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Evaluation of Tuberculosis Surveillance System in Akatsi District of Ghana

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Abstract: **The study was carried out in Akatsi District in Ghana with estimated population of 117,164. The objective of the TB surveillance system was to detect early persons with infectious lung disease and treat them to reduce transmission. The TB surveillance system was evaluated to describe the operation and performance of the system using system attributes. The evaluation was conducted using the "Updated Guidelines for Evaluating Public Health Surveillance Systems'' of the Centers for Disease Control and Prevention (CDC). The Akatsi District TB surveillance system was useful and data was used for informed decision making. The system was simple, flexible and acceptable to most of the stakeholders. Data quality was good and all cases of TB were reported to the district public health office. The system was stable but its stability was threatened by occasional delay in providing sputum microscopy results. It is limited by low representativeness of the system and untimely dissemination of surveillance data to stakeholders. The system operation, availability and representativeness could be improved by opening additional TB diagnostic centres and training more laboratory staff in sputum microscopy.**

Keywords: **Ghana, Tuberculosis, Surveillance, Evaluation.**

I. INTRODUCTION

Public health surveillance is important for disease control and prevention, providing essential data and information for decision making. Evaluation of public health surveillance seeks to determine whether a health event is monitored efficiently and how well the purpose and objectives of the system is being met[1]. The purpose of the Tuberculosis (TB) surveillance system is to detect early all cases of TB occurring in the population and put them on treatment, with expected reduction in mortality and improvement in treatment outcome.

TB is a public health problem worldwide with about one-third of the world population currently infected, eight million new cases occur every year with associated two million deaths[2]. More than 80% of all TB patients live in Sub-Saharan Africa (SSA) and Asia[3,4]. Deaths from TB account for 25% of all avoidable deaths in developing countries. The global pandemic of TB is growing as a result of spread of HIV infection, breakdown in health services and emergence of multidrug resistant TB[2,5]. The risk of developing TB is higher in people infected with Human Immunodeficiency Virus (HIV) and 13% of TB cases globally were co-infected with HIV in 2011[3]. TB is more common among men than women and affects more people in the economic productive age group (15-59 years)[6]. The African Region has approximately one quarter of the world's cases, and the highest rates of cases and deaths relative to population. SSA account for 24% of the global burden of TB cases in 2010[7].

In Ghana, TB is a major public health problem. According to WHO in 2011, the estimated prevalence of TB in Ghana was 106 per 100,000 and incident rate of 86 per 100, 000 population. The number of notified TB cases has increased from 7,425 in 1996 to 15,286 in 2009[8]. However, this had not significantly increased TB case detection rate currently estimated at 31% which is way below the 50% African average and 70% global target[9,10]. More TB cases in males were notified to the National Tuberculosis Programme (NTP) than that of females at the ratio of 2:1. Between 60-70% of TB cases

reported in Ghana, occur in the economically most productive age group (15-49 years)[11]. TB mortality in Ghana is relatively high, about 7.5 per 100,000[12]. Anecdotal evidence in Korle-Bu Teaching Hospital, Accra, indicated that TB is the cause of death in one out of seven post mortems[13]. Factors contributing to high mortality were delayed in seeking care and late diagnosis of TB and HIV co-infection.

Akatsi District had estimated 120 new cases of TB in 2012. About 418 TB cases were notified between 2007 and 2011 with 22 deaths[14-18]. TB case notification had increased from 62.0 per 100,000 population in 2007 to 88.7 per 100,000 population in 2011. Case fatality rate of TB had been very high in the district, in 2007 it was 16.1% but this had reduced to 2.3% in 2011 due to improvement in case management[14,18]. TB is the main cause of death among people infected with HIV in the district.

The objectives of the Akatsi TB surveillance system was to detect persons with infectious TB lung disease early, improve chances of cure and reduce transmission. The evaluation of the Akatsi District TB surveillance system was conducted to describe the operation and performance of the system using the system attributes, to provide recommendations to improve the operation and efficiency of the system.

II. METHODS

1. Evaluation Site:

We conducted the study from January to May, 2012 in Akatsi District, located in the southern part of the Volta Region of Ghana. It has an estimated population of 117,164 in 2012. The area of the district is about 906.4 square kilometres. It shared boundaries with, Keta district in the south, Adaklu Anyigbe district in the north, Ketu South and North districts in the east and South Tongu District in the west. The district is divided into five sub-districts with 20 health facilities consisting of two hospitals, seven health centres and 11 Community Based Health Planning Services (CHPS) Zones. One of the Hospitals is the Akatsi District Hospital and the other is privately owned, St Paul's Hospital[19].

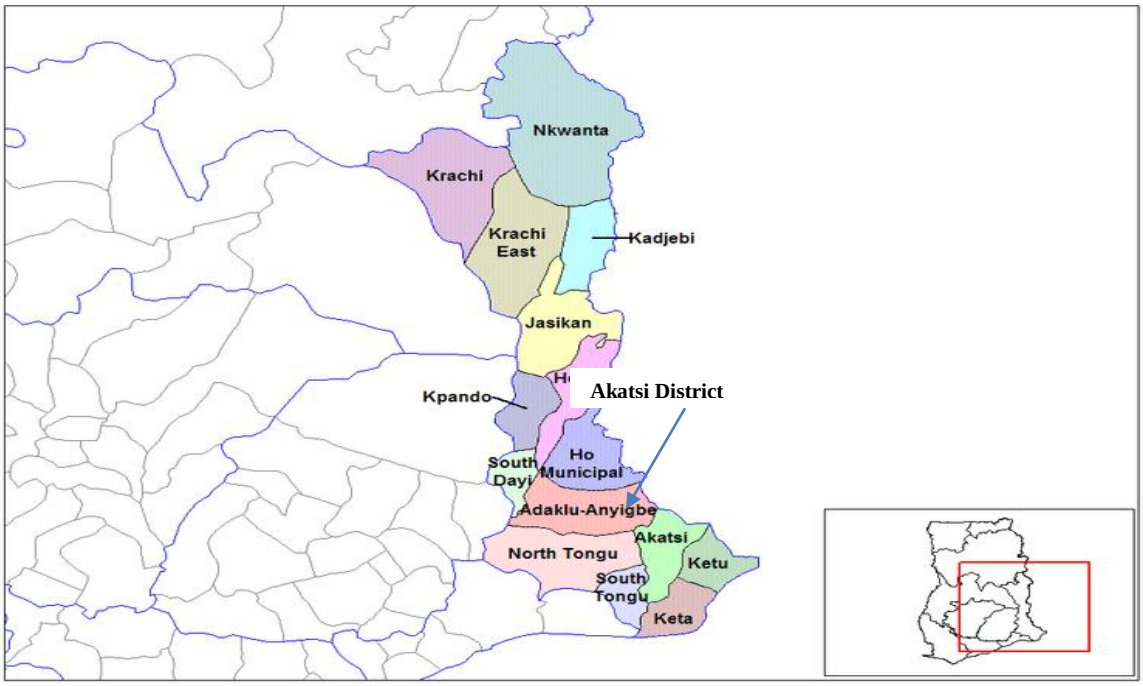

Figure 1: Map of Volta Region showing Location of Akatsi District in the region

The district has two TB diagnostic centres all located in the district capital, Akatsi. The Akatsi District Hospital and St. Paul's Hospital had one TB diagnostic centre each and are manned by trained laboratory staff. The district has one treatment centre situated in the District Hospital. The treatment centre is run by a Physician Assistant working in the District Hospital.

BCG immunization is given to newborn babies. The District Health Directorate provides health education to the public on good nutrition, early diagnosis and treatment of TB cases to reduce disease transmission and to improve on outcome of treatment for patients. Patients affected by TB in the district are mainly poor and are burden to their immediate families.

We conducted the evaluation of the TB surveillance system in Akatsi using the "Updated Guidelines for Evaluating Public Health Surveillance Systems' of Centers for Disease Control and Prevention (CDC)[20]. We reviewed records and interviewed key informants involved in TB surveillance. We visited health facilities to evaluate the use of cough registers and TB screening tools in the district. Data on TB cases in the District TB register was analyzed using EPI Info 7 to determine the data quality and representativeness of the system.

2. Data Sources:

Sources of data reviewed were Institutional TB registers, District TB register, Quarterly TB reports, Laboratory registers and District Health Information Management System (DHIMS) database.

III. RESULTS

1. Stakeholders:

In Akatsi District the stakeholders of the TB surveillance system were the District Director of Health Services (DDHS) and all the members of the District Health Management Team (DHMT). They implemented policies and made decisions for the TB surveillance system in the district and showed interest in implementing the findings to improve TB surveillance. Key informants interviewed were, District TB Coordinator, District Disease Control Officer, District Health Information Officer, Institutional TB Coordinator and Biomedical Scientist in Akatsi District Hospital.

The stakeholders of the TB surveillance system identified at the regional level were Deputy Director (Public Health) and Regional TB coordinator who were decision and policy makers on TB surveillance in the region and showed interest in knowing the level of acceptability of the surveillance system and use of cough registers in the consulting rooms in health facilities in Akatsi District.

2. Operation of the system:

TB is a notifiable disease in Ghana. The legal authority for data collection resides in the physicians and health workers who see TB cases. The population under surveillance is all the people in the district.

3. Case Definitions[21]:

The TB surveillance system in Akatsi defined a ***suspected TB*** case as any person with a cough of 2 weeks or more, a ***Confirmed Smear Positive Pulmonary TB case*** as a suspected patient with at least 2 sputum specimens positive for acid-fast bacilli (AFB), or one sputum specimen positive for AFB by microscopy and radiographic abnormalities consistent with active Pulmonary TB as determined by the treating medical officer, or one positive sputum smear by microscopy and one sputum specimen positive on culture for AFB. In addition, a ***Confirmed Smear negative Pulmonary TB case*** is a patient who fulfills all the following criteria: two sets taken at least 2 weeks apart of at least two sputum specimens negative for AFB on microscopy, radiographic abnormalities consistent with PTB and a lack of clinical response despite one week of a broad spectrum antibiotic, a decision by a physician to treat with a full course of anti-TB chemotherapy, or a patient who fulfills all the following criteria: severely ill, at least two sputum specimens negative for AFB by microscopy, radiographic abnormalities consistent with extensive pulmonary TB (interstitial and miliary), a decision by a physician to treat with a full course of anti-TB chemotherapy, or a patient whose initial sputum smears were negative, who had sputum sent for culture initially, and whose subsequent sputum culture result is positive.

4. Data Collection:

A person with cough of two weeks or more (suspected TB case) visiting a health facility was referred by health worker to the TB diagnostic centre in the District Hospital or St. Paul's Hospital for confirmation. Suspected TB cases were confirmed with sputum microcopy and or with chest X-rays. The institutional TB coordinator filled the treatment cards and capture information of TB patient into the facility TB register at the treatment centre. Patient information captured included: The name, age, sex, address of location, diagnosis, sputum microscopy results, X-ray findings, patient

classification, disease classification, treatment outcome and HIV status. A confirmed TB case was put on treatment and counseled with his/her selected treatment supporter to comply with treatment by the institutional TB coordinator. The mean time from the onset of TB symptoms to medical care was about 10 weeks.

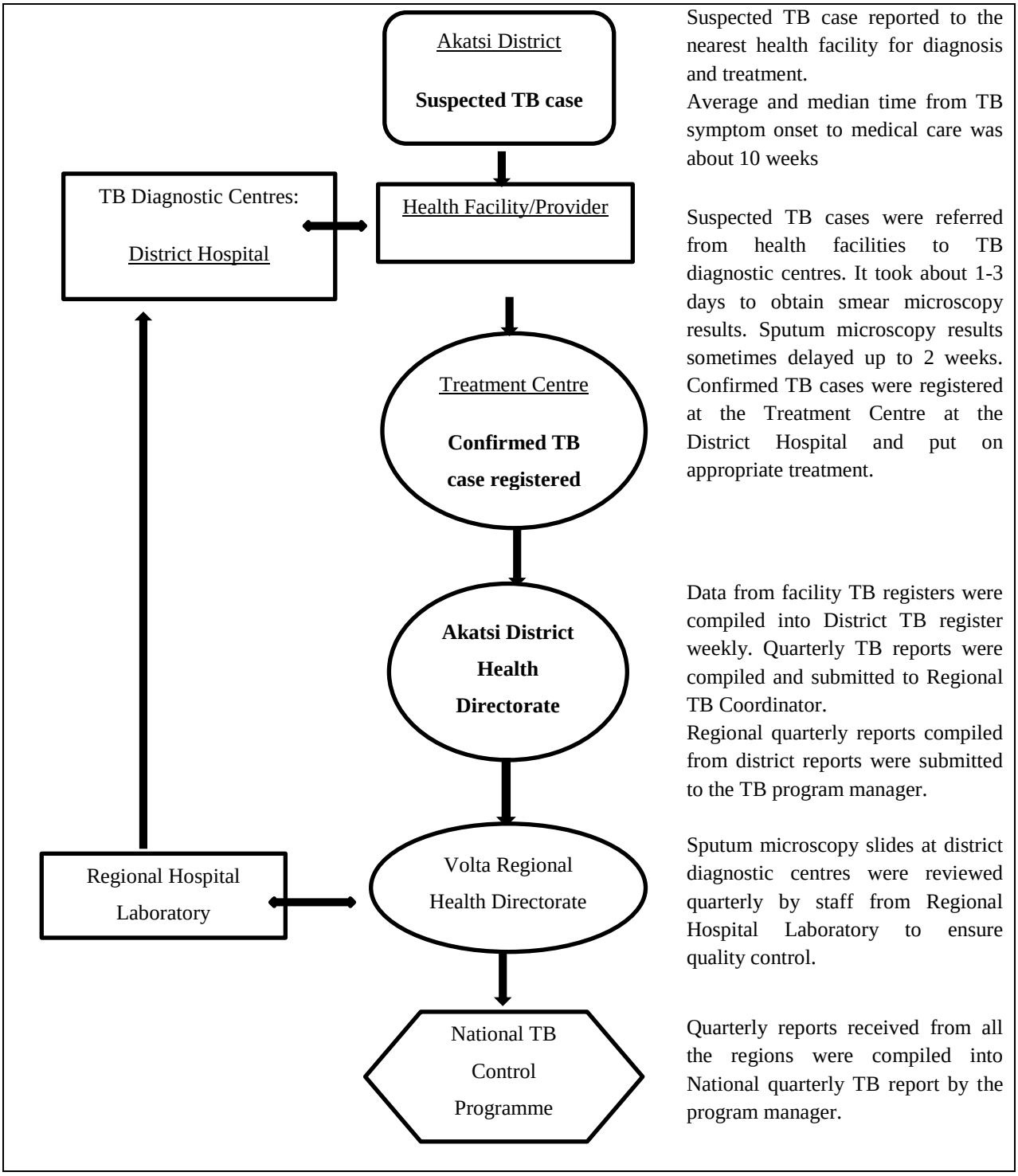

Figure 2: Data communication flow chart

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5. Data Analysis:

TB disease risk was communicated to the community by Community Based Surveillance Volunteers (CBSV) through community durbars.

Feedback provided to health facilities through quarterly review meetings and by telephone calls to facilities anytime when necessary.

Communications to the district were through quarterly regional review meetings, e-mails and telephone calls to provide feedback on reports whenever necessary. There was Facebook interaction among TB coordinators at the district and regional level.

At the national level feedback was provided through quarterly review meetings, e-mails and telephone calls.

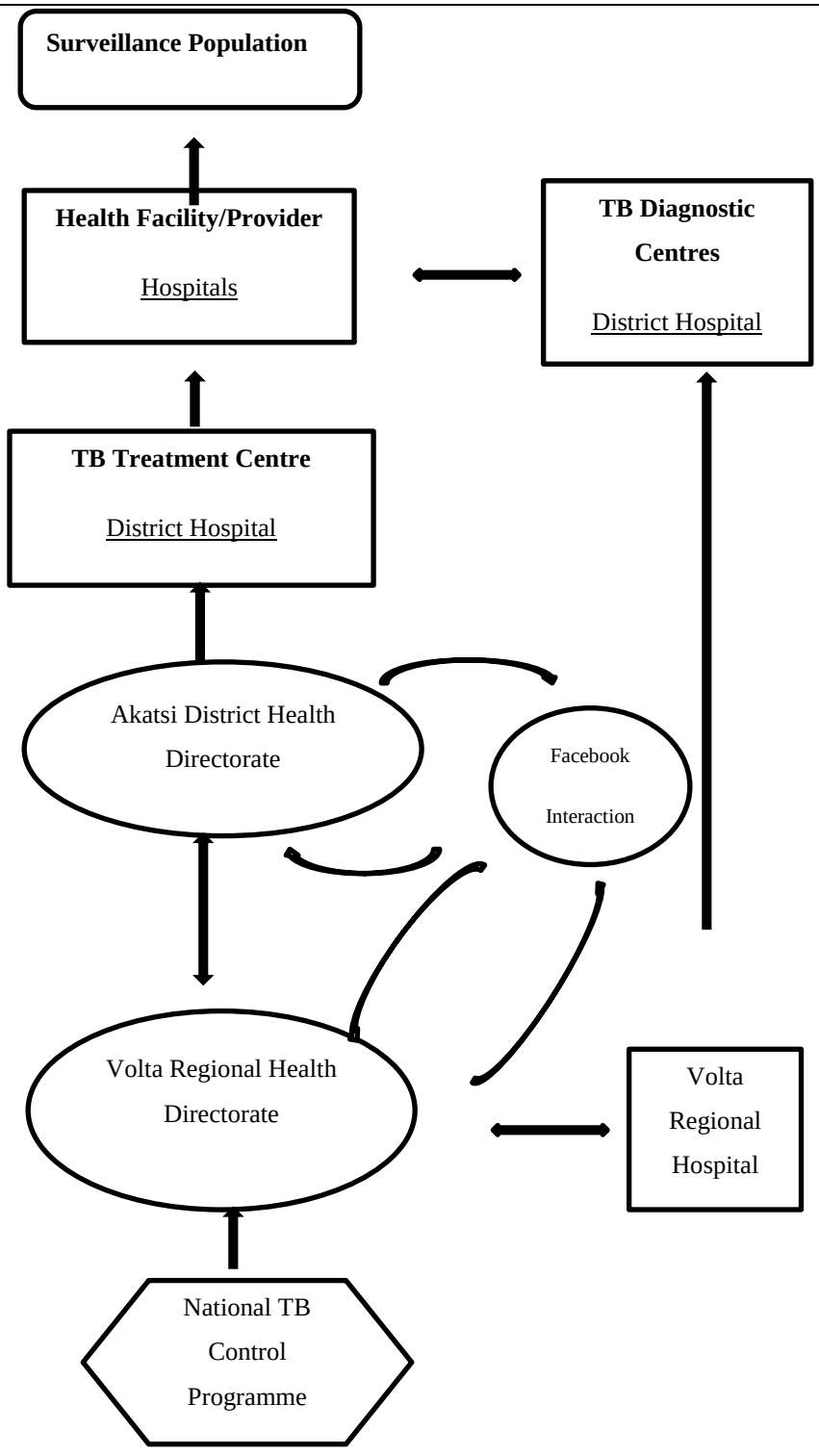

Figure 2: Surveillance information dissemination

Suspected TB cases referred from health facilities to diagnostic centres obtained microscopy results within 1-3 days depending on the availability of the designated laboratory staff for TB microscopy. Sputum microscopy results were sometimes delayed up to two weeks. Confirmed TB cases were sent to the Treatment Centre at the District Hospital where

they were registered promptly and put on treatment. The District TB Coordinator transferred all the information on TB cases in the facility register at the treatment centres into the district TB register weekly. Data from the register were analysed quarterly using a tally sheet to fill **"TB Quarterly Report on TB Registration"** form and submitted to Regional TB Coordinator. The regional TB coordinator compiled all the quarterly reports from the districts on a excel spread sheet. Regional quarterly reports generated were submitted to the TB control program manager at the National level. Sputum microscopy slides at diagnostic centres in the district were reviewed quarterly by laboratory staff from Regional Hospital Laboratory to ensure quality control. The feedback on reviewed slides were not available at the time of the evaluation.

6. Information Dissemination:

Information was disseminated through quarterly review meetings, e-mails and telephone calls. At the national level quarterly review meetings were organized for Regional TB coordinators, Deputy Directors (Public Health) and Regional Directors of Health Services. Likewise at the regional level, review meetings were organized for District Directors of Health Services, District TB Coordinators and Institutional TB Coordinators. At the district level it was for all facility in-charges, laboratory staff and Community Health Nurses. Separate meetings were held with Community Based Surveillance Volunteers (CBSV). The review meetings were held twice at all the levels instead of the planned 4 (national, regional and district level) in 2011. Disease risk was communicated to the community through CBSV. CBSVs in turn held series of durbars to inform their community members about TB.

7. Resources used to operate the system:

TB surveillance was integrated into the general health care system. However, there were focal person in-charge of various aspects of the surveillance system. At the community level, suspected TB cases were reported by Community Based Surveillance Volunteers (CBSV) to health facilities. Health workers (Physicians, Physician Assistants, Midwives or Community Health Nurses) referred suspected TB cases to TB Diagnostic Centres for sputum microscopy. The TB Diagnostic Centres had focal laboratory technician/technologist responsible for Sputum microscopy.

Table 1: Estimated personnel cost of the TB surveillance system

Level	Type of Personnel	Number of Personnel	Personnel Hours/Year	Total Annual Salary/GH₵	Total Cost/ GH₵
Community	CBSV	206	Undetermined	Nil	Nil
Health Facilities	In-charges	20	960	18,400	369,600
	Physician Assistant	1	300	14,400	14,400
	Laboratory Technician	2	1,248	16,800	33,600
District Health Directorate	TB Coordinator	1	240	14,400	14,400
	Disease Control Officers	2	480	10,800	21,600
	District Director	1	240	48,000	48,000
Total		233	2,748	122,800	501,600

There was only one TB treatment centre in the district located in the district hospital and the focal person in-charge was Physician Assistant in the hospital. The health workers involved in the surveillance system were paid by government from the consolidated fund. TB surveillance activities were funded by government and also from the Global Fund for TB, HIV/AIDS and Malaria.

The estimated total cost of the TB surveillance system in Akatsi District was GH₵518,816 consisting of personnel cost of GH₵501,600 and material cost of GH₵17,136. In 2011, GH₵8,287.32 was received for the TB control programme. This was inadequate compared with GH₵17,136 that was estimated as material cost.

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Table 2: Estimated material resources required for operating the system

Activity	Number of People	Frequency	Unit Cost/GHC	Total Cost/GHC
Quarterly Regional Review meeting	2	4	170	1,360.00
Quarterly District Review meeting	20	4	18	1,440.00
Quarterly meeting with CBSV	208	4	5	4,160.00
Contact Tracing	2	12	32	768.00
Defaulter tracing	2	12	40	960.00
Providing enablers package for TB patient	30	4	30	3,600.00
Treatment monitoring	2	12	32	768.00
Internet Service/Telephone call	2	12	10	240.00
Monitoring and Supervision	4	12	80	3,840.00
Total				**17,136.00**

8. System Performance:

8.1 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 implications of such events[20]. In Akatsi District TB surveillance system, data was used for informed decision making, planning of TB surveillance activities, developing priorities and involving community in TB control programs. In 2010, the District Health Directorate noted increased number of relapsed TB cases in the district. Investigations conducted revealed most of the relapsed TB cases lack treatment supporters; they were defaulting and not complying with prescribed treatment. Treatment supporters were made compulsory for patients before initiating treatment. This decision resulted in reduction of relapsed cases from 12 in 2010 to seven in 2011.

Decision was also made to improve on their low TB case detection rate by contact tracing, case search in Prayer Camps and use of cough registers in all the health facilities in the district using simple case definition of suspected TB case as any person with cough of two weeks or more. A screening tool for TB was also introduced to all chemical shops in the district where persons with suspected TB were screened and referred to diagnostic centres for sputum microscopy. This decision had increased case detection rate from 40.6% in 2010 to 43.7% in 2011.

8.2 System Attributes:

8.2.1 Simplicity:

Simplicity of a public health surveillance system refers to both its structure and ease of operation[20]. Surveillance system should be simple as well as meeting its objectives. Simplicity relates closely to acceptance, timeliness and the amount of resources required to operate the system. The TB surveillance system in Akatsi was simple. It uses a simple case definition, data management and analysis was easy. It takes a short time to fill the forms and patients were not followed to obtain additional information. The users described the system as simple.

8.2.2 Flexibility:

Flexibility refers to how the system could easily adapt to incorporate new demands or operating conditions with little input of resources[20]. The TB surveillance system was able to incorporate easily activities of HIV screening for all TB cases and the forms were adapted without difficulty to collect data on TB/HIV activities with ease. Recently, cough registers were introduced to health facilities in August, 2011 to improve on TB case detection. This was easily incorporated into the operation of the system. The system would adapt easily when the proposed division of the district into Akatsi South and North Districts is implemented.

8.2.3 Stability:

Stability is the ability of the system to be available, reliable and function in a consistent manner overtime[20]. The system has two diagnostic centres in the district, all located in the district capital with only one dedicated staff each. The system became unavailable when focal persons were assigned other official duties. The diagnostic centre in the district hospital

turn out results within 1-3 days after receipt of samples. Sometimes results were delayed up to two weeks. However, five other laboratory staff were available but unwilling to assist in the sputum microscopy. Occasional shortage of reagents in the laboratory made the system unavailable and unreliable. The diagnostic centres were unevenly distributed in the district making it inaccessible geographically and financially for communities far from the district capital.

Apart from delay in laboratory diagnosis, little time was spent in collecting and managing the data. The institutional coordinator spent about two hours a week in collecting relevant information from the patient and filling the TB register. At the district level, the district TB register was updated weekly. Data was compiled and analysed quarterly. The district TB coordinator required one hour per week to manage surveillance data.

8.2.4 Timeliness:

Timeliness reflects the speed between steps in a public health surveillance system[20]. The mean time from development of symptoms of TB to diagnosis at the health facility was 10 weeks (Range 8-12weeks). Quarterly Reports from District Health Directorate (DHD) to regional were timely.

There were delays in obtaining sputum microscopy results, especially in the district hospital. About 94.7% of the sputum microscopy was done at the District Hospital and 5.3% was in St. Paul's Hospital. The delays were as a result of unwillingness of some of the district hospital laboratory staff to carry out sputum microscopy on account of fear of infection.

Dissemination of information from DHD to facilities was not timely. Out of the four quarterly meetings planned in 2011, only two were held. There was Facebook interaction between stakeholders in the regional and district level on TB activities which was laudable. In this forum information on data submission and feedback were provided. All TB coordinators at regional and district level including District Directors of Health Services were involved.

8.2.5 Acceptability:

Acceptability reflects the willingness of persons and organizations to participate in the surveillance system[20]. Acceptability is largely subjective attribute and depends on the willingness of people involved in the public health surveillance system to provide accurate, consistent, complete, and timely data. Most stakeholders were willing to participate in the system. The facility reporting rate was 100%, however, there were delay of getting microscopy results from the laboratory.

8.2.6 Data Quality:

Data quality reflects the completeness and validity of the data recorded in the public health surveillance system[20]. Completeness of data collected was determined by estimating the unknown or missing values in the district TB register. The data in the register was complete for most of the variables for majority of the patients. But columns for sputum results after two-three months of treatment, five months of treatment and outcome of treatment were missing for some of the patients. The mean number of missing values in the register was five. The data quality was good and all cases of TB were reported to the district public health office.

Table 3: Number and proportion of missing entries in District TB register in Akatsi District, 2012

Month	Expected number of entries	Number of missing entries for Smear Results				Number of Missing entries for outcome
		Before Treatment	2-3 Months	5 Months	End of Treatment	
January	10	0	1	1	0	1
February	15	0	0	1	1	0
March	8	0	1	2	2	1
April	5	0	1	1	1	1
May	7	0	0	1	0	2
June	12	0	1	1	2	1
July	14	0	0	0	0	0
August	9	0	0	0	0	0

September	6	2	0	0	0	0
October	10	0	0	0	0	0
November	0	0	0	0	0	0
December	6	0	0	0	0	0
Total	**102**	**2**	**4**	**7**	**6**	**6**
Percent (%)	**100.0**	**2.0**	**3.9**	**6.9**	**5.9**	**5.9**

8.2.7 Sensitivity:

The sensitivity of a surveillance system can be considered in terms of the proportion of cases of a disease or health event detected by the surveillance system[20]. The sensitivity of the system was low. TB case notification in the district had increased from 41.2% in 2010 to 44.4% in 2011, the 102 cases detected in 2011 was below the expected 230 TB cases for that year. Even though, a lot of innovations had been undertaken to increase case detection by introduction of Cough Registers and TB screening tool, only 8 of the health facilities out the 20 were using the Cough Registers. However, the increase in TB case notification was attributed to the introduction and use of the cough registers. There was no variability in the data submitted from the treatment centre to the District Health Directorate. However, there was great variability between cases captured by the district TB register and District Health Information Management Systems (DHIMS). This was because confirmed TB cases were not entered into the consulting room registers in the district hospital. The total number of TB cases captured in the monthly morbidity returns in 2011 was seven and six of these were captured by the TB register.

8.2.8 Predictive Value Positive (PVP):

The Akatsi District TB surveillance system uses sputum microscopy as the gold standard (currently sputum culture is now considered the Gold standard). There were two diagnostic centres in the district. Smear positive cases were 49 confirmed by microscopy.

Total TB cases were 102.

$$\text{PVP} = \frac{\text{Number of suspected TB cases confirmed with sputum microscopy}}{\text{Total number of suspected TB cases}} \times 100$$

$$\textbf{PVP} = \frac{\mathbf{49}}{\mathbf{102}} \times \mathbf{100} = \mathbf{48.0\%}$$

Estimated PVP was 48.0%. This was lower than expected but was an improvement over the previous year which was 15.1% (2010).

8.2.9 Representativeness:

A public health surveillance system, that is representative, accurately describes the occurrence of the health-related event over time and its distribution in the population by place, person and time[20]. The district had two diagnostic centres and one treatment centre, all located in the district capital. Suspected TB cases were far from the district capital and some had financial difficulties in getting transport to access these facilities. Accessibility to diagnosis might affect representativeness of the surveillance system. The representativeness of the Akatsi District TB surveillance system was also determined by comparing the sex, Age and geographical distribution of TB cases in the district with those in the whole of the Volta Region. About 53.9% of the TB patients in the district were females and 46.1% (47) were males. The sex distribution of TB cases in Akatsi District was not representative. According to the World Health Organization (WHO) report of 2011, TB affects more males than females[6] this was also confirmed by the sex distribution of TB cases reported in 2011 at the Volta Regional Health Directorate[22], where male TB cases were 58.9% and females were 41.1%.

Table 4: Sex distribution of TB cases in Akatsi District and Volta Region

Sex	Akatsi District	Volta Region
Males	47(46.1)	909(58.9%)
Females	55(53.9%)	634(41.1%)
Total	102(100.0%)	1543(100.0%)

Geographically, majority of the TB cases (41.2%) were from Akatsi town where the two diagnostic centres were located and only 1.0 - 2.9% of the cases were in other towns of the district. In the same way, the occurrence of TB in Akatsi sub-district was 64.7% but in the other sub-district it was less than 10.0%. This might be due to accessibility of the diagnostic centres to communities in Akatsi Sub-district compared to the other sub-districts. It was notable that 6.9% were from neighbouring districts where the communities were closer to the diagnostic centres. The TB surveillance system was not representative.

Table 4: Distribution of TB cases by sub-district in Akatsi District in 2011

Sub-district	Number of TB Cases	Percent (%)
Akatsi	**66**	**64.7**
Avenorfeme	**10**	**9.8**
Gefia	**9**	**8.8**
Wute	**6**	**5.9**
Anyako	**2**	**2.0**
Ave Dakpa	**2**	**2.0**
Outside Akatsi District	**7**	**6.9**
Total	**102**	**100**

IV. CONCLUSION

The TB surveillance system in Akatsi District was good. It was simple, flexible, acceptable and stable and meeting its objectives. Data was used for decision making. It is limited by inadequate number of accessible diagnostic centres, untimely dissemination of results and low representativeness of the system.

Opening of additional diagnostic centres in other health facilities would increase accessibility, availability and representativeness of the system. Even though, data quality was good, ensuring complete data entry in the TB register especially for sputum microscopy results during treatment would help in accurate evaluation of treatment outcome. All laboratory staff working in TB diagnostic centres need to be trained and encouraged to perform sputum microscopy to make TB surveillance system more acceptable, available and stable. Active use of cough registers at health facilities would increase TB case detection and improve the sensitivity of the system. Timely and regular meetings is important to provide needed feedback to stakeholders.

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