, for those in project districts in 2010 (site*year=1) was 3.178 times as high as those in non-project districts in 2006, those in project districts in 2006, and those in non-project districts in 2010 (site*year=0) (**Table 2**).

Further analysing the interaction on being a project recipient and year of registration by stratified analysis, the difference of TSR before and after project intervention periods (post-baseline) was not significantly different for cases in the non-project districts (OR = 1). However, we estimated the increased probability of TSR in the project group before and after the project intervention period (coefficient = 1.156; OR = 3.178; 95% CI: 1.305–7.736; *P* = 0.011) (**Table 3**).

DISCUSSION

This study indicated that transportation subsidies and living allowances played a role in improving treatment outcomes of migrant PTB patients in Shanghai. In project districts, the TSR for migrant smear-positive PTB cases

reached 87.6% in 2010. The DID improvement of TSR, which compares the crude improvement of the project districts with the non-project districts, was 18.9%. Further, the result of the multivariable logistic regression analysis showed that the project intervention was positively associated with treatment success outcomes (OR = 3.178; 95% CI: 1.305–7.736).

In this study, the financial support was designed to promote better compliance to quality TB care in the internal migrant population. Previous studies have found that a large proportion of PTB cases in urban areas occurs in migrants.[20–23] Financial constraints were reported as the biggest barriers to TB services and compliance to normative treatment courses among migrant patients.[24,25] The results of this study are in agreement with several studies in China that revealed transportation subsidies and living allowances could improve treatment adherence in migrant PTB cases in some urban areas in China.[26,27] The reasons for increased TSR might be that the transportation subsidies and living allowances reduced the disease burden for migrant PTB cases and encouraged them to stay in Shanghai to complete the treatment course;[28] and the subsidies may also improve their trust in TB control policies, services and health providers. However, in practice, some TB control staff and PTB patients mentioned that the project subsidies were too little for the patients who really needed them to support their TB treatment; for some migrants with high income, the effect was limited.

Despite the success of this programme, certain challenges affecting project sustainability should not be overlooked. The initial project was made possible through a governmental special financing programme. According to the World Health Organization Global TB Control Programme, making DOTS pro-poor is justified on epidemiological, economic and equity grounds and will significantly contribute to the achievement of the global targets for TB.[29] It is suggested that national and local governments give priority to poverty reduction strategies in TB control. Improvements could include building a sustainable mechanism to continue and increase the investment amount; cooperating with other related departments, including departments of civil affairs, labour and social security, and nongovernmental organizations to identify the more vulnerable migrant PTB cases; specifying the amount of subsidies for migrant PTB cases on different economic levels; and raising the amount of the subsidies moderately to relieve the burden for the migrant PTB cases who really need them.

This study had some limitations. First, it was a retrospective study and secondary data were used, so the data set was limited in its ability to identify certain variables affecting TSR such as personal economic situation; education level; and regional, social, economic and ecological conditions. Second, selection of districts in project and non-project groups was based more on geography, although the analysis results in project and non-project groups in baseline showed that their background information was similar (except for occupation). Third, the non-project group did not reach the required sample size because some cases visited a doctor and registered in a municipal-level TB hospital in a non-project district but lived elsewhere. Their treatment and treatment outcome information was not completed, and they need to be retrieved for a further study.

CONCLUSION

Transportation subsidies and living allowances contributed to the improvement of TB treatment success among internal migrants TB cases in Shanghai. Despite limitations with using surveillance data, our study did allow for the assessment of the effectiveness of the project.

The project was a short-term programme with special financing subsidies for migrant PTB cases. Meanwhile, the number of migrant PTB cases is growing in urban areas; thus, a similar long-term investment by government is recommended. The project provided the same subsidies for each migrant PTB case in project districts without recognizing the poor or other vulnerable migrant groups who need more financial aid to support their TB treatment. Therefore, the priority interventions are to identify and ensure adequate subsidies for vulnerable groups.

Conflicts of interest

None declared.

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The association between household poverty rates and tuberculosis case notification rates in Cambodia, 2010

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Introduction: Poverty is a risk factor for tuberculosis (TB); it increases the risk of infection and active disease but limits diagnostic opportunities. The role of poverty in the stagnant case detection in Cambodia is unclear. This study aims to assess the relationship between district household poverty rates and sputum-positive TB case notification rates (CNRs) in Cambodia in 2010.

Methods: Poisson regression models were used to calculate the relative risk of new sputum-positive TB CNR for Operational Districts (ODs) with different poverty rates using data from the National Centre for Tuberculosis and Leprosy Control and the National Committee for SubNational Democratic Development. Models were adjusted for other major covariates and a geographical information system was used to examine the spatial distribution of these covariates in the country.

Results: The univariate model showed a positive association between household poverty rates and sputum-positive TB CNRs. However, in multivariate models, after adjusting for major covariates, household poverty rates showed a significantly negative association with sputum-positive TB CNRs (relative risk [RR] = 0.95 per 5% increase in poverty rate). The negative association was stronger among males than females (RR = 0.93 versus 0.96 per 5% increase in poverty rate). Similar spatial patterns were observed between household poverty rates and other covariates, particularly OD population density.

Conclusion: Household poverty rate is associated with a decrease in sputum-positive TB CNR in Cambodia, particularly in men. The potential of combining surveillance data and socioeconomic variables should be explored further to provide more insights for TB control programme planning.

The links between poverty and tuberculosis (TB) cases have been documented for decades in many parts of the world.[1–3] While poverty may lead to higher case notification rates (CNRs) due to the higher prevalence of active TB cases among poorer populations, it is also thought that poverty may lower CNRs as a result of reduced access to TB diagnosis and poor diagnostic capacity in such populations.

Cambodia is currently identified by the World Health Organization (WHO) as one of the 22 countries in the world that carry the highest TB burden with approximately 61 000 new TB cases per year and an incidence rate of 424 cases per 100 000 population in 2010.[4] It is estimated that 64% of Cambodians are infected with latent or active TB, and a substantial number of cases remain undetected.[5] In 1994, WHO's global TB control strategy (the DOTS strategy) was introduced and has reached almost 100% coverage and 90% treatment success rate for all forms of TB. However, the case detection rate (CDR) for all forms of TB has stagnated at around 65%. Since 2005, the country began to explore active case finding (ACF) initiatives to increase overall case notification in which the providers visit target populations in teams and use screening tools to identify TB suspects, followed by diagnostic tools to identify the TB patients on the spot.[6] The ACF initiatives try to complement case-finding through passive case-finding efforts, wherein people with symptoms visit health facilities and the health workers use screening tools to identify TB suspects.

Given the strong links between poverty and TB burden, many efforts had been made in developing countries to target poor and vulnerable groups.[7] However, TB incidence is only estimated at the national level, while

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the number of cases diagnosed and CNRs are often the only measures available at provincial and district levels. The CNR does not reflect the actual number of active TB cases but rather the number of cases diagnosed and put on treatment; the CNR can be greatly affected by access to services, which, in turn, is often affected by poverty. Provincial and district TB control authorities often rely heavily on TB case notification data to find the missing cases, but they may not be aware of the population to target within their geographical areas to maximize their efforts.

Using a cross-sectional analysis approach, this study aimed to assess the link between household poverty level and sputum-positive TB CNR in Cambodia in 2010. The study also explored the potential of using a geographical information system (GIS) to characterize the spatial distribution of poverty and other TB risk factors with the distribution of TB.[8–10]

METHODS

We performed cross-sectional ecological analyses using operational districts (ODs) as the unit of analysis. An OD is the basic organizational and reporting unit in the Cambodian health system, providing services through health centres and district referral hospitals. There are 77 ODs in Cambodia, spread over 24 provinces, each serving an average population of 180 000 (range: 35 500–525 500). The ODs are formed by combining several communes, which are the lowest-level administrative units in Cambodia, each consisting of three to 30 villages. According to the 2008 census, there were 1621 communes and 14 073 villages in Cambodia.

Data source

The number of newly diagnosed sputum-positive TB cases (including new and previously treated TB cases) in 2010 was obtained from the National TB Registry maintained by the National Centre for Tuberculosis and Leprosy Control (CENAT). The registry contains information on the number of different types of TB cases diagnosed, put on treatment and reported by all OD TB coordinators. CNRs were computed based on the number of cases and the population of the ODs projected for the year, based on figures from the latest census (2008). Case count by age group was only available for new sputum-positive TB cases (not including previously treated TB cases); therefore, CNRs for different age groups were not computed.

Household poverty data were obtained from the Commune Database maintained by the National Committee for SubNational Democratic Development, which contains core information regarding demographic, socioeconomic and physical assets of each commune in Cambodia (n = 1620). These data are collected by village chiefs and commune clerks annually and are compiled at the commune level. Household poverty rates (% of population living at or below poverty line) for each commune were derived based on the poverty line and the per capita consumption expenditure per day for the year. We estimated the OD poverty rates by spatially matching communes with ODs and averaging all the commune poverty rates in the same OD.

Population density in each OD was calculated by dividing the population projected for 2010, by the area of each OD (in square kilometres), data that were obtained from the WHO Western Pacific Regional Office MapServer for Public Health Mapping.

Other factors potentially associated with TB disease burden were selected from the Cambodia Demographic and Health Surveys (DHS) that are nationally and regionally representative household surveys that provide a wide range of monitoring and impact evaluation indicators. Because subregional estimates in the DHS surveys were not based on representative samples, we used the regional (provincial) estimates in this study and applied the same proportions to all the ODs in the same province.

Patient diagnostic rate

Patient diagnostic rate (PDR), an indicator to assess case detection, is the rate at which prevalent cases are detected by control programmes and is calculated using the number of reported cases per 100 000 per year divided by the prevalence per 100 000.[11] In this study, prevalence data were obtained from the Second National TB Prevalence Survey (2011) conducted by CENAT.[12] The denominator represents the population that had TB at the time and the numerator represents those actually detected and notified by the National TB Control Programme.

Table 1. **Categorization of values of the covariates**

Categories	Low	Medium	High
Operational districts population density (population/km^2)	< 100	100–250	≥ 250
Distance to health care facility (% of women who perceived distance as a problem in accessing health care)	< 30	30–50	≥ 50
All basic vaccination coverage (% population vaccinated)	< 70	70–80	≥ 80
HIV prevalence (% adults 15–49 who have HIV)	< 0.3	0.3–0.7	≥ 0.7

GIS spatial characterization

Data on all new and previously treated sputum-positive TB cases and OD household poverty rates were linked to their respective geo-coded OD data using the join attrition function in Arc Map GIS software V.9.3.1 (Environmental System Research Institute, Redlands, CA, USA). Similarly, OD population density, all basic vaccination coverage, distance to health care facilities and HIV prevalence were also mapped with sputum-positive TB CNR using classifications that are the same as those defined in this study.

Statistical analysis

Using multiple Poisson regression models, the logarithm of the number of new sputum-positive TB cases notified in each OD was modelled as a function of household poverty with the logarithm of the OD population as an offset. The household poverty rates were transformed into both continuous and categorical variables in increments of 5%. Relative risks (RR) of new smear-positive TB case notification rates were estimated from the models using the lowest poverty category as the referent group. A univariate model was used to assess the effect of household poverty rates on new sputum-positive TB CNRs, followed by a multivariate model adjusting for (1) OD population density; (2) HIV prevalence; (3) distance to health facility (% of women who perceived distance to health facility as a problem in accessing health care); and (4) all basic vaccination coverage (proportion vaccinated). All covariates were identified a priori and included in the model as tertile discrete continuous variables (**Table 1**). SAS 9.2 was used for all analyses.

RESULTS

All 77 ODs were included in the continuous and categorical analyses. **Table 2** shows the summary characteristics of ODs in each poverty category.

The continuous univariate model showed an overall positive association between household poverty rates and sputum-positive TB CNRs (**Table 3**). A 5% increase in household poverty rates was associated with a 2% increase in TB CNRs (RR = 1.02; 95% confidence interval [CI] = 1.00, 1.03). A significant association was seen among females (RR = 1.03; 95% CI = 1.01, 1.04 per 5% increase in poverty rate), while the association was nil for males (RR = 1.00). After adjusting for OD population density, distance to health facility, HIV prevalence and all basic vaccination coverage, the continuous adjusted model showed an overall negative association between household poverty rates and sputum-positive TB CNRs. The model suggested that a 5% increase in household poverty rates was associated with a 5% decrease in sputum-positive TB CNRs (RR = 0.95; 95% CI = 0.92, 0.96). A stronger negative association was seen among males (RR = 0.93; 95% CI = 0.91, 0.96 per 5% increase in poverty rate) than females (RR = 0.96; 95% CI = 0.93, 0.99 per 5% increase in poverty rate).

In the categorical analysis (**Figure 1**), ODs with 15%–20% of the population living below the poverty line were associated with the highest sputum-positive TB CNRs (RR = 1.35; 95% CI = 1.23, 1.48 per 5% increase in poverty rate) after adjusting for OD population density, distance to health care facility, vaccination coverage and HIV prevalence. Subsequent increase in poverty rates resulted in lower RRs. A similar trend of

Table 2. **Characteristics of operational districts in each poverty category**

Household poverty (% below poverty line)	< 15		15–19		20–24	
Number of ODs (N)	6		5		15	
	Mean	SD	Mean	SD	Mean	SD
OD populations	242 309.2	106 929.2	110 799.2	411 83.1	184 348.7	68 373.3
Population density (people/km^2)	4615.2	6950.9	245.4	113.2	251.3	114.8
Number of new sputum-positive TB cases in 2010 (new and relapsed)						
Male	104.8	27.8	84.8	31.5	115.7	56.0
Female	74.2	31.5	75.8	35.0	111.9	68.1
Relapsed (male and female)	95.0	70.1	4.8	4.1	10.4	12.0
Total	274.0	69.9	165.4	66.9	237.9	127.8
Case notification rate (per 100 000 population)	126.3	39.8	151.2	40.1	125.4	53.2
HIV prevalence (adults 15–49 years)	1.2	0.7	0.5	0.3	0.5	0.3
All basic vaccination coverage (%)	81.8	3.7	69.2	10.8	75.7	10.7
Distance to health facilities (% perceived as problem)	22.1	8.7	23.5	17.4	35.1	20.6

Household poverty (% below poverty line)	25–29		30–34		≥35	
Number of ODs (N)	23		19		9	
	Mean	SD	Mean	SD	Mean	SD
OD populations	173 205.0	72 311.5	193 672.0	112 518.2	178 326.7	63 170.8
Population density (people/km^2)	183.7	95.1	116.4	126.7	31.2	24.5
Number of new sputum-positive TB cases in 2010 (new and relapsed)						
Male	110.5	69.4	137.1	69.1	113.3	64.1
Female	90.6	62.3	127.6	76.8	87.0	50.8
Relapsed (male and female)	10.1	25.2	10.5	16.3	7.4	11.9
Total	211.3	129.7	275.2	147.3	207.8	117.3
Case notification rate (per 100 000 population)	119.0	51.3	148.8	38.9	115.2	58.4
HIV prevalence (adults 15–49 years)	0.5	0.2	0.5	0.3	0.3	0.3
All basic vaccination coverage (%)	82.2	6.0	81.8	8.0	64.4	21.6
Distance to health facilities (% perceived as problem)	35.0	14.5	42.6	11.8	56.3	12.0

ODs – operational district; SD – standard deviation

Note: HIV prevalence was averaged based on provincial-level data from 2005 DHS database. All basic vaccination coverage, distance to health facilities and education was averaged based on provincial-level data from 2010 DHS database. All basic vaccinations include BCG, measles and three doses each of tetravalent or pentavalent and polio vaccine.

decrease in RRs across the poverty level was observed in both males and females, although the RR of sputum-positive TB CNR was higher for females than males across all poverty categories.

The patient diagnostic rate (PDR) for the overall population was 0.5; the PDR for males was much lower than for females (0.37 versus 0.77) (**Figure 2**).

Spatial characterization

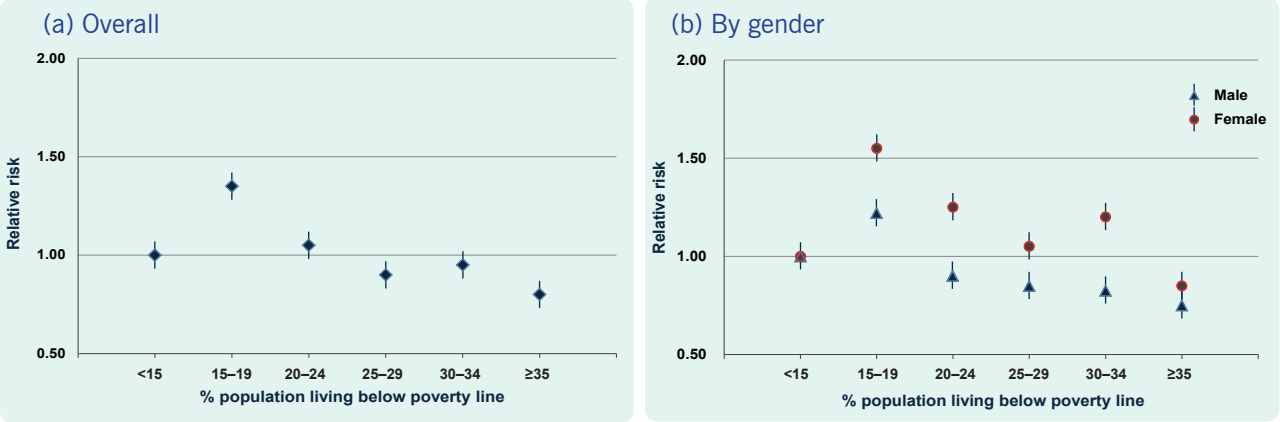
Although the highest household poverty rates are found in the northeastern part of Cambodia, the region accounts for some of the lowest sputum-positive TB CNRs (**Figure 3**). The same region also has the lowest vaccination coverage and the worst physical barrier of distance to health care facilities (**Figure 4**). The southern part of the country, which is less poor than the other regions, showed much higher sputum-positive TB CNRs. There were notable links between the map of OD population density (the top left of **Figure 4**) and the map of household poverty rate (**Figure 3**) where ODs with higher population density were often areas of lower poverty. Clusters of ODs with a high HIV prevalence were observed near the central region and along the coastal regions.

Table 3. **Effect of household poverty on tuberculosis case notification using a continuous model**

	Univariate RR (95%CI)	*P*-value	Adjusted RR (95%CI)	*P*-value
Overall	1.02 (1.00–1.03)	0.0045	0.95 (0.92–0.96)	< 0.0001
Male	1.00 (0.99–1.02)	0.4966	0.93 (0.91–0.96)	< 0.0001
Female	1.03 (1.01–1.04)	0.0006	0.96 (0.93–0.99)	0.0030

Note: All relative risks (RR) shown correspond to a 5% increase in the proportion of population living at or below the poverty level. Adjusted RR: adjusted for operational district (OD) population density, distance to health care facility, HIV prevalence and all basic vaccination coverage. All covariates were significantly associated with sputum-positive TB case notification rates (CNR) ($P < 0.0001$). Distance to health facility (% of women who perceived it as problem for accessing health care facility) and all basic vaccine coverage was positively associated with sputum-positive TB CNR, whereas OD population density and HIV prevalence was negatively associated with sputum-positive TB CNR.

Figure 1. **Relative risk for sputum-positive tuberculosis case notification in different household poverty levels, adjusted for operational district population density, distance to health care facility, vaccination coverage and HIV prevalence***



* The lines above and below each point denote 95% confidence intervals. Operational districts with < 15% population living at or below poverty line was the referent group.

DISCUSSION

Our findings suggest that there was an overall negative association between household poverty and sputum-positive TB CNR in Cambodia in 2010 after adjustment for covariates like population density, distance to health care facilities, all basic vaccination coverage and HIV prevalence. The negative association was more apparent in males than females. Without adjusting for these variables, household poverty was positively associated with sputum-positive TB CNR. Given the widely documented positive associations between poverty and TB disease burden,[13,14] we have several possible explanations for the differing findings in our study.

TB case notification (i.e. number of cases notified per 100 000 population per year) is dependent on the actual prevalence and incidence of the disease, as well as the level of case detection (i.e. proportion of incident cases put on treatment by the national programme). Although the poverty rate may be positively associated with TB prevalence and incidence rates, it may not be positively associated with CNR if CDR is low. CDR (and hence CNR) could be low due to poor geographical access to TB care, high costs associated with seeking care and poor awareness about TB disease and TB services.

In Cambodia and in most countries of the world, TB prevalence among males is significantly higher than among females.[15] The latest prevalence survey in Cambodia indicated that the male-to-female ratio of smear-positive cases was 1.82.[12] However, PDRs calculated using data from the same survey indicated that females were more likely to have been diagnosed, treated and reported than males by the programme. This matches with the findings of our study results, which illustrates that the reduction in sputum-positive TB CNR among females was not as significant as among males as poverty increases (RR of 0.96 versus 0.93 per 5% increase in poverty

Figure 2. **Prevalence of smear-positive tuberculosis,[12] annual case notification rate and calculated patient diagnostic rate in Cambodia, 2011**

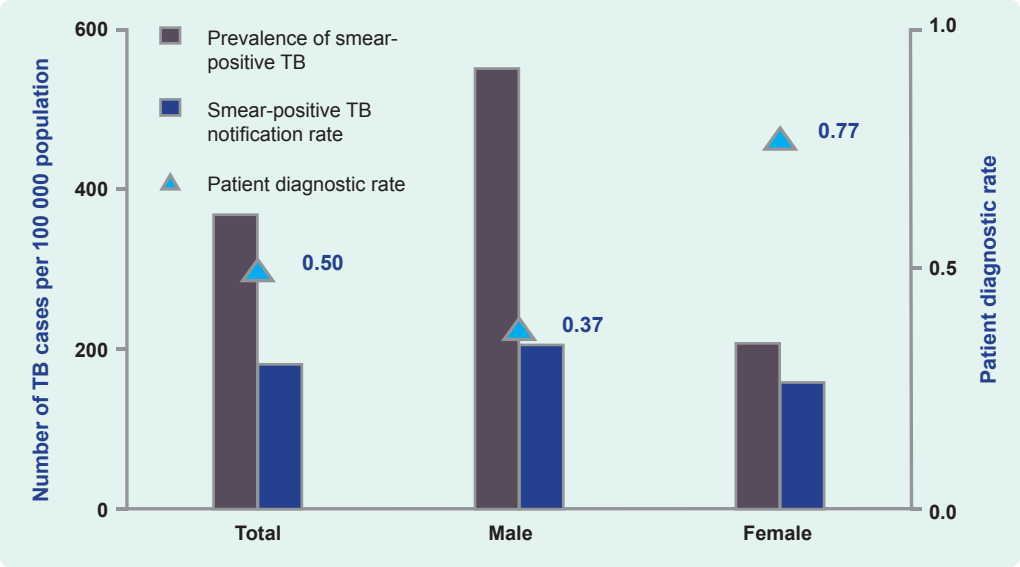
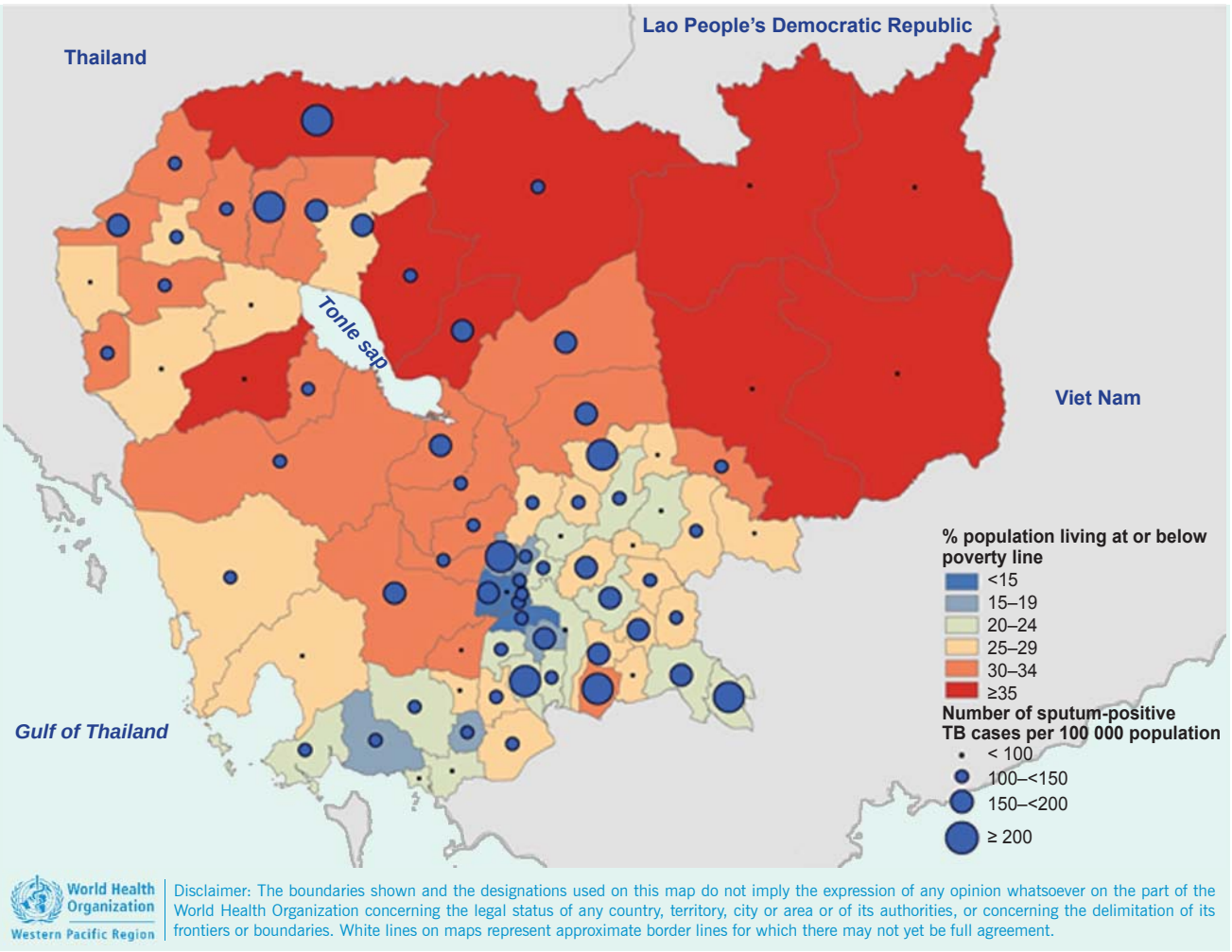
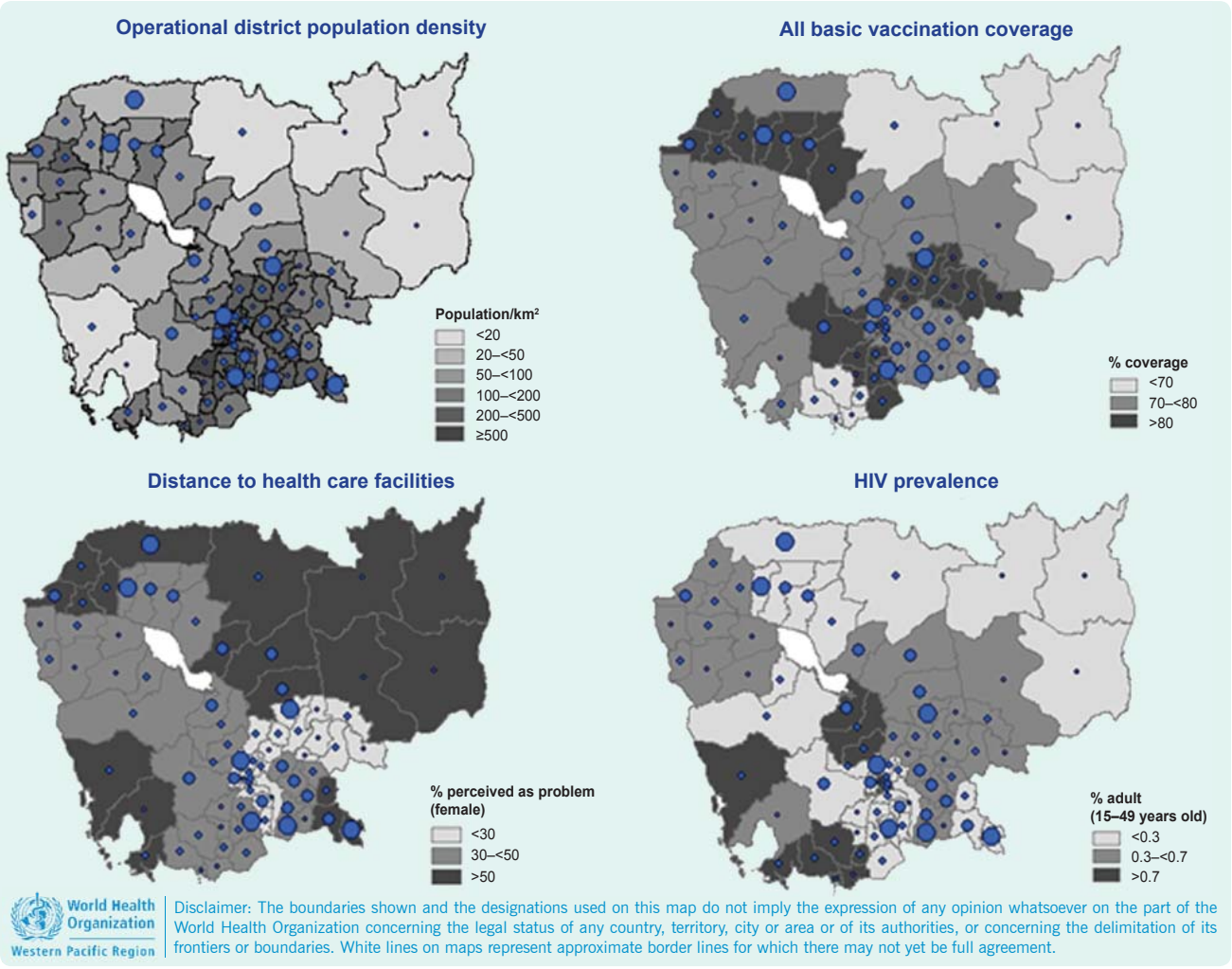


Figure 3. **Map of smear-positive tuberculosis case notification rates with operational districts household poverty levels, Cambodia, 2010**



Source: Data from the National Committee for SubNational Democratic Development, World Food Programme, National Institute of Statisitics and National Centre for Tuberculosis and Leprosy Council, Cambodia

Figure 4. **Map of tuberculosis risk factor distribution with sputum-positive tuberculosis case notification rates in Cambodia, 2010**



Note: Size of point corresponds to case notification rates, see **Figure 2** map legend.

rate). Given that the negative association is stronger in males than in females, a greater proportion of males with active TB disease may remain undetected, especially in higher poverty regions. This could be driven by the difference in health-seeking behaviours between males and females since females tend to visit government health care facilities more often as a result of their closer association with these facilities during pregnancy and childbirth. Males may be seeking care in private clinics or may be more negligent of their symptoms and diseases compared to females.

A GIS provided an effective platform for the convergence of disease-specific information in this study. It allowed for visual assessment of the distribution of TB risk factors and TB CNRs, revealing trends and interrelationships that would be more difficult to discover in tabular format. In the long-term, GIS data should be used by policy-makers to easily visualize problems in relation to existing health services and socio-demographic features so that resources can be geo-targeted to achieve maximal health outcomes.

A major limitation of this study is the reliance on ecological-population-level data that are subject to ecological fallacy and Modifiable Areal Unit Problem. Exposure levels represent averages for each population group in this study; thus, findings between average exposure and TB case notification in this study do not imply that such a relationship would be present at the individual level. The association found in one aggregation level may change if the underlying data are aggregated differently. Using ODs as the unit of analysis may not give accurate results as these districts are too large and TB and poverty rates are heterogeneously distributed within ODs. In addition, it is difficult to control for potential confounders and to establish a correct temporal sequence between the exposure and outcome. The finding from

this study may serve as preliminary investigation to stimulate additional research.

Given the widely studied links between age and TB risk, the inability to adjust for age distribution was also a limitation of our model. Age-specific CNRs were not available in an aggregated electronic database and were therefore excluded as outcome variables in our analysis. In addition, we could not adjust for OD age distribution because ODs are only used by the health ministry, while census data are collected at the provincial level. The validity of measurements is the other major limitation in this study. Household poverty rates were calculated based on standardized survey instruments administered by different village chiefs and commune clerks. It is not known whether the instruments were validated or if the survey responses were confirmed by a second representative. OD household poverty rates were calculated by averaging all the administrative district poverty rates, some of which had a wide variance. Furthermore, all covariate measures (except population density) were obtained from the DHS survey, which was only representative at the provincial level, not the OD level. ODs in the same province were assumed to have the same HIV prevalence, vaccination coverage and access problem, which may not accurately reflect the level of variance among all ODs. Distance to health care facilities was a measure of perceived barrier among women; it was not an actual measure of distance and may not reflect the experience of men. HIV prevalence data were extracted from the 2005 DHS survey, but other risk factors were extracted from the 2010 DHS survey. This is because HIV prevalence testing was not conducted in the 2010 DHS survey. While HIV prevalence in Cambodia is relatively low, we did observe a slight decrease in national HIV prevalence from 2005 to 2010. However, the extent to which this may have affected our results is unknown.

Although historically TB has been associated with poverty, few analytical studies from developing countries have tried to quantify the relative impact of poverty on TB case notification rates, explore the causal mechanism underlying this association and help programmes to geo-target areas with high poverty rates. This study is an example of using routinely collected data for research purposes. Despite the limitations inherent in these data sources, the findings are still valuable as they enhance our knowledge of disease control at a district level. Further studies are still needed to identify possible explanations for the observed association in Cambodia. These studies should strive to conduct more disaggregated analysis using smaller geographical units, provided better data on poverty rate and CNR are available. The results of such targeted studies will better reflect the true determinants of TB burden and guide the National TB Programme to implement more effective TB control interventions.

Conflicts of interest

None declared.

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Engaging women volunteers of high socioeconomic status in supporting socioeconomically disadvantaged tuberculosis patients in Chiang Rai, Thailand

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Problem: The 2008 tuberculosis (TB) surveillance of Chiang Rai Hospital, Chiang Rai, Thailand reported that 8.4% of Thai, 22.7% of hill tribe minority and 25% of migrant patients (n = 736) defaulted from treatment.

Context: TB patient management in Chiang Rai is complicated due to poverty and HIV stigma. A previous study shows unaffordable travel expense was one of the reasons of patient default.

Action: We engaged Chiang Rai women's organizations whose members are of high socioeconomic status to support poor TB patients financially and socially. A group of women formed a team to support these TB patients (n = 192) by raising and sustaining funds and providing home visits (n = 37). TB surveillance and patient-fund register data were used to evaluate TB treatment outcomes.

Outcome: The success of TB treatment was significantly higher for patients receiving financial support (relative risk [RR]: 1.351; 95% confidence interval [CI] 1.20–1.53; $P < 0.000$). Lower death rates in all groups were observed among patients receiving financial support. However, financial assistance alone did not improve treatment outcomes for migrant patients. Thirty-seven patients (25 Thai, eight hill tribe, four migrants) who were visited by women volunteers at home achieved 95% TB treatment success.

Discussion: It is possible to involve volunteers to support poor TB patients. Willingness to support TB patients was driven by presenting provincial TB epidemiology information, research data on the experience of poor patients and the inspiring experiences of other women volunteers. Future research should investigate the reasons for the high treatment success among patients who received home visits.

PROBLEM

Regardless of a country's economy or tuberculosis (TB) prevalence, TB is a disease associated with poverty,[1] and Thailand is no exception. Although the World Bank has ranked Thailand as an upper-middle-income country, the income gap between the rich and the poor is one of the most unequal in Asia.[2] The World Health Organization (WHO) classified Thailand as a country with high prevalences of TB, HIV and TB with HIV co-infection (TB/HIV).[3] Since 1998, WHO has listed Thailand as one of the 22 high TB-burden countries. Chiang Rai, Thailand's northernmost province, has a high density of hill tribe minorities and migrants from Myanmar. Of the 1.2 million people in Chiang Rai, about 18 460 people are living with HIV; the TB notification rate in 2011 was 153 per 100 000 (23% TB with HIV co-infection). The Chiang Rai provincial TB surveillance data indicates that, on average, one patient dies of TB every 36 hours in the province.

Chiang Rai Hospital (CRH), the largest provincial government hospital, provides free TB diagnosis and treatment for patients who declare that health-care costs are unaffordable. Patients are requested to visit the hospital biweekly or monthly, depending on their

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clinical conditions. Although treatment is free, TB patient management in CRH is complicated due to poverty, HIV stigma, language and cultural differences, as well as the legal status of some patients. The 2007 TB surveillance of CRH (n = 736) reported that 8.4% of Thai, 22.7% of hill tribe minority, and 25% of migrant patients, defaulted from treatment. Our previous study[4] reported that a majority of TB patients had to borrow money during their TB treatment course (six to nine months). Unaffordable travel expense was referred to as a main cause of treatment interruption, especially for hill tribe and migrant patients. Due to language barriers, these cases had to be accompanied to the hospital, which doubled the travel expense. During the investigation into reasons for default from TB treatment, we learnt about the difficulties experienced by poor patients. Older children who lost their parents had to quit school and go to work; younger children were raised by elderly grandparents.[5]

CONTEXT

In 2008 we established the "Center for Sharing," a TB patient-fund at CRH providing travel and food support for those who needed it. The initial 100 000 Thai baht (approximately US$ 3300) was granted from the Stop TB partnership.[6] Our greatest challenge was devising a way to sustain the patient-fund after the initial grant was exhausted.

ACTION

To ensure continuity of the patient-fund, we explored the feasibility of fund-raising in a sustainable manner by involving Chiang Rai women's organizations whose members are of high socioeconomic status. We obtained a list of women's organizations in Chiang Rai through an internet search, contacted the provincial social development and human security office and discussed our plans with the chair of a menopause clinic club. Subsequently, we organized the first workshop by inviting 33 women from nine women's organizations in Chiang Rai. The five-hour workshop included the following sessions:

- Pre- and post-workshop tests about TB;
- Information about TB disease;
- Chiang Rai TB epidemiology;
- Experiences of poor TB patients;
- TB control case studies on the role of women volunteers in India, Bangladesh, Indonesia and Japan; and
- Group discussion on "Can women's organizations in Chiang Rai contribute to TB care?"

The first workshop revealed most women were highly aware of the serious HIV situation in Chiang Rai, but they thought of TB as a disease of the past. Although the experiences of women volunteers from low-income countries were presented, the participants reported relating best to the Japanese volunteers' experiences. The slogan "Eradicate TB with women's hands and hearts" inspired the group, and they believed they could develop a similar project in Chiang Rai.

Two follow-up workshops to discuss and plan actions were organized. By the end of the third workshop a group was formed called "Women Volunteers to Eradicate TB." The group selected a chair, vice-chair, treasurer and secretariat and invited the TB and HIV doctors from CRH to be advisers. The volunteers performed two major activities to support TB patients: fund-raising for the TB patient-fund and home visits.

Fund-raising for TB patient-fund

The volunteers raised funds to support TB patients by organizing a charity gala dinner, selling products at provincial festivals and conferences and collecting donations from individual volunteers and women's organizations. The TB patient-fund staff identified patients who needed financial assistance for transportation and living expenses by interviewing TB patients with a simple poverty screening questionnaire.[7] The questionnaire included the following: (1) Do you have health insurance? (2) Do you have less than US$ 3 for the whole family or did you experience a food shortage during the last month? (3) Are you able to pay for travel to the TB clinic? (4) Do you have family members, friends or relatives to help when encountering a financial crisis? The support ranged from 100 to 4000 Thai baht per visit depending on the patient's circumstances.

Home visit

In addition to receiving financial support from the TB patient-fund, some patients received home visits from the volunteers. The criteria for a home visit included: extremely poor TB patients, living alone, living with

Table 1. **Treatment outcome of tuberculosis patients receiving financial support from the patient-fund, classified by ethnicity (June 2009 to March 2011)**

Patients' ethnicity	Receiving financial support		Tuberculosis treatment outcome (%)*				RR (95% CI)	*p*-value
	(Yes/No)	*n*	Success rate	Death	Treatment failure	Default		
Thai	Yes	104	72.1	23.1	0	4.8	1.42 (1.24–1.67)	$P < 0.0$
	No	443	50.1	37.4	2.3	10.2	Reference	
Hill tribe minorities	Yes	75	72.0	10.7	2.7	14.7	1.12 (0.94–1.47)	$P = 0.1$
	No	85	61.2	16.5	4.7	17.7	Reference	
Migrants	Yes	13	30.8	7.7	0	61.5	0.75 (0.31–1.84)	$P = 0.5$
	No	39	41.0	36.0	0	23.1	Reference	
Totals	Yes	192	69.3	17.2	1.0	12.5	1.35 (1.20–1.53)	$P < 0.0$
	No	567	51.6	34.2	2.5	12.2	Reference	

RR – relative risk; CI – confidence interval

* Success rate – cured and completed treatment; Default – lost to follow-up > 2 months

Note: Data from Chiang Rai Hospital's TB register and TB patient-fund register.

elderly caregivers or being isolated from the community and patient consent to home visit. In each visit, four to six volunteers visited the patient at home. The volunteers usually brought milk, eggs, clothes and cash to support the patient. The volunteers gave encouragement to patients to overcome their disease and difficulties. Each home visit lasted about 30 minutes.

Evaluation

After implementing these activities for more than 15 months, we analysed the TB register and patient-fund records and evaluated TB treatment outcomes of patients receiving and not receiving financial support. A group discussion with the members (10 women) who most frequently joined the activities was organized to explore the volunteers' motivations and challenges.

OUTCOME

TB treatment outcome of patients receiving only financial support

Of the total 759 TB patients, 72.1%, 21% and 6.9% were Thai, hill tribe, and migrant patients, respectively (**Table 1**). Nineteen per cent of Thai, 47% of hill tribe and 25% of migrant TB patients received financial support from the TB patient-fund. The overall treatment success rate of patients who received financial support was significantly higher than patients who did not receive financial support (relative risk [RR]:1.35; 95% confidence interval [CI]: 1.20–1.53; $P < 0.000$). Lower death rates in all groups were also observed among patients receiving financial support. However, financial assistance alone neither increased treatment success nor reduced default for migrant patients. The proportion of hill tribe patients who received support had higher treatment success and lower default rates compared to patients who did not receive support, but this was not significantly different. In addition to supporting the patients, the patient-fund also supported the travel for 26 children with close contact to TB patients, access to TB screening and TB preventive therapy.

TB treatment outcome of patients receiving financial support and home visit

Between June 2009 and March 2011, 37 patients (five children, 17 women and 15 men) were visited by the volunteers at home. They were 25 Thai, eight hill tribe and four migrant patients. Sixteen patients (43%) had TB with HIV co-infection. Remarkably, although these patients were considered to be either very poor or having complicated psychosocial issues, the treatment success rate of these 37 patients was 95%; two cases died (both were Thai, HIV-positive) and none defaulted. This project was not able to determine the reasons for the high treatment success of these patients. Some patients, especially the patients living alone or patients who were isolated from family and community reported feeling honoured and grateful to have the volunteers visit. One senior male patient living alone said, "It's just like a

dream, I have never thought this will happen to my life. Several people came to visit me…Thank you…Thank you so much."

Characteristics of the women volunteers, their motivations and challenges

Since June 2009, the women's organizations that have consistently supported TB patients in Chiang Rai have been the Red Cross Chapter, the Model-Mother group, the Women's Cultural Promotion Association, the Women Volunteer for Civil Defence Association and the Senior Smart-brain volunteers. The Business and Professional Women's Association has participated with annual donations to the patient-fund. About 36 women regularly participated in the volunteer activities. More than half of the volunteers were aged over 60 years (range: 37–79 years old) and had university educations. They were retired senior government officers, health staff members, business owners or wives of high-level officials such as the governor and the hospital director. Most volunteers originated and lived in Chiang Rai. The majority of these women were members of two to five women's or volunteer organizations. Many of them knew each other and had volunteered together for many years. Some women had experience visiting disaster victims or disabled people. However, visits to TB patients' homes were new to all of them.

The volunteers found home visits challenging due to bad road conditions, especially in the rainy season. Several senior women said their family asked them not to visit patients' houses for fear of TB transmission. However, the volunteers felt home visits substantially encouraged patients and family members. Volunteers felt that their home visits may have also helped reduce TB and HIV stigma because community people observed the women visit the patients at home and interact as friends.

Group discussion with the volunteers showed that the major reasons for volunteering and supporting poor TB patients were Buddhism and the traditional Thai value that doing charity is a virtue. They plan to serve as volunteers as long as their physical health allows.

DISCUSSION

To our knowledge, this is the first report from a TB high-burden country in which women with high socioeconomic status have been involved in TB care for fund-raising and home visits. Although studies from Bangladesh, Indonesia,[8] India[9] and Iraq[10] reported the important role of women volunteers as treatment supporters for TB, those volunteers were women living in the same community or having comparable socioeconomic status with TB patients. Several studies reported the role of financial support and social interventions in improving the TB situation for poor patients.[11–14] However, published literature describing the process of implementation is lacking.

This paper fills in the current knowledge gap by describing the process of engaging women volunteers with high socioeconomic status to financially and socially support poor TB patients. Willingness by these women to support the patients was driven by presenting the TB situation, providing research data on the experiences of poor patients and the experiences of women volunteers from other countries. The motivation to follow the Japanese women volunteers may be influenced by "Japanization." It has been suggested that since 1987, Thai people seem to respect and appreciate Japan as Asia's leading country for social, economic and technological advancement.[15] Mobilizing and engaging women organizations to support poor TB patients may be applicable in other settings where medical and health staff of TB services wish to support poor patients. The patients visited by women volunteers achieved very high treatment success rates despite being very poor and experiencing psychosocial difficulties. Future research should apply qualitative research to investigate the reasons for the high treatment success among patients who received home visits. A rigorous qualitative study should elicit how patients and women volunteers perceived the support.

In this paper, we report treatment outcomes from programme implementation, not from a research procedure. The stage of HIV infection, access to antiretroviral drugs and other clinical conditions may affect treatment outcome but were not available for the

analysis. Based on the limited data and methodology, we cannot conclude the effectiveness of the financial support and home visits. However, the overall treatment success of the patients receiving support was significantly higher than that of patients not-receiving support. The analysis by ethnicity showed high default rates in hill tribe and migrant patients; financial assistance alone may not be sufficient to assist these groups complete the long-term TB treatment.

Conflicts of interest

None declared.

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Bacille-Calmette-Guérin vaccine-associated suppurative lymphadenitis in Hong Kong (China), 2004 to 2012

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We note with interest the theme of "Tuberculosis (TB)" for this issue of the *Western Pacific Surveillance and Response Journal* and wish to share our experiences in investigating suppurative lymphadenitis as a result of the Bacille-Calmette-Guérin (BCG) vaccine in Hong Kong (China).

The TB notification rate in Hong Kong (China) has been decreasing in the past 50 years from a peak of 697 per 100 000 in 1952 to 72.5 per 100 000 in 2010. The number of TB notifications in Hong Kong (China) in 2010 was 5093.[1]

The BCG vaccine for the prevention of TB was developed almost 100 years ago and use of the vaccine commenced in Hong Kong (China) in 1952. The vaccine protects children against severe forms of TB such as TB meningitis and miliary TB.[2] In Hong Kong (China) we use freeze-dried BCG (Statens Serum Institut of Denmark, Copenhagen 1331 strain) by intradermal method. Originally, vaccination was offered to all newborn infants and again for primary schoolchildren; however, in September 2000, the BCG revaccination programme for primary schoolchildren was stopped.[1] Adverse effects of BCG vaccination have been reported in many countries of the world. Suppurative lymphadenitis is a known reaction with a background rate of one to 10 per 10 000 doses globally.[3] In 2010 in Hong Kong (China), more than 99% of newborn infants were given direct BCG vaccination at birth.[1]

To assess the trend of hospitalized BCG lymphadenopathy in recent years, we reviewed records of patients hospitalized between 1 January 2004 and 31 December 2012 with relevant ICD-9 code diagnoses of BCG-related adverse effects and lymphadenopathy from all public hospitals in Hong Kong (China). Public hospitals account for around 80% of secondary and tertiary care in Hong Kong (China).[4] We traced relevant demographics and clinical information of every patient through review of clinical records and interviews with patients' parents or caretakers.

We identified 109 patients with suppurative BCG lymphadenitis. Two patients hospitalized in 2004 received BCG in 2003. There were 79 boys (72%) and 30 girls with ages ranging from 14 days to 23 months old (median five months). The period between BCG vaccination and symptom onset (discovered by caretakers) ranged from 0.5 to 18.5 months (median 3.4 months). Most (94 [86%]) presented with left axillary lymphadenopathy, three supraclavicular, three infraclavicular, two clavicular, one cervical and six with left axillary and other regional lymphadenopathy. Half (56 [51%]) were managed by needle aspiration (initial management recommended by local paediatricians[5]), 21 by incision and drainage, 10 by excision and 22 by observation with follow-up.

The number of suppurative BCG lymphadenitis patients increased from three to 31 in the vaccination

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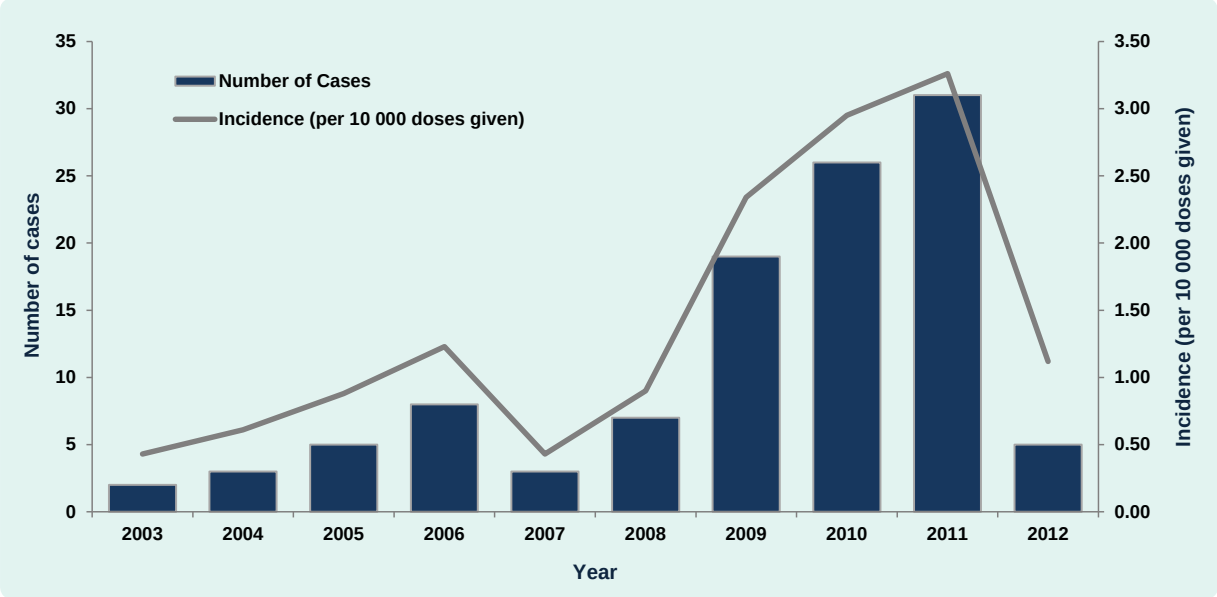
Figure 1. Incidence of suppurative BCG lymphadenitis hospitalizations by year of vaccination, 2003 to 2012*



* The number of cases and incidence for 2012 was lower than the preceding three years. This may be due to incomplete hospital data as we reviewed the data on 3 January 2013. On the other hand, the median latency period between BCG vaccination and symptom onset was around three months; those vaccinated in 2012 may be hospitalized in 2013.

years 2007 to 2011 (**Figure 1**). Although the incidence remains in line with the World Health Organization estimation (one to 10 per 10 000 doses), there was an increase in incidence of suppurative BCG lymphadenitis from 0.43 to 3.26 per 10 000 doses in vaccination years 2007 to 2011. BCG has been worthwhile for the decrease of TB notification rates in Hong Kong (China) since 1952. We recommend setting up special surveillance to monitor trends of suppurative BCG lymphadenitis in Hong Kong (China).

Conflicts of interest

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Typhoid fever: hurdles to adequate hand washing for disease prevention among the population of a peri-urban informal settlement in Fiji

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Problem/context: The Pacific island nation of Fiji Islands has high rates of endemic typhoid fever which is difficult to diagnose and often underreported. However, the majority of cases are preventable through use of safe water; adequate sanitation; vaccination; and, most sustainable of all, simple hygienic behaviour, such as hand washing with soap (HWWS). Despite many attempts by public health authorities, little progress has been made in the area of environmental adaptation and behaviour change.

Action: To explore perceptions of typhoid fever risk among urban squatters and behavioural determinants surrounding HWWS, indigenous Fijians living in informal settlements with high typhoid fever incidence were invited to participate in focus group discussions. In-depth interviews were conducted with community leaders.

Outcome: Perceptions of typhoid fever suggest confusion about risk factors, symptoms and communicability. Environmental barriers for hand washing were related to water and soap access. Standard social marketing approaches have been trialled with little clear evidence of impact. Despite this, we continue to advocate for the social and cultural determinants of typhoid prevention to remain central to future public health strategies.

Discussion: Despite behaviour change being notoriously difficult, we argue that community-driven behaviour adaptation initiatives based on sound epidemiological evidence and health communication theory are likely to have significant impact and greater likelihood of sustainability.

Typhoid is endemic in Fiji as indicated by the 1847 laboratory-confirmed cases reported between January 2008 and July 2012.[1] To put this figure in context, the population of Fiji is approximately 840 000. The rate of typhoid fever has increased in recent years, likely due to a combination of surveillance improvements and rapid urbanization. In the past decade the poverty rate also rose from 25% to 50% of the population. As the poverty rate has increased, many Fijians have moved from rural areas to informal squatter settlements in urban centres where the majority have little access to clean water and sewerage infrastructure.[2]

Age and gender remain important to the epidemiology of typhoid in Fiji; the mean age of typhoid fever patients was 27 years, and 57% of cases were male (1043/1847). For both males and females, the age group with the heaviest burden of disease was 20–29 year olds.[3] A combination of untreated waste; a proliferation of bore hole wells for washing and consumption; frequent flooding; and inadequate water, sanitation and hygiene infrastructure in the informal squatter settlements are associated with increased risk of typhoid fever.[2] The majority of typhoid fever cases (93%) that presented to hospitals in 2008 were ethnic Fijians, and more than half of those cases were males in the 20–30 and 30–39 age ranges.[4]

CONTEXT

Previous research suggests that typhoid prevention and control require a multifaceted approach incorporating sanitation, low-cost hand hygiene and hand washing with soap interventions alongside vaccination programmes.[5,6]

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Evidence from international studies indicates that between 30% and 45% of gastro-intestinal illnesses and a further 30% of acute respiratory illnesses can be simply prevented by adequate hand washing with soap at key moments: before handling food and after defecation.[7–9] Understanding the motivating factors for routine hand washing is essential to any initiative likely to result in sustained population behaviour change.[6,10] We conducted a qualitative study among residents of a urban settlement in Suva, Fiji, to (1) explore how people living in an informal settlement perceived the relevance and impact of hand washing to prevent typhoid, and (2) explore how the risk of typhoid is prioritized alongside other competing health and social challenges.

ACTION

A qualitative study design, using in-depth interviews and focus groups, was used to develop a detailed understanding of factors that influence habitual hand washing as a preventive measure against typhoid.[11]

The focus group discussion data was collected from a semi-urban settlement of around 400 people located near the capital city of Suva. The informal (i.e. urban slum or squatter) settlement is situated on the edge of the densely populated Suva-Nausori corridor. The settlement was established in the 1960s and received piped municipal water several hours per day to a few households and to a stand pipe following a typhoid fever outbreak in the early 2000s.

There were four focus groups (two male groups and two female groups) each with up to seven participants. The groups were divided by age roughly based on groups identified by a 2010 typhoid fever study from the Northern Division in Fiji.[4] The age groups were young males/females (aged 18–29) and older males/females (aged 30 and above). A sample of 27 participants was recruited for this study; the majority were indigenous Fijians and included a Methodist pastor from the settlement, a community prayer leader/community organizer, two local health centre nurses and a local behaviour change expert from a Suva-based nongovernmental organization. There were a total of five "thought-leaders" (e.g. church or women's group leaders) interview participants.

Focus group discussions and in-depth interviews were carried out in and around the informal settlement during March of 2011. Discussions involving residents of a peri-urban informal settlement were conducted in Fijian by local undergraduate Fiji National University public health students who also transcribed and translated the discussion into English. The focus group discussions were imported into NVivo Version 9 to assist with data management for thematic analysis.[12]

OUTCOME

The following key findings from the group discussions and interviews were developed out of a thematic analysis of the interview data. Substantiating quotes from the members of the group with minimal identifier information gender (male [M], female [F]) and group number based on age (18–29 years old [1], 30 years old and above [2]) are provided.

Confusion and ambivalence

For the majority of participants, perceptions about typhoid risk factors were obtained from a recent mass media prevention campaign. Typhoid prevention posters were used as decoration on the wall of the house where the interviews took place. Pamphlets, radio and television advertisements also promoted the risk of typhoid; however, attention on the disease rather than the common risk factors, such as poor hand washing efficacy, confused the focus for some participants.

> "…when I came home from work there was a pamphlet explaining typhoid, describing how it is spread and ways of preventing it; I also saw information on the TV. I am confused between typhoid and filariasis due to the information on posters in the hospitals and the pamphlets." (1F)

Contradictions or misinterpretation of public health messages was evident. Despite many participants being able to recite public health messages, experiential knowledge and behaviours were not consistent.

> "The important message received from ads is washing hands after using the toilet and before meals. It is important for people to wash their hands to stop the spread not only of typhoid but also some other diseases. Sometimes I don't wash my hands because

I do not believe that I would get the disease, but other times I do wash my hands." (2F)

"...seeing the poster has brought about fear that typhoid is here and it is real; that fear encourages me to practise proper hygiene. Sometimes I don't wash my hands because I do not believe that I would get the diseases." (2M)

By far, the most significant driver to behaviour change was first-hand experience with disease in the local community.

"The community got really sick and they got scared and that was the factor when everyone started to pay attention. If there is a case around then we get really serious and start to worry." (1F)

"...don't want my family to go through what I did, so I encourage them, especially the children, to wash their hands." (2F)

Brand name soap – the ideal soap?

Female participants expressed preference for the widely promoted soap, Protex®. There was a pervasive belief that soaps were ranked in quality, and those that are promoted widely (on billboards) are most desired, even if not used. Indeed, the pervasive commercial advertising for more expensive soap brands was well recognized among female participants. The marketing and resulting perceptions among the participants contradicts the official hand washing media which advocate the use of more affordable laundry soap. Successful marketing of expensive commercial soap brands has led to the incorrect perception that expensive antibacterial soaps are required to prevent disease.

"Sometimes people think it's a waste to use on the hands...it is not the only soap that kills germs... not everyone can afford Protex® soap. People think that hand washing with Protex® is the only way to prevent typhoid fever." (1F)

Emotional drivers to hand washing included disgust, protection and nurturance. Other affective motivators such as worry and fear about unwanted attention from landlords and health authorities (after a typhoid case was notified) were also evident.

"...She doesn't want her family to go through what she did, and therefore she encourages hand washing in her family, but sometimes she forgets... (2F)

"Remove visible dirt when it is not greasy and dirty. Just don't touch anything dirty. Wash with a good soap. Some soap you wash your hands with may not make your hands clean." (1M)

Community driven programmes – a key determinant of behaviour change?

Hand washing interventions were notably more salient when conducted by members of the local community. Ad hoc initiatives, presented by outsiders were undermined and largely were disregarded.

"...we talked about it once, but when the health workers leave things will go back to normal." (1F)

"...Information directly from community members would make a difference, and people would actually act on the advice given because they have seen first-hand information about typhoid and not just heard or seen it on radio and television. Information given by those who have actually had typhoid is important. The ads on TV are good, but they're not as effective as community members going from house to house to inform people." (1M)

Bathing and laundry were the primary means of hand washing (by proxy) rather than deliberate hand washing with soap at the key junctures, such as when preparing food or eating meals. Laundry and bathing the body are so intrinsic to basic hygiene and are closely motivated by the need to nurture and or feel clean. Oral hygiene was also widely reported as habitual.

"Washing dishes and showering is one way we wash hands. Doing the laundry and washing the dishes are opportunities to wash hands." (2F)

> "...back at home at 6pm to have shower, wash properly then have dinner and off to bed...Wake up, brush teeth and wash face, sometimes bathe..." (2M)

Water – a pervasive environmental challenge

Some households in the settlement still rely on well water; however, access to piped water has improved for many in the settlement since 2007. A fundamental and pervasive appreciation of the value of water was notable among participants. Clean water was a scarce commodity (particularly water that had not been pre-used or stagnant).

Poor access to water (due mainly to service cuts and shortages with piped water infrastructure) and soap combined with a belief that hand washing required large amounts of water undermined any behavioural intention. Indeed, laundry and bathing were considered higher priorities than hand washing.

> "...can't waste so much water just for washing hands, since there is shortage of water; it's time consuming to use well water during water cuts. The hands are just a small part of the body." (1F)

> "...People use basins to wash dishes, but they might use the same water to wash hands because they don't want to waste water." (2F)

DISCUSSION

Our findings reveal several key areas for potential improvement. First, confusion persists over transmission of and effective protection from typhoid fever within this settlement. Access to clean and reliable water remains a barrier; the reliance on stored water as backup for daily use is a disincentive for consistent hand washing with clean water. In addition, the mass marketing of antibacterial soaps has undermined the perceived efficacy of ordinary, low cost soaps for hand washing. Finally, social marketing efforts, such as posters and pamphlets are attractive and collectable, but appear to have minimal impact in providing a consistent and salient message that may, alongside other environmental changes, effect change.

Health communications addressing environmental adaptation behaviours (necessitated by contextual challenges) and that also provide feedback on the costs and benefits of hand washing behaviour might prove more effective than those that provide standard health education messages or hygiene techniques. Environmental barriers to hand washing, such as access to clean water and soap, were a significant but not exclusive deterrent to hand washing. These factors exist in the context of general ambivalence about the benefits of timely hand washing and perceptions of clean versus dirty hands. Common beliefs about bacterial transmission and risks to family health were somewhat erratic, based on prior experience and family routines and habits but not on formal knowledge or instruction. Health communications could also emphasize that relatively small amounts of water and soap can be effective if hand washing with soap is performed at minimum key junctures. Similarly, social barriers for hand washing with soap such as traditional gender and age (elder) related status influence behaviour and norm-setting in communities. Focusing on establishing behavioural norms that are responsive to the environment (that is, higher risk and lower resources) may produce longer-term intrinsic changes among that population.

CONCLUSION

Behaviour change is the single most challenging dimension of public health. Low efficacy health education efforts are testament to the public health challenges.[13–15] The added challenge for promoting hand washing is that the consequences are often delayed. Drawing upon the intrinsic values within a community such as looking good to others, protecting children and family, smelling good and not feeling dirty might have greater currency than objective instructional messages.[6,14,15] Either way, community-driven initiatives based on sound epidemiological evidence and health communication theory are likely to have significant impact and greater likelihood of sustainability beyond the life of the intervention.

Conflicts of interest

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Emergence of chikungunya in Moonlapamok and Khong Districts, Champassak Province, the Lao People's Democratic Republic, May to September 2012

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Introduction: Chikungunya is a vector-borne disease transmitted to humans by *Aedes* mosquitoes, which are widespread in the Lao People's Democratic Republic. However, chikungunya virus (CHIKV) had not been detected in the country before outbreaks reported in July 2012. The first outbreaks were detected through health care worker event-based surveillance.

Methods: The case definition for the outbreaks was defined as a person with acute onset of fever (≥ 38 °C) and severe arthralgia (joint pain) or arthritis from 1 May 2012 in Champassak Province. Rapid response teams conducted active case finding, performed an environmental assessment including an entomological survey and implemented control measures. Descriptive analysis was undertaken in Microsoft Excel.

Results: There were 197 cases (attack rate 3.4%) of suspected chikungunya reported from 10 villages in Moonlapamok and Khong Districts of Champassak Province. All age groups (age range: seven months–74 years) were affected with slightly more female (56%) than male cases. Thirty-one per cent (16 of 52) of serum samples tested positive for CHIKV by polymerase chain reaction. The environmental assessment found poor water storage practices and high entomological indices.

Discussion: These outbreaks show the effectiveness of health care worker event-based surveillance and the importance of sharing of information across borders for detecting emerging diseases. Public health education is an important measure to prevent epidemics of chikungunya. Information about chikungunya should be supplied to health care workers in the region so they are alert to the potential spread and are able to implement control measures for this disease.

Chikungunya is a vector-borne disease transmitted to humans by *Aedes* mosquitoes and is characterized by sudden onset of high fever and severe joint pains. Although rarely fatal, chronic conditions such as rheumatic symptoms and depression are common and debilitating.[1] Many parts of Asia are considered endemic for chikungunya. The Lao People's Democratic Republic is a land-locked country in South-East Asia that borders Cambodia, Thailand, Viet Nam, China and Myanmar. Although the *Aedes* mosquitoes vectors are widespread in the Lao People's Democratic Republic,[2] Chikungunya virus (CHIKV) had not been detected in the country before July 2012.

On 13 July 2012, surveillance staff from the National Centre for Laboratory and Epidemiology (NCLE) were conducting routine work in Champassak Province in the far south of the Lao People's Democratic Republic. They were informed by Moonlapamok District health care workers about patients with fever, rash, body pain and joint pain in Thakang village, a remote village 8 km from the Cambodian border. As there had been recent

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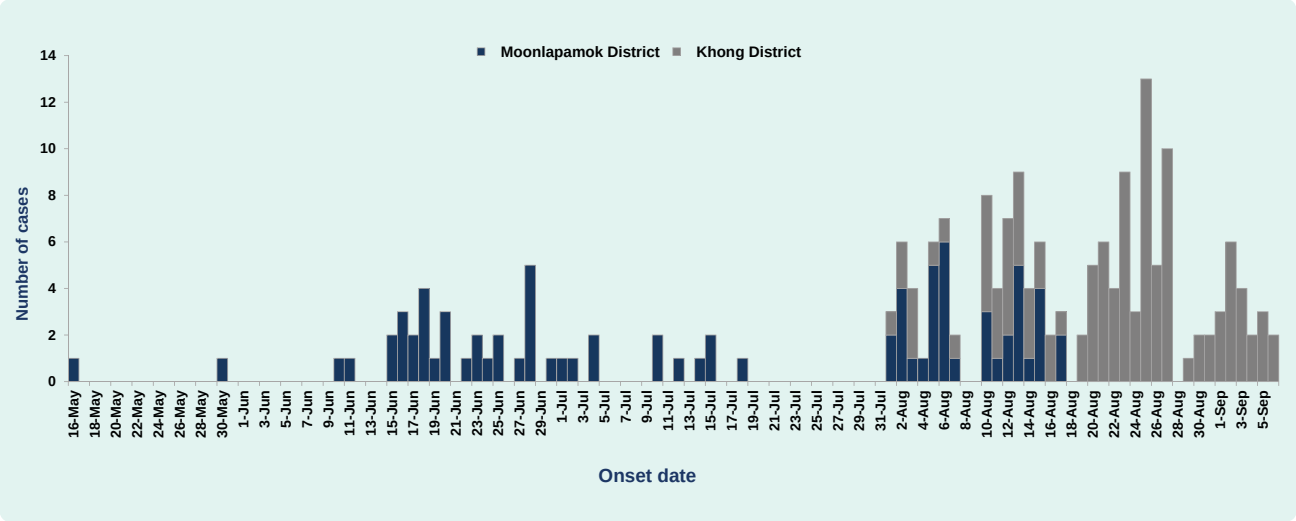
Figure 1. **Epidemic curve of chikungunya cases (*n* = 197) in Moonlapamok and Khong Districts, Champassak Province, May to September 2012**



outbreaks of chikungunya reported in Cambodia, one of the NCLE surveillance staff thought these cases could possibly be chikungunya.

In response, an outbreak investigation was conducted by district and provincial authorities. In the same month, two further outbreaks of suspected chikungunya were reported from two new villages in Moonlapamok District – Kaanleuag and Nadi. With the spread of this emerging disease, the NCLE deployed a central Rapid Response Team (RRT). Between July and September 2012 further villages in both Moonlapamok and Khong Districts reported outbreaks of suspected chikungunya. We describe the investigations and control measures established for these outbreaks and discuss recommendations for chikungunya control in the Lao People's Democratic Republic.

METHODS

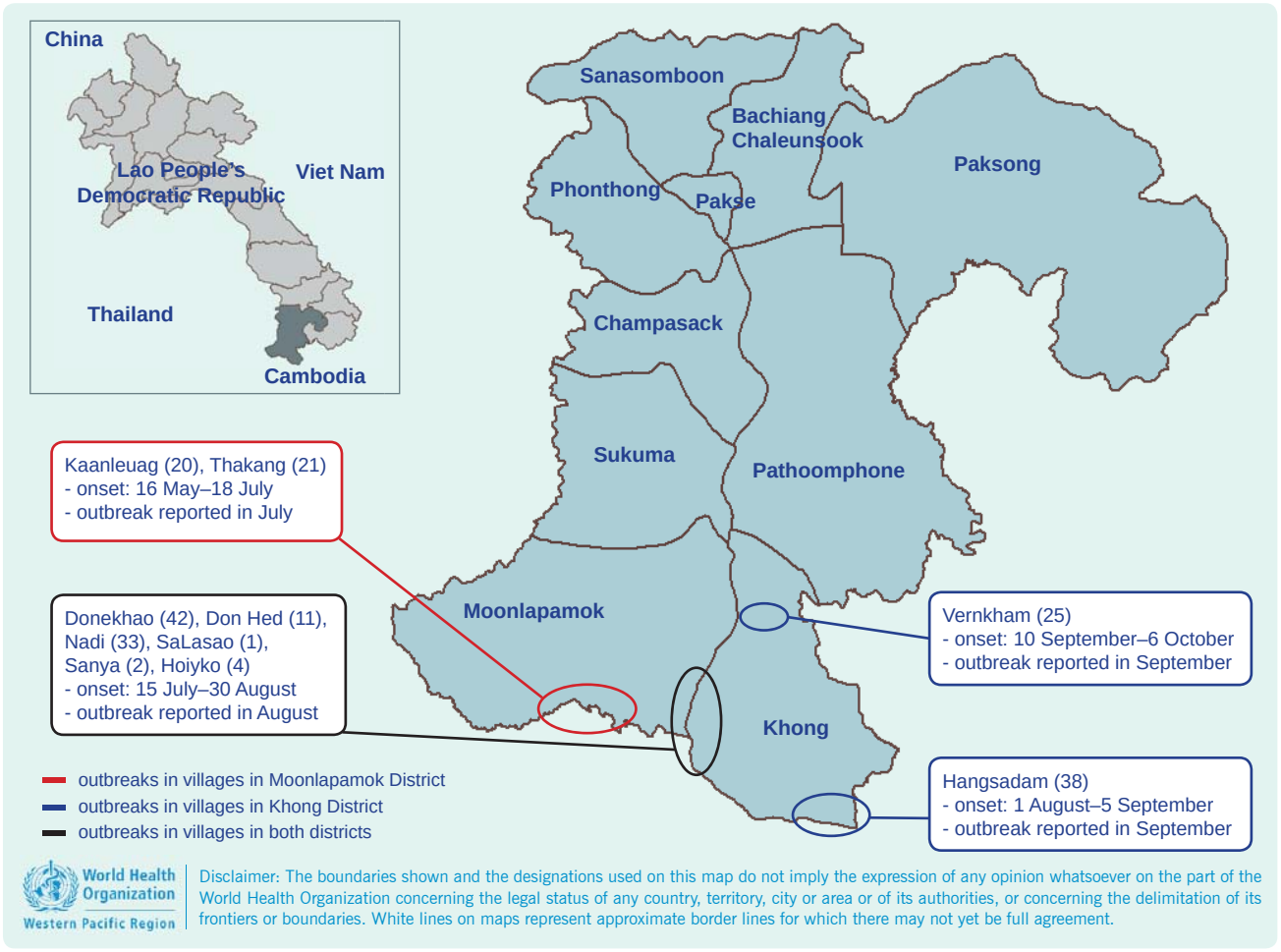
District and provincial RRTs were deployed for the first two reported outbreaks in Thakang and Kaanleuag villages, Moonlapamok District. A central RRT comprised of staff from the NCLE, field epidemiology trainees from the Department of Disease Control and the World Health Organization joined provincial and district response teams to investigate the outbreak in Nadi villages, Moonlapamok District, Champassak Province from 7 to 11 August 2012. Outbreaks in four further villages (Doneheid, Donekhao, Hangsadam, Vernkham) in Khong District were investigated by district and provincial RRTs from August to September 2012. The results of these investigations were sent to NCLE for analysis.

The teams conducted active case-finding by interviewing village leaders and village health volunteers in affected villages and doing a retrospective review of logbooks in the Champassak provincial hospital, affected district hospitals and affected village health centres. Active case finding was also conducted in five villages neighbouring Nadi village, Moonlapamok District by the central RRT.

The case definition for all outbreaks was defined as a person with acute onset of fever (> 38 °C) and severe arthralgia (joint pain) or arthritis since 1 May 2012 in Champassak Province. All cases meeting the case definition were recorded in a line list (name, age, location, onset date, symptom, sample collection). For cases meeting the case definition, with onset in the previous five days, serum were samples collected and tested for CHIKV by polymerase chain reaction (PCR) at NCLE. As there were positive samples for CHIKV, testing was not done for other pathogens, as per the testing strategy.

An environmental assessment including a larva survey was carried out by the central RRT in 35 households of Nadi village, Moonlapamok District. House Index (HI: percentage of houses positive for larvae), Container Index (CI: percentage of water-holding containers positive for larvae) and Bretaeu Index

Figure 2. **Distribution of chikungunya outbreaks in Moonlapamok and Khong Districts, Champassak Province, July to September 2012**



Note: Numbers in parenthesis refer to suspected cases.

(BI: number of positive containers per 100 houses) were calculated. Descriptive analysis was undertaken in Microsoft Excel.

RESULTS

Between 1 May and 6 September 2012, 197 cases of suspected chikungunya were reported from 10 villages in Moonlapamok and Khong Districts of Champassak Province with onset between 16 May and 6 September (**Figures 1 and 2**).

The overall attack rate was 3.4% (197/5807) but was higher in certain villages such as Donkhao (42/277, 15%) in Khong District and Kanleung (20/187, 11%) in Moonlapamok District (**Figures 2**). All age groups were affected, and ages ranged from seven months to 96 years old (median: 35 years; interquartile range: 50–16 = 34 years). More females (122/197, 62%) than males were affected but the attack rate was slightly higher in males (2.8%) than females (2.1%).

As per the case definition, all cases had fever and all had arthralgia. Other clinical signs and symptoms reported were petechia rash (82%) and body pain (73%). A total of 52 serums samples were tested and 16 (30.8%) were positive for CHIKV.

All cases were reported from health centres and villages and no cases were detected from district or provincial hospital logbook records. Some cases with similar symptoms were diagnosed as rheumatic fever and were followed up but not thought to be associated with the outbreaks.

The environmental survey found water from the Khong River was being stored in large jars outside the majority of homes; the jars were not changed regularly or covered. For the entomological survey of 35 households, the following indices were estimated: HI: 51%, CI: 24% and BI: 85.

The villagers were provided health education on community clean-up to prevent mosquito breeding sites such as rubbish and water containers. Villagers were also advised to avoid mosquito bites and sleep under mosquito nets, especially if symptomatic, to prevent onward transmission. Villagers were also advised to visit a health care worker if they became sick. Provincial and district health workers were provided training on CHIKV epidemiology and control measures and informed to report any outbreaks immediately.

The last reported case of suspected chikungunya was on 6 September 2012 in Vernkham village, Khong District.

DISCUSSION

Chikungunya is an emerging disease in South-East Asia. Sporadic cases of chikungunya have been reported in Cambodia, including in provinces bordering the Lao People's Democratic Republic, since 2011, and recent outbreaks affected rural communities in early 2012.[3,4] The Lao People's Democratic Republic is a landlocked country bordered by Thailand, Viet Nam, China, Myanmar and Cambodia. In Thailand, the first appearance of chikungunya was in 1960, and many outbreaks have been reported over the years since then.[5] China experienced its first outbreaks in 2010.[6] Other countries in the region such as India, Sri Lanka and Malaysia have also reported outbreaks.[7–9] Between July and September 2010, the Lao People's Democratic Republic conducted the first chikungunya sero-survey in Vientiane Capital with all nine district and six central hospitals. Two hundred serum samples were tested by enzyme-linked immunosorbent assay (ELISA) and PCR for Chikungunya. However, no samples were positive for CHIKV (unpublished data, NCLE). Both adults and children were affected by this outbreak meaning that adults were not immune and that the disease was new to this area. Therefore, we believe these outbreaks to be the first chikungunya diagnosis in the Lao People's Democratic Republic and therefore that chikungunya is emerging in the Lao People's Democratic Republic.

Between May to September 2012, 195 suspected chikungunya cases were reported to NCLE and investigated. This is a low number of cases compared to other countries in the region. There were some limitations to these outbreak investigations which could lead to underestimation or overestimation of the number of cases. First, cases with milder symptoms were not included in the outbreak case definition and so the number of cases presented here likely underestimates the size of the outbreak. Furthermore, cases may have gone undetected due to misdiagnoses as other febrile diseases with similar clinical presentations to chikungunya (e.g. dengue, malaria and measles). On the other hand, only a small number of the cases were laboratory-confirmed, so other infections may be responsible for some of the clinically suspected chikungunya cases. Of note, there were cases of malaria and dengue confirmed in the affected districts during the period of the outbreak (May to September), and dengue virus shares the same vector. These diseases cannot be excluded and were not tested for due to limited reagent availability.

This emerging disease must continue to be taken seriously, and prevention and control measures should be established or strengthened in affected areas. Public health education about chikungunya, such as etiology and incidence of the disease, disease prevention, vector mosquitoes and their control should be distributed to the public and supplied to health care workers so they are alert to the potential spread and emergence of this disease. As the vectors are the same as for dengue, this information could be supplied together for both diseases. Personal protection from biting mosquitoes is also a critical measure that could minimize the expansion of chikungunya in epidemic areas. Advice on the use of mosquito nets (including when sleeping during the daytime) and the use of mosquito repellents and mosquito coils should also be encouraged.

This first report of chikungunya in the Lao People's Democratic Republic was made by a surveillance officer who had learnt of outbreaks in Cambodia. All further outbreaks were also detected and reported via health care workers to the Lao People's Democratic Republic event-based

surveillance system. This provides good evidence of the effectiveness of health care worker event-based surveillance and cross-border information sharing in detecting new emerging diseases and responding to them appropriately.

Conflicts of interest

None declared.

Funding

None.

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Needs for disaster medicine: lessons from the field of the Great East Japan Earthquake

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Problem: The Great East Japan Earthquake, which occurred in Tohoku, Japan on 11 March 2011, was followed by a devastating tsunami and damage to nuclear power plants that resulted in radiation leakage.

Context: The medical care, equipment and communication needs of four Disaster Medical Assistance Teams (DMAT) during four missions are discussed. DMATs are medically trained mobile teams used in the acute phase of disasters.

Action: The DMATs conducted four missions in devastated areas from the day of the earthquake to day 10. The first and second missions were to triage, resuscitate and treat trauma victims in Tokyo and Miyagi, respectively. The third mission was to conduct emergency medicine and primary care in Iwate. The fourth was to assist with the evacuation and screening of inpatients with radiation exposure in Fukushima.

Outcome: Triage, resuscitation and trauma expertise and equipment were required in Missions 1 and 2. Emergency medicine in hospitals and primary care in first-aid stations and evacuation areas were required for Mission 3. In Mission 4, the DMAT assisted with evacuation by ambulances and buses and screened people for radiation exposure. Only land phones and transceivers were available for Missions 1 to 3 although they were ineffective for urgent purposes.

Discussion: These DMAT missions showed that there are new needs for DMATs in primary care, radiation screening and evacuation after the acute phase of a disaster. Alternative methods for communication infrastructure post-disaster need to be investigated with telecommunication experts.

The Great East Japan Earthquake occurred at 14:46 on 11 March 2011. The centre of the earthquake was offshore of Sanriku in Miyagi Prefecture in Tohoku, Japan (**Figure 1**). The magnitude was 9.0 with a maximum seismic intensity of 7.0 at a depth of 24 km. A tsunami followed 15 minutes after the earthquake. Reactors at nuclear power plants were badly damaged and resulted in radiation leaking into the surrounding Fukushima Prefecture. The magnitude and duration of shaking (more than three minutes) ranked this earthquake as one of the largest earthquakes since 1990.[1]

Casualties from the Great East Japan Earthquake were typical for earthquakes followed by tsunamis with large numbers of dead and missing people but a small number of injured (dead 15 879, missing 2700, injured 6130; injury-to-death ratio was 0.4).[2–4] In comparison, the 1995 Great Hanshin-Awaji Earthquake, one of the largest earthquakes in Japan without a tsunami, had 6434 deaths, three missing and 43 792 injured (injury-to-death ratio was 6.8).[5] The Great East Japan Earthquake resulted in less need for trauma surgery and resuscitation and a higher need for primary care.

This paper discusses the experience in the field of members of the Tokyo Medical and Dental University Hospital (TMDUH) Disaster Medical Assistance Teams (DMATs) and concentrates particularly on medical expertise, equipment needs and operational or tactical field communication needs.

CONTEXT

Action following any disaster requires response from a broad set of areas including public health, security, social structures, public works and engineering, education, energy supply, food and nutrition, shelter and clothing, water and sanitation, medical care, logistics

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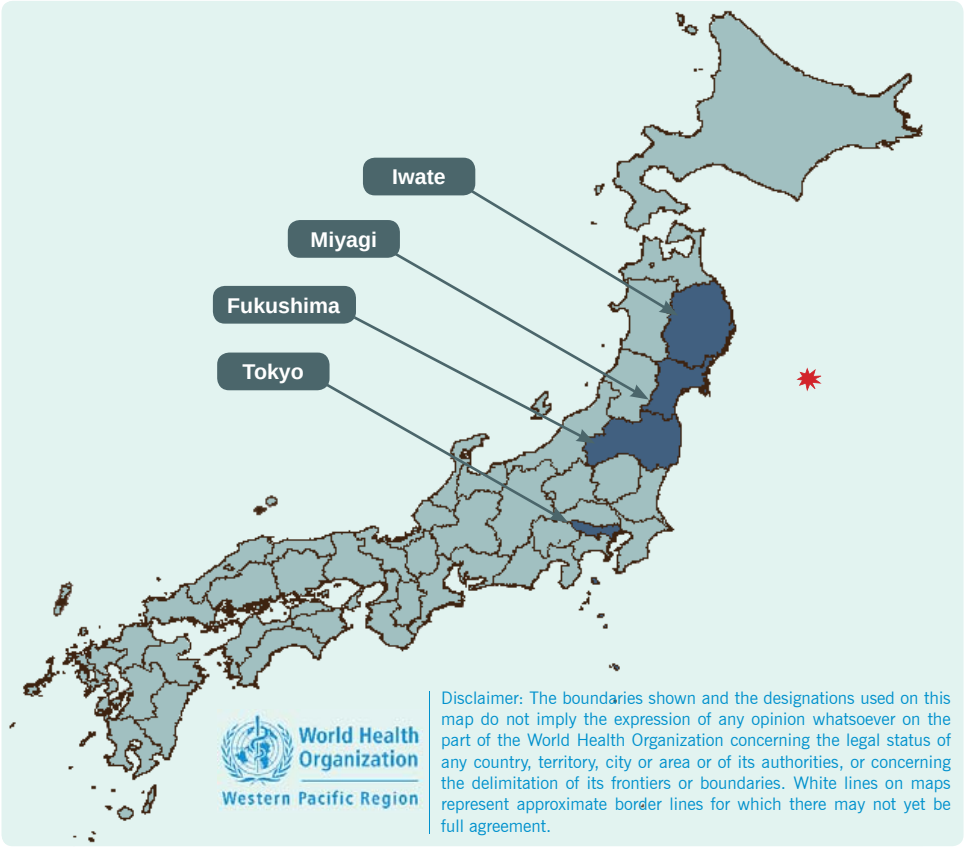
Figure 1. **Map of Tohoku, Japan and epicentre of the 11 March 2011 earthquake**



Epicentre – 38° 6′ 12″N 142° 51′ 12″ E (Japan Meteorological Agency)

and transportation and communication.[6] DMATs are medically trained mobile teams used in the acute phase of disasters. They were introduced into Japan in 2005 after recognizing a gap between the capacity of conventional emergency assistance and the need for emergency medicine in the days immediately following disasters. It has been estimated that the medical assistance teams may have prevented up to 500 deaths following the Great East Japan Earthquake.[7]

There were more than 700 DMATs in Japan in March 2010. Between day 1 and day 12 post-earthquake, 1816 members from about 340 DMATs gathered in the devastated area.[8] In this paper, the authors focus on the broadening of requirements for DMATs for medical care, logistics and transportation and communication.

ACTION

Four TMDUH DMATs conducted four missions. Mission 1 was conducted in Tokyo on the day of the earthquake. Missions 2, 3 and 4 were carried out in three different prefectures of Tohoku. Miyagi is the closest prefecture to the centre of the earthquake. Iwate and Fukushima lie north of Miyagi (**Figure 1**). Three TMDUH DMAT members were dispatched twice to different areas.

Field experience of DMAT – Mission 1

The first TMDUH DMAT mission was to triage, resuscitate and treat trauma patients from a collapsed building in Tokyo. The DMAT left TMDUH 34 minutes after the earthquake. The collapsed building was an historic building called Kudan Kaikan where a graduation ceremony was being held. During the earthquake, the ceiling fell, and a mass casualty incident occurred with 36 casualties. After triaging, 17% were classified as severe and urgent casualties including a traumatic cardiopulmonary arrest and severe head and chest trauma, 22% as intermediate casualties and 61% as minor casualties.

While responding to Kudan Kaikan, the DMAT tried without success to communicate with TMDUH. While the mobile networks were operational, connection was not possible due to overuse of the system. Therefore, the DMAT was unable to inform the hospital of the number and the type of victims being sent there.

Field experience of DMAT – Mission 2

Mission 2 in Miyagi began the day after the earthquake and lasted to day 3. The TMDUH DMAT mission was to assist with emergency medical needs of the Sendai Medical Centre (SMC), which is 5 km from the coastline. Nine DMATs from all over Japan gathered at SMC. They rotated among four posts: severe and urgent care, intermediate care, minor care and triage. Activity was intense with casualties constantly being transferred from devastated areas. About 100 ambulances per day transferred casualties to SMC, seven times more than usual. Thirteen per cent of all casualties were severe and urgent; almost all of them were trauma patients. The majority of casualties with no need for admission had mild hypothermia. DMATs needed resuscitation and trauma sets and blankets.

During these two days, communication was limited to working land phones and transceivers to connect with paramedics operating in the devastated areas. DMATs collected information only through face-to-face meetings with paramedics from the affected areas. Therefore, DMATs were unable to know the casualty numbers and to prepare for individual casualty needs before their arrival.

Field experience of DMAT – Mission 3

Mission 3 began approximately one week after the earthquake, and although this was not originally designated as an activity of DMATs, they were deployed to Iwate. The mission was to provide emergency medicine and primary care. The TMDUH DMAT assisted Ofunato Prefectural Hospital (OPH), five first-aid stations and an evacuation area. OPH lies only 1.5 km from the coastline. At this hospital, only 3% of patients required severe and urgent care, 50% required intermediate medical care and 47% required minor medical care.

The DMAT made rounds to five first-aid stations and an evacuation area near the coastline. Most patients presented with mild respiratory infection; there were few direct disaster-related presentations. Medical expertise and equipment were needed to treat emergency and primary care patients. Ambulances were needed 2.6 times more than usual because other hospitals in the area were destroyed.

Despite no urgent need for communication in this mission, the DMATs communication options and capabilities were still limited. The satellite phone worked in OPH, but it took about 10 minutes to connect to service and was therefore not used for urgent situations.

Field experience of DMAT – Mission 4

Mission 4 began nine days after the earthquake in Fukushima. The coastal area in Fukushima was polluted by radiation following damage to a nuclear power plant. The TMDUH DMAT and other DMATs coordinated with the Emergency Headquarters of Radiation Exposure which comprised the Nuclear and Industrial Safety Agency and the National Institute of Radiological Sciences at the Fukushima Prefectural Government.

The TMDUH DMAT screened inpatients in the hospitals and health care facilities for radiation exposure and evacuated casualties from the radiation-affected area. Elderly and disabled patients in hospitals and nursing homes were transferred to screening points at a high school. Members of the DMAT wore personal protective equipment and screened the patients using dose-metres to detect the amount of radiation exposure. None of the patients' exposure level was higher than the baseline.

At this point in time, almost all communication methods were available and operable.

OUTCOME

The experiences of the TMDUH DMATs on the four missions varied with regards to medical expertise, equipment and communication (**Table 1**). The DMATs' medical training and experience in trauma and emergency care was absolutely necessary for the first two missions. The equipment used was mainly for trauma-associated cases. A large number of ambulances and basic supplies such as blankets for hypothermia were needed.

New functions were required of DMATs during Missions 3 and 4. DMATs, who are trained to be flexible by assisting in various medical situations, were deployed for primary care surge capacity and in the unusual circumstances of supporting mass screening and

Table 1. **Comparison of medical expertise and equipment by perceived importance and of field communication methods, TMDUH DMAT* mission, Great East Japan Earthquake, 2011**

	Medical expertise and equipment	Perceived importance†	Field communication method available					
			Land phone	Mobile	Satellite phone	Internet	Transceiver	Radio phone
DMAT 1	Resuscitation	++						
Day 1	Trauma	++	✓	x	x	x	✓	x
Tokyo	Ambulance	++						
DMAT 2	Resuscitation	++						
Day 2–3	Trauma	++	✓	x	x	x	✓	x
Miyagi	Ambulance	++						
	Blanket	++						
DMAT 3	Emergency medicine	+						
Day 7–8	Primary care	+++	✓	x	✓	x	✓	x
Iwate	Ambulance	+						
DMAT 4	Evacuation	+++						
Day 11–12	(Transportation)		✓	✓	✓	✓	✓	✓
Fukushima	Radiation screening	+++						

* TMDUH DMAT – Tokyo Medical and Dental University Hospital Disaster Medical Assistance Team

† Perceived importance of medical expertise and equipment ranked by TMDUH DMAT from + to +++

transportation of patients from radiation-affected areas (**Figure 2**).

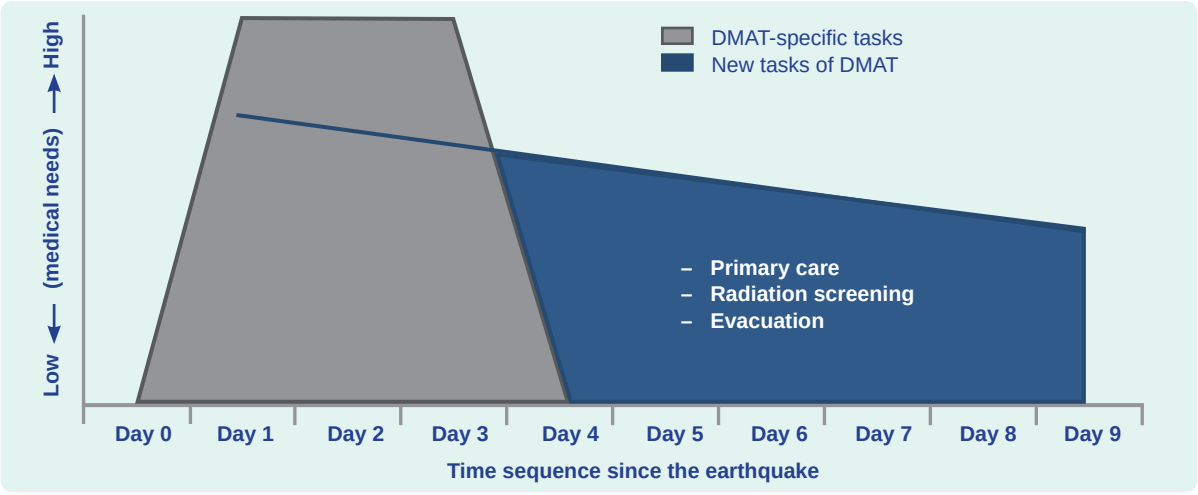
A significant difficulty arose from the lack of adequate operational communication. While phones and communication equipment were available, communication links did not function due to heavy use by other citizens. This lack of communication made it difficult to get credible information from the field about the devastated areas, and it was necessary to allow greater time for handover of the casualties through face-to-face communication with paramedics once the ambulances reached the hospitals.

DISCUSSION

The two main lessons learnt by TMDUH DMATs were those associated with field communication and that new tasks were required for this specific response.

From day 1 to day 8, TMDUH DMATs suffered poor communication capability, similar to that of other DMATs.[9] As a result, the most credible method for collecting medical information about the patients being transported to hospitals was by talking with paramedics on arrival from the affected areas. Improved and alternative

Figure 2. **Graphical representation of the new tasks required by DMATs by day, Great East Japan Earthquake, 2011**



DMAT – Disaster Medical Assistance Team

methods for communication infrastructure post-disaster have been suggested,[10] and DMATs wish to work with telecommunication experts in this development, including the utilization of satellite phones. The main benefit of satellite phones is that they can be used independently of busy phone lines or Internet connections and mobiles. However, this experience showed that a weakness of satellite phones is the slowness of the connection between two areas. Technological innovation will make satellite phones more useful tools. During the World Trade Center attack in 2001, "the lack of communication method probably resulted in more problems than all other factors combined."[11] Many stakeholders have a serious interest in improving communication during disasters.

Through the TMDUH DMAT experience, new additional duties for DMAT operations were recognized. After the acute phase of a disaster, surge capacity in the devastated area was needed for primary care, radiation screening and evacuation (**Figure 2**). In general, medical services are required immediately following a disaster; this need then decreases day by day. During the earthquake response, DMATs focused on trauma treatment and resuscitation from day one to day three. In previous events, TMDUH DMATs did not participate in further medical support. However in this event DMATs were used for new needs in disaster medicine – a novel outcome.

There are some limitations in this paper. As it reflects the experience of only TMDUH DMATs following the Great East Japan Earthquake, the perceived importance of expertise, equipment and operational communication may not be representative of all DMATs. The number of patients to whom we provided medical care in Missions 2 to 4 could not be accurately counted. However, this firsthand experience has value as it identifies significant communication issues and expanded roles for DMATs in the future.

In conclusion, DMATs must be ready to lessen preventable deaths and further injury during the acute phase of an emergency response. As this paper and others show, there are additional needs for DMATs in primary care, radiation screening and evacuation.[12,13] DMATs should be prepared to practise primary care and address radiation as indispensable knowledge in the future. DMAT training courses should include lectures, simulated training and examination on primary care and radiation issues. The experience of the TMDUH DMATs shows that there is a need to broaden both the professional flexibility of DMAT members and communication methods during disaster responses.

Conflicts of interest

None

Funding

None

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Western Pacific Surveillance and Response Instructions to Authors

ABOUT WPSAR

The aims of WPSAR are:

1. to provide an open access journal to publish articles on the surveillance of and response to public health events and emergencies in the WHO Western Pacific Region and in areas with relevance to the Western Pacific Region; and
2. to build capacity in communicating epidemiological and operational research within the WHO Western Pacific Region.

Our objectives are:

1. to provide a platform for people working in surveillance and response in the Western Pacific Region to share their scientific and operational findings;
2. to publish a broad range of articles not limited to conventional research articles:
   - to disseminate short reports on outbreak investigations;
   - to publish analyses of surveillance data on communicable diseases;
   - to encourage the publication of evaluations of new and existing surveillance systems;
   - to promote the use of risk assessment for public health by facilitating risk assessment articles;
   - to support preparedness and response to public health events and emergencies through the dissemination of lessons learnt from such events; and
3. to build capacity in communicating epidemiological and operational findings in the Western Pacific Region through pre-submission assistance.

Scope

WPSAR covers all activities related to the surveillance of and response to public health events and emergencies, with a focus on topics that are relevant to the Western Pacific Region. Public health events may be acute or ongoing and can fall under any of the following areas: communicable diseases, natural disasters, food safety, bioterrorism, and chemical and radiological events. Other events and topics may also be considered. Response activities include those for acute events, e.g. responding to natural disasters, or for response to cases or epidemics of disease.

Why publish in WPSAR?

WPSAR is not limited to conventional research. It publishes a broad range of articles, including short outbreak investigation reports, lessons from the field, analyses of surveillance data, evaluations of surveillance systems and risk assessments for public health events. There are limited opportunities to publish these types of articles in other journals. We also accept the more traditional original research, perspectives and case reports/case series articles.

WPSAR is an open access journal, meaning it is free of charge for both readers and authors. It is also a continuous publication, which means articles are published as soon as they have completed the review and editing process.

WPSAR accepts all articles that fit the scope of the journal and that meet the minimum publication standards. We are especially interested in field epidemiology and operational research.

WPSAR also aims to build capacity in scientific writing and encourages submissions from authors with little or no experience in publishing in peer-reviewed journals. The Coordinating Editor often works with new authors on their submissions to ensure that articles fit the scope of WPSAR and meet the minimum standards for publication.

INSTRUCTIONS TO AUTHORS FOR ARTICLE WRITING AND SUBMISSION

WPSAR follows the guidelines of the *Uniform Requirements for Articles Submitted to Biomedical Journals by the International Committee for Medical Journal Editors* (ICMJE).

Formatting guidelines

Please submit your article in a Microsoft® Office Word file or a compatible file in English. Double-spaced, 12-point Arial font should be used to format your article. Please remove all automatic formatting including automatic numbering and referencing before submitting.

The format of the article will depend on the article type. Please see below for specific instructions per article type.

Outbreak Investigation Report

A short article describing a field or outbreak investigation including how it was detected, investigated and controlled. Rapid risk assessments undertaken during these investigations are also encouraged. These articles may be considered for rapid publication.

- Structured article with an abstract of ≤ 250 words and sections for introduction, methods, results and discussion
- Structured abstract with sections for objective, methods, results and discussion
- Word limit: ≤ 1500 words
- ≤ 15 references
- ≤ 2 figures/graphs/pictures

More comprehensive investigations can be submitted as Original Research.

Surveillance Report

A summary and interpretation of surveillance data over a given period of time. A description of the surveillance system and the limitations of the data collected must be included.

- Unstructured abstract of ≤ 250 words
- Word limit: ≤ 2000 words
- ≤ 15 references
- ≤ 10 figures/graphs/pictures

Surveillance System Implementation/Evaluation

An article describing the implementation of a new surveillance system or an evaluation of an existing surveillance system used to detect public health events.

- Unstructured abstract of ≤ 250 words
- Word limit: ≤ 2000 words
- ≤ 15 references
- ≤ 3 figures/graphs/pictures

Risk Assessments

An article detailing a risk assessment of a public health threat or event.

- Structured article with an abstract ≤ 250 words and sections for introduction (including risk question/s), risk assessment methodology, results, discussion and recommendations
- Structured abstract with objectives, method, results and discussion
- The results should include an assessment and/or characterization of the hazard, exposure and context, as well as the level of risk or risk characterization. The limitations must also be included. Risk management may be included in the discussion.
- Word limit: ≤ 3000 words
- ≤ 30 references
- ≤ 3 figures/graphs/pictures

Original Research

Original research articles may include epidemiological studies including outbreak investigations.

- Structured article with an abstract of ≤ 250 words and sections for introduction, methods, results and discussion
- Structured abstract with objective, methods, results and discussion
- Word limit: ≤ 3000 words
- ≤ 40 references
- ≤ 5 figures/graphs/pictures

Lessons from the Field

An article describing a problem faced in field epidemiology or during a public health event and the experience in trying to overcome the problem.

- Structured article with an abstract ≤ 250 words and sections for problem, context, action, lesson(s) learnt or outcome and discussion
- Structured abstract with the headings of problem, context, action, lesson(s) learnt and discussion
- Word limit: ≤ 2000 words
- ≤ 15 references
- ≤ 3 figures/graphs/pictures

Perspectives

An unstructured article discussing an issue regarding the surveillance of and response to public health events. The scope of the discussion must be clearly defined.

- Word limit: ≤ 1000 words
- ≤ 10 references
- ≤ 1 illustration

Case Report or Case Series

An unstructured article describing an unusual case or series of cases of public health significance. Subheadings may be used to increase the readability of the article.

- Unstructured abstract of ≤ 250 words
- Word limit: ≤ 2000 words
- ≤ 15 references
- ≤ 3 figures/graphs/pictures

Regional Analysis

An article providing an analysis of a topic for the Western Pacific Region, typically authored by WHO staff as part of their routine work on behalf of Member States. Regional Analyses do not undergo peer review.

Letter to the Editor

A letter commenting on a previously published article OR a letter commenting on the theme of the issue. Letters do not undergo peer review.

- Word limit: ≤ 500 words
- ≤ 5 references
- ≤ 1 illustration

News, Meeting and Conference Reports

News items and meeting and conference reports do not undergo peer review. Please contact the Coordinating Editor at WPSAR@wpro.who.int if you intend on submitting such an article.

Illustrations

Refer to the article type for the limit on illustrations (figures/graphs/pictures). Please insert all illustrations at the end of the article with titles. Each illustration must be referred to in the text and must be understood on its own. Use Microsoft® Office Excel for graphs and Microsoft® Office Word for tables and diagrams. Additionally, please provide a Microsoft® Office Excel spreadsheet of the data used to create a graph. Footnotes should be placed under the illustration and should use the following symbols in superscript format: *, †, ‡, §, ‖, **, ††, etc.

References

Reference the most recent and relevant publications. Please use the Vancouver referencing style with in-text citations and a bibliography at the end of the text. Sample references can be viewed on the National Institutes of Health website.

Place the bibliography at the end of the article text and not as footnotes. Write journal names in full. Use superscript sequential numbering for citing references in the text. Place the number after any punctuation. For example:

> These results are consistent with the original study.[11]

Reference personal communication in the text only and include the person's full name and institution.

Caution should be used in referencing websites; it should be done only when their content has been substantially described in the article.

Peer review process

Every article is initially screened by the Editorial Team to ensure it fits the scope of the journal. All articles, with the exception of regional analyses, letters to the editor, news items and meeting and conference reports, then undergo external peer review by two reviewers. This blind peer review process ensures that the reviewer does not know the identity of the author(s) and the author(s) do not know the identity of the reviewer. Significant effort is made to make this process timely, but since it relies on the availability and cooperation of persons external to the journal, it can take considerable time.

Upon receipt of the reviews, the Coordinating Editor assesses the comments and recommendations made by the reviewers, and then decides on the outcome of the peer review process. One of four options will be chosen: accept submission, accept with revisions, submit for review, or decline submission. The corresponding author will be advised of this outcome.

If the article has been accepted or accepted with revisions are required, you will be invited to revise your article according to the reviewer comments. A separate MS Word document outlining how you addressed each of the reviewer comments is also required. You must indicate the page and paragraph numbers where the changes were made and should provide reasons for not making a suggested change. Both the changes and reasons will be assessed

against the reviewer comments by the Coordinating Editor and may require further clarification from the authors. Once all comments have been adequately addressed, the article will commence the publication process.

If the outcome of the review process is "submit for review", then the same process is followed. However, the resubmitted article and responses to the reviewer comments are sent back to the original reviewers for another round of peer review. You will be asked to respond to a second round of reviewer comments, which will again be assessed by the Coordinating Editor. Once both sets of reviewer comments have been adequately addressed, the article will commence the publication process.

The publication process comprises rigorous editing for content and style by an external technical editor, followed by layout and proofreading. Authors may be asked to provide further information or clarifications during these stages. An article is not formally accepted for publication until these stages have been completed and approval has been granted by the Editorial Team. The authors will also have an opportunity to approve the final proof prior to publication on the WPSAR website. The article will be batched with others in the next quarterly issue.

Authorship

As per the International Committee of Medical Journal Editors (ICMJE), all authors should have contributed significantly to the article through one or more of the following in each category A, B and C:

A

- Study design
- Data collection
- Data analysis
- Data interpretation

B

- Drafting the article
- Critically revising the article

C

- Final approval of the article for submission

Any other contributors may be listed in the Acknowledgements section.

Acknowledgements

Contributors who do not fulfil the authorship requirements may be acknowledged. Permission from all contributors in the acknowledgement section should be sought. We assume that permission has been granted and will not follow up with the authors to confirm.

Ethics and permissions

It is the responsibility of authors to gain appropriate ethics approval for their work. A statement of ethics approval obtained or an explanation of why ethics approval was not required should be included for all articles during the submission process.

License for publication

Prior to publication, all authors are asked to sign a licence to publish that grants exclusive copyright license to the World Health Organization.

Conflicts of interest

A conflict of interest is defined by ICMJE as "when an author or author's institution, reviewer, or editor has financial or personal relationships that inappropriately influence (bias) his or her actions". Conflicts of interest may be financial, institutional, research or personal. A relationship does not always represent a conflict of interest and does not necessarily preclude publication in WPSAR. All authors and reviewers will be required to state any potential conflicts of interest, which will be assessed by the Editorial Team.

Funding

Authors will be required to state the sources of funding for their work.

Photographs for cover

If authors have taken photographs that are relevant to their article, they may be submitted for consideration for publication on the cover of the issue. Submission of a photograph does not guarantee its publication.

Language

Articles should be written in English. Authors who require assistance with preparing their articles in English should contact WPSAR at WPSAR@wpro.who.int. Once published, all abstracts and most articles are translated into Chinese.

Article submission process

Submit articles to the Coordinating Editor through the online journal management system on the WPSAR website. When submitting the article, you will be requested to provide the following:

- a cover letter describing the article and why it should be published;
- a title page with:
  - the article title,
  - a short title,
  - a brief description of the article of ≤ 50 words,
  - ≤ 7 keywords,
  - full names of all authors and institutions,
  - full contact details of the corresponding author,
  - data in an MS Excel spreadsheet for any graphs
  - names and e-mail addresses of two suggested reviewers (optional but recommended);
- acknowledgements, conflicts of interest, ethics statement and funding information (attached as a separate file to ensure a blind review);
- an MS Word file or equivalent of the article; and
- a scanned copy of the WPSAR licence for publication signed by all authors.

With the online journal management system, you will be able to track the progress of your article through the editorial process. If you encounter any difficulties with this system, please refer to our *WPSAR online journal system – User guide for authors*.

Corrections

If authors of a published article become aware of any errors with the article, they should contact the Coordinating Editor at WPSAR@wpro.who.int. Corrections will be published online.

World Health Organization
Western Pacific Region

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