Evaluation of the Surveillance System for Extra Pulmonary Tuberculosis in Suriname

Paper submitted in fulfillment of the requirements for the degree of Master in Public Health

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W.Balesar

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Executive Summary

The National Tuberculosis Program (NTP) of Suriname has a surveillance system which records and reports all diagnosed tuberculosis (TB)-cases for program supervision, monitoring, and evaluation. With the global rise of Human immunodeficiency virus (HIV) infection over recent decades, studies have reported increasing association of extra pulmonary tuberculosis (EPTB) with HIV infected individuals. Suriname is a country in the Caribbean with a high prevalence of HIV among TB cases (~30%). However, data reports generated by the NTP surveillance system indicate a lower-than-expected proportion of EPTB.

The objective for this study is to estimate the analytic performance of the TB surveillance database in capturing EPTB (i.e., sensitivity, specificity and positive predictive value (PPV)) and to thereby determine whether EPTB may be under-diagnosed and/or under-reported or whether it is in fact being diagnosed and reported, but then being lost in the classification rules of the database. The Centers for Disease Control and Prevention (CDC) “Updated guidelines for evaluating Public Health Surveillance Systems” (2001) was used as the framework for measuring the sensitivity, specificity and PPV of the NTP surveillance system for EPTB.

To explore the underlying reasons for the low proportion of EPTB, a retrospective quantitative analysis was conducted for all tuberculosis cases notified to the NTP and Academic Hospital during 2007-2011. A data collection tool was designed for comparing the site of disease registered in the NTP database (test) to the site of disease information obtained from medical record abstraction (gold standard).
The results of the study showed that of 576 cases, which were included in this study, the sensitivity of the NTP database in capturing EPTB was 61% and the positive predictive value was 82.5%, when medical record review was used as the gold standard. The true proportion of EPTB identified by medical record review was 13% among all reported cases (as determined by medical record abstraction), which was still very low in comparison to other healthcare settings (20-30%). Unspecified sites of EPTB were common, accounting for 32% of EPTB cases in the database and 52% of EPTB cases ascertained by medical record review. Among the remaining EPTB cases with specified sites, the most common were consistent with observations elsewhere (i.e. lymph nodes 31%, pleura 26%, central nervous system 14%). Lower-than-expected frequency of involvement was observed for bone (0%) and disseminated TB (3%).

This study showed that the low proportion of EPTB cases observed in routine reports generated from the database was in part due to classification rules of the surveillance database undercounting EPTB cases, when they also had pulmonary involvement. However, even medical record abstraction showed a low proportion of EPTB. This finding suggests that pre-NTP deficits in EPTB recognition, diagnosis and/or reporting are probably also contributing to what is being observed.

Because of the high prevalence of HIV among TB patients in Suriname, completeness and validity of the data recorded in the public health surveillance system are critical to understanding the clinical epidemiology of TB and TB/HIV in this setting and to guide future prevention and care efforts. Recommendations:

- Modify the database to eliminate misclassification.
- Educate and train clinicians and NTP staff to maximize ascertainment for all sites of TB involvement.
- Streamline of reporting processes for better data-quality data.
- The Monitoring & Evaluation Unit should support the NTP in making operational improvements and conduct a retrospective analysis of EPTB cases to identify omissions or lost of information.
Acknowledgements

Throughout this phase of exchange of epidemiologic concepts and study-analyses, I am privileged to have experienced the vision and leadership of Christopher Spitters, MD, MPH (Medical Director, Medical Consultant, and Clinical Associate Professor), Rachel Eersel, MD, MPH (Public Health Advisor HIV/STI, PAHO/WHO Suriname) and Prof.Dr. A.Vrede (Pathologist, Professor at the Medical Research Institute Suriname). Also to Ms. Stephanie Laryea Msc, MPH, consultant at the PAHO, I am very thankful for her support in finalizing the thesis.

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Finally, to the BOG-staff for support from Dr. Lesley Resida, Mr. Duncan Noter and Dr. Corona, I send thanks and all the best wishes for your dedicated efforts. And I am thankful to my great family.
List of Abbreviations & Acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACSM</td>
<td>Advocacy, communication and social mobilization</td>
</tr>
<tr>
<td>AIDS</td>
<td>Acquired immunodeficiency syndrome</td>
</tr>
<tr>
<td>AZ</td>
<td>Academic Hospital (Academisch Ziekenhuis)</td>
</tr>
<tr>
<td>BGVS</td>
<td>Company of Drugs Supply in Suriname (Bedrijf Geneesmiddelen Voorziening in Suriname)</td>
</tr>
<tr>
<td>BOG</td>
<td>Bureau of Public Health (Bureau Openbare Gezondheidszorg)</td>
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<tr>
<td>CAREC</td>
<td>Caribbean Epidemiology Center</td>
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<tr>
<td>CD</td>
<td>Communicable Diseases</td>
</tr>
<tr>
<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence interval</td>
</tr>
<tr>
<td>CNS</td>
<td>Central nervous system</td>
</tr>
<tr>
<td>DOT</td>
<td>Directly observed treatment</td>
</tr>
<tr>
<td>DOTS</td>
<td>Directly observed treatment, short-course (global strategy for TB control)</td>
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<tr>
<td>EP</td>
<td>Extra pulmonary</td>
</tr>
<tr>
<td>EPTB</td>
<td>Extra pulmonary tuberculosis</td>
</tr>
<tr>
<td>FN</td>
<td>False Negative</td>
</tr>
<tr>
<td>FP</td>
<td>False Positive</td>
</tr>
<tr>
<td>GFATM</td>
<td>Global Fund for AIDS, Tuberculosis and Malaria</td>
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<tr>
<td>HIV</td>
<td>Human immunodeficiency virus</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>IHR</td>
<td>International Health Regulations</td>
</tr>
<tr>
<td>MDR-TB</td>
<td>Multidrug-resistant tuberculosis</td>
</tr>
<tr>
<td>M&amp;E</td>
<td>Monitoring and Evaluation</td>
</tr>
<tr>
<td>MM</td>
<td>Medical Mission (Medische Zending)</td>
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<tr>
<td>MOH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>NAP</td>
<td>National AIDS Program</td>
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<tr>
<td>NGO</td>
<td>Nongovernmental organization</td>
</tr>
<tr>
<td>NPV</td>
<td>Negative Predictive Value</td>
</tr>
<tr>
<td>NTP</td>
<td>National Tuberculosis Program</td>
</tr>
<tr>
<td>PAHO</td>
<td>Pan American Health Organization</td>
</tr>
<tr>
<td>PLWHIV</td>
<td>People living with HIV</td>
</tr>
<tr>
<td>PHC</td>
<td>Primary health care</td>
</tr>
<tr>
<td>PPM</td>
<td>Public-private mix</td>
</tr>
<tr>
<td>PPV</td>
<td>Positive Predictive Value</td>
</tr>
<tr>
<td>RGD</td>
<td>Regional Health Services (Regionale Gezondheids Dienst)</td>
</tr>
<tr>
<td>RR</td>
<td>Relative Risk</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
<tr>
<td>STI</td>
<td>Sexually transmitted infection</td>
</tr>
<tr>
<td>SZF</td>
<td>State health assurance (Stichting Staatsziekenfonds)</td>
</tr>
<tr>
<td>TB</td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>TN</td>
<td>True Negative</td>
</tr>
<tr>
<td>TP</td>
<td>True Positive</td>
</tr>
<tr>
<td>WRD</td>
<td>WHO – approved rapid diagnostics</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
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</table>
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Introduction

1.1 What is TB & HIV and its burden in Suriname

Tuberculosis (TB) is an infectious disease caused by the bacillus Mycobacterium tuberculosis. It typically affects the lungs, but can affect other sites as well. Extra-pulmonary tuberculosis (EPTB) refers to tuberculosis disease of organs other than the lungs (e.g. pleura, lymph nodes, meninges, joints and bones, skin, abdomen) and is milder form of disease in terms of infectivity as compared to pulmonary TB. Pulmonary tuberculosis (PTB) refers to disease involving the lung parenchyma. Whereas sputum can easily obtained for the detection of disease in lungs, diagnosis of EPTB is often difficult requiring invasive, less sensitive, and often expensive radiological and laboratory investigations.\(^1\)

The disease spreads in the air when people with pulmonary TB expel bacteria (e.g. coughing). In general, a relatively small proportion of people infected with mycobacterium tuberculosis will go on to develop TB disease; however, the probability of developing TB is much higher among people infected with the human immunodeficiency virus (HIV).\(^1\) TB is also more common among men than women, and affects mostly adults in the economically productive age groups; around two-thirds of cases are estimated to occur among people aged 15-59 years.\(^2\)

The most common method for diagnosing PTB worldwide is sputum smear microscopy (developed more than 100 years ago), in which bacteria is observed in sputum samples examined under a microscope. In countries with more developed laboratory capacity, cases of TB may also be diagnosed via culture methods (the current gold standard) or, increasingly, using rapid molecular tests.\(^1,2\)

The burden of tuberculosis disease- including illness, disability, and direct and indirect costs of the illness- can be reduced rapidly through prompt diagnosis and effective treatment. Untreated, patients remain ill with tuberculosis for an average of at least two years. An effective program detects most patients within 1 or 2 months.\(^2,3\)

In countries with a generalized acquired immunodeficiency syndrome (AIDS) epidemic, HIV infection remains the leading risk factor for the development of TB disease. TB is
also the foremost cause of death among people living with HIV. HIV is a retrovirus that infects the vital organs of the human immune system. The disease progresses in the absence of antiretroviral therapy. The rate of disease progression varies widely between individuals and depends on many patient factors (i.e. age, ability to defend against HIV, access to health care, coexisting infections, genetic inheritance, resistance to certain strains of HIV). HIV can be transmitted through sexual, perinatal and blood contacts.  

Tuberculosis is highly associated with HIV infection and with overt HIV disease worldwide. Globally, the percentage of patients with TB and HIV co-infection ranges from less than 1% in low HIV-prevalence countries to 50-70% in countries with a high HIV prevalence. Although the prevalence of HIV infection varies widely among and with countries, in persons with HIV infection, there is always an increased risk that tuberculosis infection can become active TB disease.  

Suriname has made important strides forward in many areas regarding the response against HIV. From 2007 on there has been a decline in the number of newly registered HIV-cases. According to the Global Report of the UNAIDS 2010, Suriname is one of the few countries in the Caribbean that has experienced a decrease of more than 25% of the incidence rate of HIV-infection. Also, mortality rates are slightly decreasing since 2006. This is probability due to the increased access to HIV-testing (including the almost tripled screening of pregnant women) and the nationwide treatment with Antiretroviral (ARV) and increased availability of condoms. A great deal of the progress was made possible through external financial assistance (i.e. Global fund grants).

In Suriname from 2000-2003 an average of 64% of TB patients were tested on HIV. Of these persons tested, 23% were HIV positive. In the next 4 years, from 2004-2008, the average percentage of testing went up to 72%, while the HIV prevalence remained more or less the same (24%).

With the global rise of HIV infection over recent decades, studies have reported increasing association of EPTB in HIV infected individuals. In the United States (US), a retrospective medical record review of 320 cases of EPTB from 1995-2007 at a single US public hospital determined the most common sites of EPTB were lymphatic (28%),
disseminated (23%) and CNS/meningeal (22%). One hundred fifty-four (48%) were HIV infected, 40% had concomitant pulmonary tuberculosis and 14.7% died within 12 months of EPTB diagnosis.\textsuperscript{5} In another study in Côte d'Ivoire, disseminated tuberculosis was found in 44% of patients with HIV wasting who came to autopsy; the diagnosis had not been made \textit{ante mortem}.\textsuperscript{6} While another study in India during 2006 found the ratio of smear-positive TB:EPTB was found to be 1:0.24 and 1:0.06 among HIV sero-positives and sero-negatives, respectively.\textsuperscript{7} These studies shows that of the EPTB-cases 24 to 48% were HIV infected and disseminated tuberculosis may be difficult to diagnose.

1.2 What is the response of the Bureau of Public Health and the Surveillance System?

The NTP is a public health program of the Bureau of Public Health (BOG) in Suriname’s Ministry of Health (MOH) that is working towards a ‘Tuberculosis free Suriname’. The overarching goal of the NTP is to reduce the incidence, mortality, and transmission of TB and the strategic goals are to detect 95% of expected sputum positive TB cases and to cure 95% of these cases.\textsuperscript{8}

The NTP is under the direct responsibility of the BOG, which reports to the Director of MOH. The NTP coordinates all activities through the BOG.\textsuperscript{8, 9} It receives specific funding and support from the Ministry of Health through BOG for drugs, for personnel, and for other administrative needs. The NTP also receives external funding from the Global Fund for AIDS, TB and Malaria.\textsuperscript{9}

The NTP staff is formally in charge of the main functions of the NTP; therefore, this team is responsible for policy, planning, management, training, supply, supervision, monitoring, implementation of TB services and recording and reporting.\textsuperscript{9,10} The activities of the NTP is in accord with the performance framework of the TB grant: Sur-910-G05- T. The NTP is supervising DOT-sites in the districts, interior and Paramaribo. There are training-sessions of TB for all stakeholders: RGD-nurses and physicians, Medical Mission health workers and physicians, training of DOT-supporters, TB-lab personnel, infection control and training in prevention and care of Multidrug resistant TB (MDR- TB) for nurses.\textsuperscript{8,11}
The NTP of Suriname follows World Health Organization’s (WHO) global and Pan American Health Organization’s (PAHO) regional Stop TB Strategy.\textsuperscript{8, 9, 10}

1. Implement and expand quality directly observed treatment short-course (DOTS) in Suriname;

2. Address tuberculosis/ human immunodeficiency virus (TB/HIV), multidrug-resistant tuberculosis (MDR-TB) and the needs of vulnerable populations (TB/HIV collaborative activities, prevention and management of MDR-TB, treatment of TB under DOTS in prisons);

3. Contribute to health system strengthening;

4. Develop or strengthen partnership to ensure equitable access to all TB patients;

5. Engage communities and affected people for advocacy, communication and social mobilization (ACSM).

As such, one objective of the DOTS-NTP strategy is to record and report all diagnosed TB-cases, including extra-pulmonary tuberculosis (EPTB) using the NTP-surveillance system for program supervision, monitoring and evaluation.\textsuperscript{8, 10, 11} All collected TB data are then electronically entered by the data-entry specialist. The NTP-surveillance system is supervised by the Epidemiology Unit of the BOG and the Monitoring and Evaluation (M&E) unit of the MOH. The NTP surveillance system conducts weekly active surveillance to collect data and confirms diagnosis to ensure reports that are more complete. The NTP nurses go to the Central Laboratory (a department of BOG), to the Sanatorium (department of the Academic Hospital), the RGD-DOT sites, and if necessary to the laboratory of Academic Hospital, the clinics of the lung-specialists, and at homes of TB-patients.\textsuperscript{12} This type of surveillance is particularly useful in establishing prevalence rates for conditions, where there may be lack of data or where cases occur sporadically.

Public Health surveillance has been defined by the CDC as: “Ongoing, systematic collection, analysis, and interpretation of health data essential to the planning, implementing, and evaluation of public health practice, closely integrated with the timely
dissemination of these data to those who need to know”.

The final link of the surveillance chain is the application of these data to prevention and control. So one of the main goals of surveillance for diseases such as TB, is to identify infectious individuals before they infect others, thus preventing an exponentially growing epidemic.

In Suriname, TB medicines are distributed free of charge to all TB patients. The NTP is also in charge of screening high risk populations as in the prisons, Amerindian villages and Maroons villages. Also info-sessions for the community, schools, and villages are done by radio, television, newspapers and folders. Rapid testing is available using two Gene X-pert machines and test kits.

The law in Suriname requires everyone who tests positive for TB to be treated. There is a legislation for reporting of communicable diseases as determined in the national degree of 26 October 1962 implementing Regulation of the infectious diseases 1953 [GB 1962 No. 137] as amended by SB 1980 No.116. There are 4 classes: a category A, B, C and D. Tuberculosis belongs to class C, and has to be reported to the director of the MOH, regardless of site of disease.

1.3 Theoretical framework

From the CDC’s guidelines for “Evaluation of Public Health Surveillance system”, we can measure the accuracy/validity of surveillance for EPTB in Suriname (see appendix 1 & 2). The model from the CDC guidelines was introduced to the NTP by the national surveillance manual of 2006. This model included the characteristics “Sensitivity”, and “PPV”, which can be used to evaluate quantitatively the NTP Surveillance system. There were also other characteristics to evaluate qualitatively the Public Health Surveillance system as “Usefulness”, “Simplicity”, “Data Quality”, “Acceptability” etc. For this study numbers of TB cases over 2007-2011 were used as data, to evaluate the surveillance system of the NTP. This study included the quantitative characteristics “Sensitivity” and “PPV” (the qualitative attributes were not used for this study). The lower-than-expected proportion of EPTB found in the data reports generated by the NTP surveillance system indicates potential challenges regarding reporting,
classification, or both. From 2007 through 2011, the proportion of reported TB cases classified as EPTB ranged from 6 to 15% (Table 1). This range is substantially lower than analogous figures from comparison settings in Table 2.

Table 1: Tuberculosis by Site (Pulmonary vs. Extra pulmonary), Suriname 2007 - 2011

<table>
<thead>
<tr>
<th>YEAR</th>
<th>TOTAL CASES</th>
<th>PULMONARY (%)</th>
<th>EXTRAPULMONARY (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>122</td>
<td>87%</td>
<td>13%</td>
</tr>
<tr>
<td>2008</td>
<td>98</td>
<td>90%</td>
<td>10%</td>
</tr>
<tr>
<td>2009</td>
<td>156</td>
<td>94%</td>
<td>6%</td>
</tr>
<tr>
<td>2010</td>
<td>198</td>
<td>92%</td>
<td>8%</td>
</tr>
<tr>
<td>2011</td>
<td>132</td>
<td>85%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Source: NTP Surveillance Database (For Suriname the average of EP is only about 10% over a year)

Table 2: EPTB by Nation/Region

<table>
<thead>
<tr>
<th>Nation/Region</th>
<th>Percentage of TB Cases Classified as EPTB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suriname</td>
<td>6-15%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>40-45%</td>
</tr>
<tr>
<td>United States</td>
<td>20%</td>
</tr>
<tr>
<td>African Region</td>
<td>22%</td>
</tr>
<tr>
<td>Nations with comprehensive, diagnostic and reporting systems for TB</td>
<td>20-30%</td>
</tr>
<tr>
<td>Guyana</td>
<td>17%</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>11%</td>
</tr>
<tr>
<td>Jamaica</td>
<td>6%</td>
</tr>
<tr>
<td>World</td>
<td>17%</td>
</tr>
</tbody>
</table>

Possible explanations for the lower-than-expected proportion of EPTB in Suriname can be: 18, 19
- Under-diagnosis;
- Under-reporting;
- Misclassification of extra pulmonary cases as pulmonary by the database (the M&E unit has given the instruction to classify a case of PTB and EPTB, as PTB);
- Circulating strains in Suriname having a lower tropism for extra pulmonary sites;
- Other;
- A combination of these.
Background of Suriname

2.1 Geography

Suriname, officially known as the Republic of Suriname, is the smallest independent country in northern South America and covers 163,821 km$^2$ (63,251 square miles). It is bordered by French Guiana to the east, Guyana to the west, Brazil to the south and the Atlantic Ocean to the north. Situated on the Guiana Shield, it lies between latitudes 1° and 6°N, and longitudes 54° and 58°W.$^{20,21}$ The country can be divided into two main geographic regions. The northern, lowland coastal area has been cultivated, and most of the population lives here. The southern part consists of tropical rainforest and hinterland along the border with Brazil, covering about 80% of Suriname's land surface. The capital is Paramaribo and the official language is Dutch.$^{20,21}$

2.2 Demography

The estimated population of Suriname is 531,170, with a sex ratio of one-to-one.$^{22}$ Of the population is 28.5% between 0-14 years, 62.0% between 15-59 years and 9.5% are 60+ years.$^{1,19}$ The major ethnic groups are Hindustani, who account for approximately 27.4% of the population, and Creole 17.7%. The third largest ethnic group, consist of Javanese, with 14.6%. The population in the hinterland consists of Maroons, 14.7% and Amerindians (Indigenous, 3.7%). Smaller ethnic groups in the coastal area include Chinese1.8% and White0.8%. Mixed: 12.5%, other: 0.5% and unknown: 6.6%.$^{22}$

The overall literacy of the population aged 15 years and older estimated to be 94.2%. However, in the interior, only 51% of the population is literate. Female literacy is lower than male and the literacy percentage declines with age.$^{22}$

2.3 The Health System

Under Article 36, the constitution of the Republic of Suriname states that everyone has the right to health and that is the responsibility of the government to promote health by systematically improving living and working conditions and to give information on the protection of health.$^9,12$
The Ministry of Health (MOH) is responsible for the availability, accessibility and affordability of health care. The main responsibilities of the MOH are the following: policy making, evaluation, coordination, and setting of standards and values.\textsuperscript{8, 9, 23} The core institutions of the health care system are the Central Office of the Ministry of Health, the Bureau of Public Health (BOG) and the Geneeskundige Inspectie (Medical Inspectorate). The Central Office and the inspectorate of the MOH function at the level of national health planning and standard-setting, inspection and monitoring, while the BOG is responsible for program development, data collection, preventive services, and health promotion to the total population.\textsuperscript{8, 9, 23}

The providers of health care include the government-subsidized primary health care organizations for the poor and near poor: namely, the Regional Health Service (RGD), which covers the coastal area, and the Medical Mission (MM), which covers the population living in the interior.\textsuperscript{9, 23} Inpatient hospital care is provided by five hospitals; three are public and two are private. The Academic Hospital is the largest public hospital with 420 hospital beds and a Sanatorium for TB patients (28 hospital beds).\textsuperscript{8, 23}

The three major types of financing for health care: \textsuperscript{9, 23}

- The State Health Insurance Fund (SZF) that pays for a comprehensive package of health benefits for 35% of the population, including civil servants and a small number of people who enroll voluntarily. The fund is financed by wage tax contributions, subsidies from general tax revenues and voluntary premiums;
- The Ministry of Social Affairs (MSA) pays for primary and hospital health care for the poor and near poor (free-of-charge). This covers 42% of the population;
- Private firms and private health insurance cover approximately 20% of the population.

The Drug Supply Company Suriname (BGVS) distributes all drugs on the national list to private and public pharmacies, as well as to the hospitals. These institutes deliver the drugs on prescription to the patients, according to their membership in one of the Health Insurance Companies.\textsuperscript{9, 10}
Methods

The hypotheses for this study are:

Null hypothesis: The NTP surveillance database has sensitivity, specificity, and/or predictive value that are not substantially less than 100% (implying that the database is accurate in showing a relatively low proportion of reported EPTB case, compared to what is observed elsewhere).

Alternative hypothesis: The NTP database has sensitivity, specificity and/or predictive value that are substantially less than 100% (implying that the database classification rules and/or NTP surveillance processes are contributing to the low perceived proportion of EPTB).

For the statistical analytical performance, we have the NTP-surveillance data at one side as “detected by surveillance” during 2007 through 2011. The other data for the gold standard (“condition present”) will be collected by a retrospective quantitative study.

Procedures:

Inclusion criteria for this retrospective study was as follows: all tuberculosis cases notified to the NTP and Academic Hospital during 2007 through 2011 for whom clinical records could be located (gold standard).

A data collection tool (appendix 3) was designed to extract from clinical records relevant demographic and clinical information of all TB cases, verification of cases’ classification under the surveillance system’s case definitions, additional detail regarding site of disease for EP cases (e.g. lymph nodes, pleura, bone, CNS, genitourinary, peritoneum, gastrointestinal tract, and others), mycobacteriology results, treatment outcomes, and HIV-related variables (e.g., serologic results and treatment).

Classification based on anatomical site of disease:\n
- Pulmonary tuberculosis (PTB) refers to any bacteriologically confirmed or clinically diagnosed case of TB involving the lung parenchyma or the tracheobronchial tree. Miliary TB is classified as PTB because there are lesions
in the lungs. Tuberculous intra-thoracic lymphadenopathy (mediastinal and/or hilar) or tuberculous pleural effusion, without radiographic abnormalities in the lungs, constitutes a case of extra-pulmonary TB. A patient with both pulmonary and extra-pulmonary TB should be classified as a case of PTB.

- Extra-pulmonary tuberculosis (EPTB) refers to any bacteriologically confirmed or clinically diagnosed case of TB involving organs other than the lungs, e.g. pleura, lymph nodes, abdomen, genitourinary tract, skin, joints and bones, meninges.

*Case definitions*:

- A bacteriologically confirmed TB case is one from whom a biological specimen is positive by smear microscopy, culture or rapid test (such as Xpert MTB/RIF). All such cases should be notified, regardless of whether TB treatment has started.

- A clinically diagnosed TB case is one who does not fulfill the criteria for bacteriological confirmation but has been diagnosed with active TB by a clinician or other medical practitioner who has decided to give the patient a full course of TB treatment. This definition includes cases diagnosed on the basis of X-ray abnormalities or suggestive histology and extra-pulmonary cases without laboratory confirmation. Clinically diagnosed cases subsequently found to be bacteriologically positive (before or after starting treatment) should be reclassified as bacteriologically confirmed.

Bacteriologically confirmed or clinically diagnosed cases of TB are also classified according to:

- anatomical site of disease;
- history of previous treatment;
- drug resistance;
- HIV status.

**Data collection:**

Four medical students were trained in collecting data and data entry by the NTP manager, MOH Epidemiologist, and NTP Medical Consultant in September 2012. Data
was abstracted by medical students from clinical records onto paper forms. Data was then entered into an Access database by the NTP data entry specialist.

Data Analysis.\textsuperscript{12,25,26}

For the calculation of the performance of the surveillance database for recording EPTB a 2x2 table method was used for determining sensitivity, specificity, and positive predictive value. Clinical data served as the gold standard (i.e., true positive, true negative) against which the surveillance database (i.e., test) was compared.\textsuperscript{25, 26, 27}

In cell ‘a’, (see APPENDIX 1) we enter those in whom the test in question correctly diagnosed the disease EPTB (as determined by the gold standard). In other words, the test (NTP Surveillance Database) is positive, as is the gold standard. These are the true positives (TP).\textsuperscript{25, 28}

In cell ‘b’, we enter those who have positive results for the test (NTP Surveillance Database) in question but do not have disease according to the ‘gold standard test’. The test (NTP Surveillance Database) has wrongly diagnosed the disease: These are false positives (FP).\textsuperscript{25, 28}

In cell ‘c’, we enter those who have disease on the ‘gold standard test’ but have negative results with the test in question. The test has wrongly labeled Pulmonary TB as ‘normal’. These are false negatives (FN).\textsuperscript{25, 28}

In cell ‘d’, we enter those who have no Pulmonary TB as determined by the ‘gold standard test’ and are also negative with the test. These are true negatives (TN).\textsuperscript{25, 28}

Statistics;

Confidence interval calculation: \textsuperscript{26}

95% confidence interval (CI) for a proportion = 1.96 \{[p(1-p)]/n\}^{1/2}

The McCallum-Layton statistical software was used\textsuperscript{28}.
Sub analyses for Specific Site of Disease:

Finally, this study also includes analysis of EPTB cases by specific site of disease and stratified by HIV status to compare local observations with those reported elsewhere.

In this study a frequency table for the specific site of EP involvement is added, with a column for the clinical data (chart abstraction) and a column for the database. This table is stratified by HIV status. Relative risk (RR) for central nervous system (CNS) and pleural sites of involvement among HIV-infected versus HIV-negative patients was estimated to compare with the findings of others reported in the literature.\(^5, 6, 7\)

The MedCalc, easy-to-use statistical software was used for the RR calculations.\(^28\) This study compared the differences in RR estimated between clinical and database EP sites, as well.

**Sensitivity (positive in disease):**\(^24, 25\)

Sensitivity is the ability of a test to correctly classify an individual as ‘diseased’

\[
\text{Sensitivity} = \frac{a}{a+c} = \frac{\text{true positive}}{\text{true positive} + \text{false negative}}
\]

= Probability of being test positive when disease present

**Specificity (negative in health):**\(^24, 25\)

The ability of a test to correctly classify an individual as disease-free is called the test’s specificity.

\[
\text{Specificity} = \frac{d}{b+d} = \frac{\text{true negative}}{\text{false positive} + \text{true negative}}
\]

= Probability of being test negative when disease absent.
Positive Predictive Value (PPV):\textsuperscript{24, 25}

It is the percentage of patients with a positive test who actually have the disease. In a 2 x 2 table, cell ‘a’ is ‘true positives’ and cell ‘b’ is ‘false positives’. In real life situation, we do the test first and we do not have results of ‘gold standard’ available. We want to know how this test (NTP Surveillance Database) is doing. PPV tells us about this – how many of test positives are true positives; and if this number is higher (as close to 100 as possible), then it suggests that this test is doing as good as ‘gold standard’.

\[
PPV = \frac{a}{a+b} = \frac{a \text{ (true positive)}}{a+b \text{ (true positive + false positive)}}
\]

= Probability (patient having disease when test is positive)

Negative Predictive Value (NPV):\textsuperscript{24, 25}

It is the percentage of patients with a negative test who do not have the disease. In the 2 x 2 table, cell ‘d’ is ‘true negatives’ and cell ‘c’ is ‘false negatives’. NPV tells us how many of test negatives are true negatives; and if this number is higher (should be close to 100), then it suggests that this test (NTP Surveillance Database) is doing as good as ‘gold standard’.

\[
NPV = \frac{d}{c+d} = \frac{d \text{ (true negative)}}{c+d \text{ (false negative + true negative)}}
\]

= Probability (patient not having disease when test is negative)
Results

601 Cases were reported to the NTP during the period under investigation (2007-2011). Records were not located for 4.2%, leaving 576 cases that were included in the study. In table 3 are the numbers of the record review (retrospective study) and NTP database findings compared.

From the record review, 499 cases are PTB, 47 cases EPTB and 30 cases are both PTB and EPTB. Sites not specified in the chart, is zero.

From the NTP database, 519 cases are PTB, 57 cases EPTB, and (by virtue of the database definition rules classifying any PTB as Pulmonary only) no cases were Both EP and PTB. Sites not specified in chart, is zero.

Table 3: Comparing abstracted data for EPTB to surveillance system data:

<table>
<thead>
<tr>
<th>Site(s)</th>
<th>Record review(Study)</th>
<th>NTP-Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary only</td>
<td>A=499</td>
<td>C=519</td>
</tr>
<tr>
<td>Extra pulmonary only</td>
<td>B1= 47</td>
<td>D= 57</td>
</tr>
<tr>
<td>Both EP &amp; PULM TB</td>
<td>B2=30</td>
<td></td>
</tr>
<tr>
<td>Not specified in chart</td>
<td>E= 0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>576(A+B1+B2)</td>
<td>576(C+D)</td>
</tr>
</tbody>
</table>

A+B1+B2= C+D

In table 4 the true proportion of EPTB in the record review is noted in percentage.

From the record review, the percentage of EP only is 8.2% and both EP & PTB is 5.2%. The total of any EP is 13.4%.

Table 4: True proportion of EPTB

<table>
<thead>
<tr>
<th></th>
<th>( \frac{B1}{A+B1+B2} ) = 8.2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOTH EP &amp; PULM</td>
<td>( \frac{B2}{A+B1+B2} ) = 5.2% +</td>
</tr>
<tr>
<td>Any EP</td>
<td>( \frac{B1+B2}{A+B1+B2} ) = 13.4%</td>
</tr>
</tbody>
</table>

In table 5 the 2x2 table method is interpreted for the findings of table 3.
In this 2x2 table the condition of EPTB is considered present if it was found to be so in the record review (gold standard).\textsuperscript{13, 25, 27}

The numbers are filled in the 2x2 table for the analysis for sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).

The 95% Confidence interval (CI) for these characteristics are also calculated.

Table 5a: Data for calculating analytic performance of the surveillance database for recording EPTB

<table>
<thead>
<tr>
<th>Surveillance Database</th>
<th>Record Review</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ANY EP</td>
<td>PULM ONLY</td>
</tr>
<tr>
<td>EPTB</td>
<td>47 (TP)</td>
<td>10 (FP)</td>
</tr>
<tr>
<td>PULMONARY TB</td>
<td>30 (FN)</td>
<td>489(TN)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>77(TP+FN)</td>
<td>499(FP+TN)</td>
</tr>
</tbody>
</table>

The gold standard (in diagnostic testing), is a procedure that always identifies the true condition – diseased or disease free – of a patient. Of course, we do not always have a gold standard immediately available or one totally free from error. (Sometimes, we must wait for autopsy results for definitive classification of the patient’s condition.)\textsuperscript{24, 25}

It is the extent to which the NTP Surveillance Database (test) measures what it is supposed to measure; in other words, it is the accuracy of the NTP Surveillance Database. Validity is measured by sensitivity and specificity. These terms are best illustrated using a conventional two-by-two (2 x 2) table.

Table 5b: Data for calculating the analytic performance of the NTP surveillance database for EPTB

<table>
<thead>
<tr>
<th>Surveillance Database (NTP)</th>
<th>Record Review (Study) = gold standard</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ANY EP</td>
<td>PULM ONLY</td>
</tr>
<tr>
<td>EPTB</td>
<td>47 (TP)</td>
<td>a 10 (FP)</td>
</tr>
<tr>
<td>PULMONARY TB</td>
<td>30 (FN)</td>
<td>c 489(TN)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>77(a+b)</td>
<td>499(b+d)</td>
</tr>
</tbody>
</table>
The study results are:

Sensitivity = TP/(TP+FN) = (47/77) x 100% = 61.0% (95% CI: 50.1-71.9)

Specificity = TN/(FP+TN) = (489/499)x100%=98.0% (95% CI: 96.8-99.2)

PPV = TP/(TP+FP) =(47/57)x 100% = 82.5% (95% CI: 72.6-92.4)

NPV = TN/(FN+TN)=(489/519)x100%=96.0% (95%CI: 94.3-97.7)

Sensitivity and positive predictive value both departed substantially from 100%, leading to a rejection of the null hypothesis for those variables. Specificity and negative predictive value approached 100%, leading to acceptance of the null hypothesis for those variables. See table 6.

Table 6: Analytic performance of the surveillance database for recording EPTB

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Point estimate (%)</th>
<th>95% Confidence Interval (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>61</td>
<td>50-72</td>
</tr>
<tr>
<td>Specificity</td>
<td>98</td>
<td>97-99</td>
</tr>
<tr>
<td>Positive Predictive Value</td>
<td>83</td>
<td>73-92</td>
</tr>
<tr>
<td>Negative Predictive Value</td>
<td>96</td>
<td>94-98</td>
</tr>
</tbody>
</table>

In table 7, a frequency table for the specific site of EP involvement, with a column for the clinical data (chart abstraction) and a column for the database is generated. This table is stratified by HIV status. The key findings are that we see a high proportion of cases with unspecified site of EPTB 42 [55%] of 77 in the chart review and 18 [32%] of 57 from the database.

After subtracting out cases with unspecified site of EPTB, the database showed lymphatic involvement in 12 (31%) of 39, pleura in 33%, CNS in 15%, and skin in 15%. Disseminated TB was recorded as such in only 1% and bone 0%. Analogous figures from the record review were 31%, 26%, 14%, 11%, 3% and 0% (for lymphatic, pleura, CNS, skin, disseminated, and bone, respectively).
Table 7: EPTB by specific site of involvement, source of information and HIV status

<table>
<thead>
<tr>
<th>Site of EP Involvement</th>
<th>Clinical Chart Review</th>
<th>Surveillance Database</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIV negative</td>
<td>HIV positive</td>
</tr>
<tr>
<td>Lymphatic</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Pleural</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>CNS meningeval</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Bone/joint</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Genitourinary</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Skin</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Pericard</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Nose</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>eye</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Disseminated</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>22</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>18</td>
</tr>
</tbody>
</table>

Tables 7a and 7b show that CNS involvement with EPTB was nearly four times more likely among HIV infected patients than among HIV-negative EPTB cases. This finding approached statistical significance (p=0.09-0.11, depending on data source).

Conversely, HIV infected patients tended to be one-third to one-half less likely to develop pleural EPTB compared to HIV-negative EPTB cases; however, this finding was not statistically significant (p = 0.26-0.32, depending on data source).

Table 7a: CNS involvement with EPTB by source of information and HIV status

<table>
<thead>
<tr>
<th>Clinical Chart Review</th>
<th>Surveillance Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV-</td>
<td>HIV+</td>
</tr>
<tr>
<td>CNS</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
</tr>
<tr>
<td>Relative Risk CNS in HIV+:</td>
<td>RR=3.94 (95%CI: 0.80-19.4 ; p=0.09)</td>
</tr>
</tbody>
</table>
Table 7b: Pleural Involvement with EPTB by source of information and HIV status

<table>
<thead>
<tr>
<th>Clinical Chart Review</th>
<th>Surveillance Database</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIV-</td>
</tr>
<tr>
<td>Pleural</td>
<td>7</td>
</tr>
<tr>
<td>Other</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
</tr>
<tr>
<td>Relative Risk Pleural in HIV+:</td>
<td>RR=0.38 (95% CI: 0.54-2.59; p=0.32)</td>
</tr>
</tbody>
</table>
Discussion & Conclusion

The rationale for this study was to determine which NTP surveillance processes are contributing to the relatively low proportion of EPTB in a setting with high HIV prevalence among TB-cases. The clinical record review proportion of EPTB is about 13%, which is still very low in comparison to other settings.

For the surveillance database the sensitivity of 61% in ascertaining EPTB is very low, failing to detect almost 40% of cases (i.e., missing 4 out of 10 cases). This is, at least in part, because per database directives all cases with both EP & Pulmonary TB are (mis)classified as Pulmonary TB, which leads to under counting of EPTB in the surveillance database design.

Furthermore, even though database specificity is high (96%) for classification of EPTB, the relatively low prevalence of EPTB combined with that imperfect specificity does lead to some pulmonary cases being falsely classified as EP by the database and a resulting PPV value that also falls substantially below 100%: one in six cases classified as EPTB by the surveillance system are falsely so. Failure to ascertain EPTB, however, may not be solely a database case definition problem. The frequency of EP involvement observed via record review still falls below the range of 20-30% that one expects for EP involvement as published in case series and surveillance reports\textsuperscript{8,15}. Even higher proportions of EP involvement are observed in populations where HIV infection is common, such as in Suriname. In this context, the observed reported rate of 6-15% EPTB in Suriname seems incredibly low. Consequently, classification rules are not the sole explanation for what appears to be under-ascertainment of EPTB in Suriname. Other possible sources could include:

- failure of clinicians to recognize or report multiple sites of involvement in patients presenting with pulmonary disease as the primary site;
- omissions in documentation somewhere between the bedside and the case report that lead to loss of EP involvement that is actually clinically recognized;
- frank under-diagnosis or under-reporting of EPTB by clinicians caring for patients outside the NTP/AZ system;
- circulation of strains of Mycobacterium Tuberculosis in Suriname that lack tropism for EP sites.

In table 7 we see a high proportion of cases with unspecified site of disease (42 [52%] of 77 in the chart review and 18 [32%] of 57 from the database). Notwithstanding that, among cases with known site of disease, the most commonly observed sites were consistent with expectations based on observation elsewhere (e.g. LN 31%, pleura 26%). The relatively high proportion of CNS involvement (14%), is also consistent with findings from settings with high HIV prevalence among TB cases.\textsuperscript{1, 14, 15} Surprisingly high was the involvement of skin in 11% of cases. Unexpectedly low frequency sites of involvement were bone (0%) and disseminated (3%). Possible explanations for relative under-reporting of bone and disseminated TB include:

- reticence to conduct vertebral body or paraspinous aspiration or low sensitivity of these spinal sites for diagnosis;
- concurrent diagnosis of pulmonary involvement and under-reporting of the spinal or disseminated involvement.

As observed in work by others\textsuperscript{1, 14, 15}, a nearly-significant trend toward higher relative risk of CNS involvement and non-significant trend toward lower relative risk of pleural involvement was observed among HIV-infected EPTB cases. The immune suppression caused by HIV probably leads to greater risk of CNS involvement and is associated with less pleural TB.

The proportion of EPTB cases with unspecified site of disease may account for some of the low frequency of otherwise commonly reported sites of disease, as well as the inability to demonstrate a significant association between HIV infection and certain sites of involvement. More concerning, however, is the implications of that finding (one-third to one-half of EPTB cases having no specified site of disease) for overall quality of the TB surveillance system. In that respect, this evaluation study of EPTB in Suriname may
have raised as many questions as it answered and limit the degree to which this study’s findings can be interpreted with confidence. According to the CDC guidelines, data quality “reflects the completeness and validity of the data recorded in the public health surveillance system”. Both the clinical records which were reviewed and the surveillance database demonstrate a lack of completeness and accuracy. As an internal matter, the clarity of hard copy or electronic surveillance forms, the quality of training and supervision of persons who complete these surveillance forms, and the care exercised in data-management influences the performance of our NTP. These elements all merit heightened scrutiny going forward. At the same time, clinicians are responsible for reporting the specific site of EPTB. The high proportion of cases with unspecified site of involvement has to be traced out what can be the reasons and this has to be solved together with the treating clinicians for EPTB. As a first step, a retrospective analysis of a sample of all NTP and clinical records for such cases by a multidisciplinary group could serve.

This study shows that there are a significant low proportion of EPTB cases that is in part due to classification rules of the surveillance database. Although EPTB is less important than pulmonary TB in terms of disease control, it remains a common source of morbidity and mortality, particularly among immune suppressed individuals. Because of a high prevalence of HIV among TB patients in Suriname we need completeness and validity of the data recorded in the public health surveillance system to better understand the clinical epidemiology of TB and TB/HIV in this setting to guide future prevention and care efforts.
Recommendations

To strengthen NTP surveillance data management the following recommendations are necessary:

- Modify database to permit full counting of both pulmonary and extra pulmonary sites of disease (rather than either pulmonary or extra pulmonary). Then create analysis programs to generate the data for outside partners (e.g. PAHO, WHO) that reflects the classification rules they prefer to use for global comparisons.
- Education and training for clinicians and NTP surveillance staff regarding the importance of completeness and specificity in identifying all sites of involvement.
- Education and training for NTP data entry staff in appropriately ensuring site of disease is specified and accurately coding them.
- Supervision and systematic review of database entry to ensure accuracy and completeness of site of disease (and other key epidemiologic and clinical variables).
- Track future trends in EPTB to see if findings begin to approximate global comparison figures and, if they do not, carry out additional efforts to determine whether and why EPTB is not being diagnosed and reported more frequently.
- The NTP and the M&E unit with all the responsible partners (NTP/Epidemiology surveillance personnel, logistics, Pathology-anatomical lab, lung specialists, TB nurses, data-entry personnel) should conduct a retrospective analysis of EPTB cases with unspecified-site-of-disease records to identify where omissions or losses of information are occurring and improve the quality of data collection and management going forward.
- Streamlining of reporting processes would improve dataflow and lead to better quality data. Computer-based data entry, if well designed, will contribute to improved data completeness and quality. The M&E unit should support the NTP in making operational improvements to ensure that this occurs.
- Develop a national strategic TB surveillance plan by all stakeholders (Infrastructure, Resources, Capabilities, Scope, Organization)
References


21. Encyclopedia.com, articles about Suriname, Suriname facts, information, pictures.


**APPENDIX 1:**

<table>
<thead>
<tr>
<th>Detected by surveillance</th>
<th>Condition present</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
<td>True positive</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>False positive</td>
<td></td>
<td>A+B</td>
</tr>
<tr>
<td>No</td>
<td>False negative</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>True negative</td>
<td></td>
<td>C+D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A+C</td>
<td>B+D</td>
</tr>
</tbody>
</table>

* Sensitivity = A/(A+C)

† Predictive value positive (PVP) = A/(A+B)

Source: Center for Disease Control, Updated Guidelines for evaluating Public Health Surveillance Systems. MMWR, Recommendation and Reports, July 27, 2001/50 ( RR13 ); 1-35
APPENDIX 2:

Definitions from CDC’s Guidelines for Evaluating Public Health Surveillance Systems

Usefulness:

A public health surveillance system is useful if it contributes to the prevention and control of adverse health-related events, including an improved understanding of the public health implication of such events. A public health surveillance system can also be useful if it helps to determine that an adverse health-related event previously thought to be unimportant is actually important. In addition, data from a surveillance system can be useful in contributing to performance measures, including health indicators that are used in needs assessments and accountability systems.

Simplicity:

The simplicity of a public health surveillance system refers to both its structure and ease of operation. Surveillance systems should be as simple as possible while still meeting their objectives.

Flexibility:

A flexible public health surveillance system can adapt to changing information needs or operating conditions with little additional time, personnel, or allocated funds. Flexible systems can accommodate, for example, new health-related events, changes in case definitions or technology, and variations in funding or reporting sources. In addition, systems that use standard data format (e.g. in electronic data interchange) can be easily integrated with other systems and thus might be considered flexible.

Data Quality:

Data quality reflects the completeness and validity of the data recorded in the public health surveillance system.

Acceptability:

Acceptability reflects the willingness of persons and organizations to participate in the surveillance system.
**Sensitivity**
The sensitivity of a surveillance system can be considered on two levels. First, at the level of case reporting, sensitivity refers to the proportion of cases of a disease (or other health-related event) detected by the surveillance system. Second, sensitivity can refer to the ability to detect outbreaks, including the ability to monitor changes in the number of cases over time.

**Positive Predictive Value**
Positive Predictive Value is the proportion or reported cases that actually have the health-related event under surveillance.

**Representativeness**
A public health surveillance system that is representative accurately describes the occurrence of a health-related event over time and its distribution in the population by place and person.

**Timeliness**
Timeliness reflects the speed between steps in a public health surveillance system.

**Stability**
Stability refers to the reliability (i.e., the ability to collect, manage, and provide data properly without failure) and availability (the ability to be operational when it is needed) of the public health surveillance system.
APPENDIX 3:
CROSS-STUDY DATA COLLECTION TOOL
CLINICAL OPERATIONAL RESEARCH, SURINAME NTP, 18 JULY 2012

PATIENT CODE: __________
ACTHERNAAM: ___________ VOORNAAM: __________
GEBOORTE DATUM (DD/MM/YYYY): ___/___/____
STRAAT: ___________________ PLAATS: __________
STAD: ______________________ WIJK: __________
YEAR OF CASE REPORT: __________

NOTED RISK FACTORS:
- Immigrant (country:______________)
- Mining
- Homelessness
- Mental illness
- Prison/jail
- Diabetes
- Renal failure
- Other: ...

Final diagnosis:
- Tuberculosis--culture confirmed
- Tuberculosis--smear-positive (no culture)
- Tuberculosis--smear-negative and culture-negative
- Non-TBC mycobacterial disease
- Other (specify: ________________)
- Unknown

Case Classification
- New (first time treated for active TB)
- Previously Treated*  
  - Default
  - Failure
  - Relapse
- Transfer-in (from another country after starting treatment there)
Gross Classification of Disease Site
- Pulmonary only
- Pulmonary + EP
- EP only
- EP site: _________
- Unknown

Detailed classification of disease site (circle each site that applies):
- Pulmonary
- Extrapulmonary
  - LN
    - Cervical
    - Intrathoracic
    - Abdominal
    - Other (specify: ________________)
    - Not specified
  - Pleura
  - Peritoneum
- Bone
  - Spine
  - Hip
  - Other (specify: ________________)
  - Not specified
- CNS
  - Meninges
  - Tuberculoma(s)
- Genitourinary
  - Kidney
  - Collecting system (e.g., ureter, bladder)
  - Tubo-ovarian
  - Epididymis
  - Other (specify: ________________)
  - Not specified
- Peritoneum
- Gastrointestinal tract
- Other (specify: ________________)

Sputum--smear result at time of diagnosis
- Positive
- Negative
- Not recorded in record

Sputum--culture result at time of diagnosis

* Specify details about previous treatment (e.g., regimen, dates, reason for default or failure, etc.): _____________________________________________________________
• Positive
• Negative
• Not recorded in record

Source(s) of extrapulmonary specimen for positive TBC cultures (list each site with a positive culture if there are multiple sites):

______________________
______________________
______________________

DST results (mark each result that applies):

<table>
<thead>
<tr>
<th>DRUG</th>
<th>MOLECULAR TESTING (HAIN TEST OR XPERT)</th>
<th>CULTURE-BASED TESTING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SENSITIVE</td>
<td>RESISTANT</td>
</tr>
<tr>
<td>ISONIAZID</td>
<td></td>
<td></td>
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<tr>
<td>RIFAMPIN</td>
<td></td>
<td></td>
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<tr>
<td>ETHAMBUTOL</td>
<td></td>
<td></td>
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<tr>
<td>STREPTOMYCN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PYRAZINAMIDE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS:

Chest radiograph
• Normal
• Abnormal, consistent with TB
  o Cavitary
  o Non-cavitary (e.g., upper lobe, nodular, fibronodular, adenopathy, effusion)
• Abnormal, not consistent with TB
• Not done
• Unknown

TST result
• Done (___ mm)
• Not done
• Unknown

Date TB treatment started: _______________
If not available, date treatment initiation noted in record:______________

Treatment Regimen (choose one)
• 2HRZE+4HR
• 2HRZE+7HR
• Other (specify:___________________________________________)
• Not enough information to know
Treating Physician: Herkul Gopie Simpson Other: __________________________

Treatment Setting—Months 1-2 (circle each that applies)
- Sanatorium/AZ Ward
- Pulmonary Clinic
- NTP
- Community—Paramaribo
- Community—non-Paramaribo
- Other (specify: ____________________________)
- Not recorded

Treatment Supervision—Months 1 and 2 (circle each that applies; if multiple selections, please explain in COMMENTS section)
- DOT
- Non-DOT (specify:____________________)
- Not recorded

COMMENTS:

Treatment Supervision—Months ≥3 (circle each that applies; if multiple selections, please explain in COMMENTS section)
- DOT
- Non-DOT (specify:____________________)
- Not recorded

COMMENTS:

Sputum smear conversion documented?
- Yes (date of collection of first consistently negative specimen or date of only negative specimen __________)
- No
- Not recorded

Sputum culture conversion documented?
- Yes (date of collection of first consistently negative specimen or date of only negative specimen __________)
- No
- Not recorded

Date of last dose of TB treatment: ____________
If date of last dose not available, then give the date treatment termination was noted in record:

_______________

Treatment Outcome
- Cured
• Completed
• Defaulted*
• Failed*
• Died*
• Transferred*
• Still on treatment*
• Other*
• Not recorded

*Describe details here for outcomes (e.g., reasons, dates, etc.):

Further Information about Deceased Cases (skip to HIV section if patient survived):

Date of death:

Place of death (e.g., home, sanatorium, hospital, other):

Geographic location of death (i.e., city, resort):

Proximate cause of death (final event in sequence that led to death):

Contributing condition #1 (if present):

Contributing condition #2 (if present):

Other contributing conditions (if present):

Was death related to TB disease? (choose /circle one, then explain in a brief sentence or two why you chose that option)

Related
Unrelated
Not sure

Brief narrative summary of series of events that led to death and their degree of relatedness to TB:
Was death related to adverse effects of or drug interactions from TB treatment? (choose /circle one, then explain in a brief sentence or two why you chose that option)
Related
Unrelated
Not sure

Brief narrative summary of relatedness to adverse effects from anti-TB drugs:

HIV
- Negative (if HIV negative, stop here)
- Positive
- Not done
- Unknown

If HIV-positive:
CD4 at time closest to diagnosis:__________
  Date tested:______________
  Date noted:______________

Last known CD4
  Date tested:______________
  Date noted:______________

Other opportunistic infections or malignancies (current or past) noted in record:
  Diagnosis:_________________ Date:______________
  Diagnosis:_________________ Date:______________
  Diagnosis:_________________ Date:______________

Co-trimoxazole prophylaxis
- Yes
  - Date started:______________
  - Date noted:______________
- No
- Other (specify:______________)
- Unknown/not specified
Anti-retroviral therapy

- Yes (date started:_____________; date noted in TB/NTP record:_____________)

  If yes, specify (drugs, doses, and frequency—as much information as is known):

- Not specified
- Definitely Not on antiretroviral therapy