1.0 INTRODUCTION

1.1 BACKGROUND

Tuberculosis ranks among the top ten causes of global mortality. Globally it kills nearly 2 million people each year and is the second leading cause of death after Human Immune Deficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS).Tuberculosis (TB) is primarily an illness of the respiratory system, and is spread by coughing and sneezing from an infectious person. Nearly a third of the world's population is infected with the bacilli that causes TB and are at risk of developing tuberculosis (TB).[1, 2] Left untreated, each person with active TB disease will infect on average between 10 and 15 people every year. In 2004, estimated per capita TB incidence was stable or falling in five out of six World Health Organization (WHO regions, but growing at 0.6% per year globally. The exception is the African region, where TB incidence was still rising.[3, 4]

HIV increases the risk of developing TB and accounts for much of the increase in countries where prevalence is high. [4] Co-infection is common and could be as high as 70% in high-burdened countries. Gains made in global TB control in the 1970 and 80s are being dramatically reversed by the effect of HIV/AIDS. HIV is the main reason for failure to meet Tuberculosis (TB) control targets in high HIV settings.[3]

Drug-resistant TB is a major problem. Resistance to single anti-tuberculosis drugs have been reported in almost every country surveyed. To make the situation worse, drugs resistant to all the major anti-TB drugs have emerged. [4] Drug-resistant TB is caused by inconsistent or partial treatment, when patients do not take all their medicines regularly for the required period because they start to feel better, because doctors and health workers prescribe the wrong treatment regimens, or because the drug supply is unreliable. A particularly dangerous form of drug-resistant TB is multidrug-resistant TB (MDR-TB), which is defined as the disease caused by TB bacilli resistant to at least isoniazid and rifampicin, the two most powerful anti-TB drugs.[4, 5]

Directly-Observed Therapy Short Course (DOTS)

In the early 1990s, the essential tools and services needed for management of TB were packaged as a strategic program called Directly Observed Treatment Short Course (DOTS). The organizational principles of the DOTS strategy are the availability of a decentralised diagnostic and treatment network based on existing health facilities and integrated with primary health care, good programme management based on accountability and supervision of health care workers and an evaluation system of case-finding and cohort analysis of treatment outcome. [2] The DOTS strategy refers to the broad comprehensive plan for TB control through crucial health system interventions: it includes the five essential elements (political commitment, case detection through smear/bacteriology, effective drug supply, standardized treatment with patient support, and monitoring and evaluation system). Global TB control hinges on the success of this strategy.

Direct observation of therapy (DOT) refers to only one component of the DOTS strategy. It refers to the actual administration of the TB drugss. It has been shown that a cure rate of 95% can be achieved under this program using several potent antibiotics for 6 months or more. Under the program, patients are expected to take their medication under supervision by a health worker or community volunteers through the course of treatment. [6]

In March 2000, the Amsterdam Declaration to Stop TB called for increased political commitment and financial resources to reach the targets for global TB control by 2005. In May 2000, a World Health Assembly (WHA) resolution restated this call. In response to both the Amsterdam Declaration and the WHA resolution, National Tuberculosis Programme (NTP) managers of the 22 high-burden countries, technical partners, financial partners, and the global TB network of WHO agreed to develop a Global DOTS Expansion Plan (GDEP) at the first DOTS Expansion Working Group meeting in Cairo in November 2000. As at 2004, DOTS was being applied in 183 countries. Areas of particular weakness are laboratory services, human resource development and the monitoring of TB/HIV control. [4] The main procedure for TB diagnosis is sputum smear microscopy.

However, this procedure picks only about 60% of smear positive pulmonary TB cases. Smear negative PTB cases are more common in HIV sero-positive cases although smear positive disease predominates.[6]

Case detection in 2004 was 53% globally, and was likely to exceed 60% in 2006, falling short of the 70% target: Treatment success was 82% in the 2003 cohort of 1.7 million patients, approaching the 85% target. Overall, the implementation of a newly-launched global plan is to reverse the rise in incidence globally by 2015, as specified in the Millennium Development Goals.[7, 8]

1.2 LITERATURE REVIEW

The World Health Organization (WHO) estimates that the largest number of new TB cases in 2004 occurred in WHO's South-East Asia Region, which accounted for 33% of incident cases globally. However, the estimated incidence per capita in sub-Saharan Africa is nearly twice that of the South-East Asia Region, at nearly 400 cases per 100 000 population. In sub-Saharan Africa, there was an increase in 20% in incidence mostly in countries worse affected by HIV/AIDS epidemic. [5] It is estimated that 1.7 million deaths resulted from TB in 2004. Both the highest number of deaths and the highest mortality per capita are in the WHO Africa region. [3, 4] The achievement of global targets for TB control will depend on the achievement of successful TB treatment outcomes in the micro-communities of sub-district, district, countries and sub-region. [9] Treatment outcome in new pulmonary smear-positive patients is used as a major indicator of programme quality.

Cohort analysis

The recommended approach by WHO and IUATLD for evaluation of outcomes of TB treatment services at community level is the process of Cohort Analysis.[9] A cohort is a group of patients diagnosed and registered for treatment during a specific period. Treatment outcome for all the patients in the cohort is done according to WHO and International Union Against Tuberculosis and Lung Disease (IUATLD) classification for outcomes. There are six standard mutually exclusive outcomes for TB patients. These are cured, treatment completed, treatment failure, died, default (treatment interrupted) and transferred out which are further explained in table 1.The denominator for all outcomes is the number of cases registered for treatment. These figures are reported as percentages of all registered cases within a specified period. Although treatment outcomes are expressed as percentages, they are usually referred to as "rates".

Cohort analysis is the key management tool for evaluating the effectiveness of NTP. It allows the identification of problems, so that the NTP can institute appropriate action to overcome them and improve programme performance. It is recommended that cohort analysis be undertaken at district, regional and national levels if corrective action is to be taken. [2, 9]

Table 1: **Treatment Outcome categories**

Outcome Category	Definitions of outcome (WHO/ IUATLD)	Summary categories (WHO)
Cured	Patient who is smear negative at one month prior to treatment completion and at least one previous occasion during the course of treatment.	Successfully treated
Treatment completed	Patient who has completed full course of treatment but has no proof of cure.	
Death	Patient who dies from any cause during the cause of treatment.	Unsuccessful treated
Treatment failure	Patient remains positive or has become positive after five months of treatment.	
Treatment interrupted(defaulted)	Patient whose treatment was interrupted for two months or more.	
Transfer out	Patient who has been transferred out to another unit and whose treatment outcome is unknown.	
Not evaluated/Unknown	No information on treatment outcome.	

Source: World Health Organization. Global Tuberculosis Control. WHO Report 2004

Tuberculosis in sub-Saharan Africa

Although, treatment success rates vary in developed and developing countries, studies in sub-Saharan Africa on treatment outcomes suggest that management of TB is still a big challenge. WHO reports suggest that treatment success rates under DOTS varies from 69% in sub-Saharan Africa to 94% in western pacific. By the end of year 2003, 22 countries had reached 70% target of case detection of new smear-positive and 85%

of treatment success rate. However treatment success rate has been much lower in countries such as Swaziland and Uganda because of high death rates due to TB/HIV co-infection.[8]

A study conducted in South Africa in an urban out-patient specialist TB facility revealed that males were more likely to default and increasing age was significant for death.It was also found that negative pre-treatment sputum smears and those who were unemployed were more likely to be lost to follow-up.[10]

A retrospective cohort analysis of TB treatment outcome in Ile-Ife in Nigeria found high cure and completed rate (86%) of Pulmonary Tuberculosis (PTB) patients. Patients' compliance was good irrespective of age, sex and proximity to the health facility. The rate of treatment failure, default and transferred out were comparable in both sexes.[11] Similar success rates have been reported in some developed countries like Italy and Canada.[12] [13] In contrast, Salami AK and Oluboyo PO in Ilorin, Southern Nigeria, did a similar study but found very low cure rate (43.7%) and a high default rate (44.2%). Poor outcomes were associated with male gender, age above 65 years and unemployment.[14]

Being smear positive or negative PTB can influence the outcome of treatment.A study of treatment outcomes in all PTB cases in Malawi found significant differences in treatment outcomes between smear negative and smear positive PTB cases in age range 15 to 44 years. They also reported a higher mortality in smear negative PTB due to HIV sero-positive status with an advanced immune compromised and low CD4 count at the time of diagnosis.[15, 16]

Tuberculosis control in Ghana

Ghana is a West African country with a population of about 21.8 million. It covers a land area of approximately 238,533 sq km. The country shares border with Cote D'voire to the west, Burkina Faso to the north and Togo to the east. The country is divided into ten administrative regions and 110 districts. The country's gross domestic product (GDP) is about 1302 US dollars. Average HIV sero-prevalence is 3.4%.

However HIV sero-prevalence rate of over seventy percent have been reported among commercial sex workers in Accra and Kumasi, the two biggest cities.[17]

TB is a major health problem in Ghana. Statistics on the disease are incomplete but indications are that the incidence is high and is rising alarmingly. it is estimated that over half of the adult population in Ghana are infected although the majority do not have the clinical disease.[18,19]

WHO estimates that in a district of about 100 000 population in Ghana, 200 new cases should be expected every year, out of whom 100 are expected to be infectious and 100 are expected to die because they will either not report for treatment or would be misdiagnosed and put on wrong treatment. Ghana has been recording a steep rise in TB cases since 1995 at an average of about 12 000 new cases every year compared with an average of 5 000 cases per year in the 1980s.[19-21] The Ghana Ministry of Health estimates that TB cases in the country will rise to 80 000 per year if adequate measures are not put in place.
In year 2002, the national TB control program achieved 56% cure rate, falling short of the global target of 85% for newly detected smear positive TB cases. [21, 22]

The proportion of sexes among patients below age 15 in Ghana to be about the same. However, there are more men with TB than women in age 15 and above. The worse affected age group with PTB is 15 - 49 years.[7]

The Ghana Health Service operates a well-integrated tuberculosis control program. The National TB Program (NTP) launched in June 1994 is the principal executing agency. It was for many years supported by the Danish government and is currently supported with a grant from the Global Fund and the Government of Ghana. The NTP was established with an aim to reduce the transmission of the disease to a level where it will no longer be a major public health problem.

The main strategy for TB control programme is DOTS as recommended by World Health Organization. Through this strategy, the NTP was expected to decentralize the diagnosis and management of tuberculosis, with the introduction of widely available sputum microscopy and rigorous training of health personnel. This was intended to reduce doctor delay and thereby improve tuberculosis control.[18] The National Tuberculosis Control Programme (NTCP) has established the Central Tuberculosis Unit (CTU). A national tuberculosis control advisory committee made up of people from academia, clinical practitioners and other stakeholders support the NTP through technical advise, advocacy and review of policies, strategies and plans for action.

At regional level, a senior medical officer with a degree in public health is responsible for TB control. He/she is assisted by a coordinator in the day-day monitoring of TB activities including supervision of TB control activities, training of district staff, compilation of regional data, dug supply, laboratory reagents and equipment. He/she works closely with the central unit.

At the district level, the district director of health services is primarily responsible for TB control assisted by a district coordinator. He/she ensures that the national technical guidelines are being followed by all NTP implementing institutions.

DOTS is now implemented in all 110 districts but with evidently varying degree of success. All the DOTS centers in the country are static. There is no ongoing ambulatory TB treatment. Case-finding is passive and eight months short course chemotherapy is the standard of care. Drugs for the treatment of TB are centrally supplied to regions and districts and administration is guided by the national TB treatment guideline produced by the NTP. Drugs used are rifampicin, isoniazid, pyrazinamide, and streptomycin in the intensive phase and isoniazid and thiacetazone in the continuation phase. Routine Voluntary Counciling and Testing (VCT) for HIV is not a policy in TB patient management.[19, 20] However, patients who get adverse drug reaction to thiacetazone are put on ethambutol.

Very scanty epidemiological analysis of operational data on TB in Ghana, at national or district level, is published in the literature. A pubmed search of articles on tuberculosis in Ghana using the words "Tuberculosis, Ghana" yields a total of 78 articles, less that 20% of which report analysis of treatment outcome and its determinates within the national control program. Such analysis, in the context of operational research is needed to be regularly undertaken and reported to guide the control program.

In a retrospective comparative case notes review of patients who died or were cured of tuberculosis at the Komfo Anokye Teaching Hospital found that mortality was associated with HIV positivity, increasing age, residence in a rural area, sputum-smear negative and more prolonged symptoms duration prior to initial diagnosis. Furthermore, patients who died were 2.1 times more likely to have a history of previous TB treatment, 2.0 times more likely to have previously defaulted from treatment, and 2.9 times more likely to have at least 5 chest radiographic zones affected by disease.[23] In a study that investigated factors associated with treatment default and completion at the Effia-Nkwanta hospital in the western region of Ghana found default from treatment was significantly associated with income per month (P = 0.03), ability to afford supplementary drugs (P = 0.008), availability of social support (P = 0.005) and problems relating with others while on treatment (P = 0.01). A cordial relationship between patients and health staff was the main motivating factor for completion of treatment, whilst financial difficulty was the main reason for defaulting from treatment.[24]

In a separate report from the same hospital, a defaulter rate at the same hospital was reported to be 13.9%. Default from treatment was significantly associated with male sex, smear positivity and living in communities far from the treatment centre. The mean defaulting moment was 3.4 months. The overall probability of a patient remaining on treatment 5 months after starting was 3.6%.[25]

A study in rural southern Ghana reported that being a female, young in age (less than 25 years) and living in close proximity to a health facility were associated with good compliance and higher cure rate. [26] They found that male gender was a highly significant risk factor for default. Similar findings have been made in studies in the Gambia, Madagascar, Saudi Arabia and Malaysia.[27-29] No report of similar parameters is available from other parts of the country to permit an in-country comparative review. No report on TB incidence and treatment outcomes in the northern parts of the country exist in the peer-reviewed literature.

Tuberculosis control in Kassena Nankana District (KND)

The Kassena-Nankana district is one of the 110 administrative districts in the country. It is located in the Upper-East region and shares border to the north with Burkina Faso. It covers a land area of 1685km square and has a population of 141,000, most of whom are peasant farmers. Most of the KND is rural. Only the central area, Navrongo, the district capital is of sub-urban character. Health service delivery is administered through the District Health Management Team. Health facilities in the district include a 130-bed referral hospital located in Navrongo and four health centres located within the four principal geographical cardinals. Laboratory services are only available at the district hospital. The hospital is all purpose and has a special ward for the management of TB patients.

DOTS was launched in the KND in 1994. There are four primary health care centres, one each in the East, West, North and Southern zones in the KND. Suspected cases of tuberculosis report directly to the out-patient department of the hospital usually with a history of unsuccessful treatment with antibiotics for upper respiratory tract infection or pneumonia at the health center level.

At the outpatient department suspected TB Patients are sent to the hospital laboratory where early morning sputum is collected on three consecutive days. Sputum smears are prepared and the slides stained with Ziehl Nielsen. It takes an average of about two to three weeks for microscopy results to be available. This is because the hospital has for a long time had only one microscope which is used for all of its microscopy work. At least two sputum smear examination must be positive for *Mycobacterium tuberculosis* for diagnosis of smear-positive PTB. A chest radiograph is done in the investigation of each suspected case .If all three sputum examinations are negative, patients are put on antibiotics. If no improvement after a full course of antibiotics but clinical and chest x-ray findings are suggestive of tuberculosis, a presumptive diagnosis of smear negative pulmonary TB is made. However, periodic shortage of reagents for Ziehl Nielsen stain is not uncommon. The laboratory does not have facilities for sputum culture. The attending clinician prescribes the TB regimen according to the guidelines developed by NTP. The TB regimens comprise short course chemotherapy for pulmonary smear-positive cases and very ill smear-negative patients, standard course chemotherapy for smear negative and re-treatment course for relapses and treatment failures.

All drugs for TB treatment are free. However, if there is any concomitant illness, patients pay for the drugs for that particular illness. Drug supply for TB treatment is from the central pharmacy to the regional pharmacy. The district TB coordinator receives supplies from the regional pharmacy. A buffer stock is stored at the district hospital. Tuberculosis service at the hospital is largely a nurse-run service. A medical officer is called when there is a particular indication, such as any severe illness.

All TB patients are registered in the district TB register. This register is also used to capture information on demographic characteristics, disease category, treatment regimen and outcome of treatment. All TB patients are admitted for two months during the intensive phase of treatment. The average daily occupancy rate of TB beds is 5.72 according to the hospital records. Daily supervision of drug intake by nurses is undertaken in the ward. Sputum-smear examination is done at the end of the intensive phase. If the two months sputum smear examination is negative, the patient is discharged with a four-week course of drugs and asked to report to the hospital monthly for drug refills, weight check and an assessment of general well-being.

Patients who remain smear positive at 2 months of treatment see the medical officer and usually remain admitted for supervised treatment until they become smear negative before discharge. In addition to this, each patient is given two client cards. The card contains summary information on the patient including doses of the TB drugs the patient is taking and the number of days or months the patient has taken her drugs. The client cards are kept on the ward during the intensive phase and the nurse charts on the cards each time the patient takes his or her drugs.

After the two months intensive phase, one of the cards is given to the patient to take home after being taught how to complete the drug chart and the other is kept on the ward. The patient brings the card to the TB ward every month when he or she comes for refill of TB drugs. The nurse counts the number of tablets the patient has charted on the card. She then supplies the drugs for another month.

Although it is intended that direct observation of treatment be done during the continuation phase, this is hardly achieved. There is no direct supervision of intake of drugs once discharged from the hospital. The health centers do not play any role in the continuation phase of TB treatment. Patients in the continuation phase get sputum smear examination done again at the fifth and eighth month for those on short course and fifth and twelfth month for standard course regimens. Nurse-in-charge of the TB ward does the monthly follow up and documents treatment outcomes in the TB register. The sub-district health centres are however brought in when a patient refuses admission for the intensive phase. The injectable anti-tuberculosis drug (streptomycin) is sent to the nearest health centre where the patient goes daily for the injection until the intensive phase has been completed. However, more than 95% of the patients accept to be admitted in the ward.

In spite of the fact that DOTS strategy has been in existence in the district for over ten years, no systematic cohort analysis of TB patients has been conducted over the period to evaluate the program to guide the implementation of the strategy. No epidemiological data about TB in KND exist in the literature. This study uses available data at the district hospital and seeks to describe the background epidemiology and set baseline parameters against which progress or an intervention could be instituted and monitored by the district health management team and the research center.

1.3 PROBLEM STATEMENT AND JUSTIFICATION FOR THE STUDY

Poor TB treatment outcome with a lot of failures, defaulters and deaths have been a focal point for discussion in recent years in Ghana. Poor patients' compliance leads to treatment failures and usually patients' interrupt or stop treatment before the end for various reasons. This causes significant public health problems and possible development of multidrug resistant strains. Knowing about factors associated with treatment outcomes in particular settings gives more insight to strategic approach to better management of TB cases. The variations in treatment outcomes shown in the different studies and the low cure rate reported in studies in Ghana justify studies to examine the various treatment outcomes especially in rural communities in northern Ghana

The Navrongo Health Research Center located in the Kassena-Nankana district maintains a demographic surveillance system within the entire district. Using this system, the research has been able to conduct important operational research that has significantly influenced government policy in health delivery system. The system enables a plethora of operational research designs to be deployed. The Research Center is a Ghana Health System (GHS) facility and the findings of its research studies are presented in reported and research papers to the GHS. No research activities have been undertaken in the area of tuberculosis in the KND.

1.4 AIM AND OBJECTIVES OF THE STUDY

The aim of this study was to assess treatment outcome of Pulmonary Tuberculosis (PTB) cases from January 1998 to December 2002 in the Kassena Nankana District of Northern Ghana.

The objectives are:

1. To describe the profile of PTB patients diagnosed at the district hospital.
2. To determine the treatment outcome of PTB cases in the Kassena Nankana District Hospital over a 5 year period, January 1998 to December 2002,using treatment outcome indicators recommended by the WHO and the IUATLD.

3. To determine factors which influence treatment outcomes in PTB cases from January 1998 to December 2002.
4. To describe the trend of pulmonary tuberculosis treatment outcomes in relation to case notification over the five year period.
5. To provide information essential for setting the agenda for operational research in TB management in the Kassena-Nankana district.

2.0 METHODOLOGY

2.1 Study design:

This was an analytical study using existing hospital records. A cohort analysis of all PTB patients registered in the district hospital from 1998 to 2002 was done.

2.2 Study population

Records of all adult patients who reported at the district hospital and diagnosed with PTB during the period of 1998 to 2002 comprised the study population. Treatment outcomes were categorised by nurses-in-charge of the TB ward. This was done according to the national treatment guideline.

2.3 Sampling

All registered PTB cases were considered in the cohort analysis. No sample size calculation thus applied. For the purpose of this analysis, children were not included in the study because of the very small number.

2.4 Data collection

Secondary data was used form routinely collected hospital records on all PTB cases documented in the TB register. A questionnaire or data extraction sheet specially designed to achieve clarity and to permit easy data entry was completed using the TB register. (Appendix 1) The questions on the data extraction sheet followed exactly the format in the tuberculosis register. This procedure ensured that the TB register was not taken away from the ward. The questionnaire was filled by a medical officer who works at the district hospital. Thirty questionnaire were filled a day to avoid fatigue and mistakes. Patient initials and pins were used instead of names to maintain confidentiality. Transcribed information was cross-checked with the information in the TB register. Data entry was double-entered by two experienced data entry clerks at the Navrongo Health Research Center using Epi-info 2000 (3.2 version) and validated. Appropriate check codes were put in place to detect errors. Verification was run using the same software and discrepancies between the two databases resolved by referring to material in the original TB ward register, providing further opportunity to cross-check transcribed data.

Exposure and outcome variables data were extracted from the records. The exposure variables were: sex, age, treatment regimen, pre-treatment sputum smear examination and two month sputum smear conversion. The outcome measures were the recorded treatment outcome categories: cured, treatment completed, default or treatment interrupter, failure, death, transfer out and not available.

2.5 Analysis

A cohort analysis was done using Epi info (version 3.2) and Stata 8.0 (Stata Corporation, College Station, Texas, USA). Due to small number of patients for each year, data was aggregated over the five year period, although a disaggregated data analysis for each year was also done, specifically for patients' profile and treatment outcome. In aggregating the data, it was assumed that the factors that led to adherence or non-adherence were the same throughout the five year period.

Frequencies and proportions for the various outcomes were done according to recommendation by WHO and IUATLD. The denominator for all outcomes is the number of cases registered for treatment. Association between treatment outcomes and age and then sex were done using Chi square test or Fisher's exact test, where it was appropriate (when cell sizes were less than 5). Findings were considered statistically significant if P-value was less than 5%. Odds ratio with 95% confidence intervals were also computed.

Treatment outcome was dichotomised into successful and unsuccessful outcomes. Successful outcome is made up of cured and completed treatment cases (expressed as a percentage of the number of cases registered in the cohort) while unsuccessful outcome is made up of default, death, failures, transfer out and those whose outcomes were not evaluated (expressed as a percentage of the number of cases registered in the cohort).[30] Sex, age, treatment regimen, pre-treatment sputum smear examination and two sputum smear conversion were categorized and analysed as independent predictors for treatment outcome. Logistic regression analysis, using automatic stepwise selection, was used to identify important predictors or factors associated with treatment outcome of patients.

Case detection was calculated and represented graphically. Trend of outcomes over the five-year period using proportions and graphical representation was done and appropriate statistical test (Chi square test for trend) used to test for any significant difference in the proportions of the outcomes over the five-year period.

2.6 Ethical issues

Permission was obtained from the senior medical officer in-charge of the Kassena Nankana district hospital to use the patients' records. Names of patients were omitted on the questionnaire that was used to capture data for entry to ensure confidentiality. Ethical clearance was obtained from the University of the Witwatersrand Committee for Research on Human Subjects (Medical).

3.0 RESULTS

3.1 Case finding

A total of 302 tuberculosis cases were diagnosed and managed at the hospital over the five year period. Out of this number, 232(77%) were diagnosed as pulmonary tuberculosis (Figure 1). There were significantly more male 186 (80%, 95% C.I. 74.5-85.1) than female 46(20%, 95%C.I 14.9-25.5) patients. The ages ranged from less than one year to 100 years. The mean age for all pulmonary tuberculosis (PTB) patients was 46 years with a standard deviation of 18. However, comparing mean age between the sexes, males were significantly older 47 (95% C.I. 44.7-50.1) than the females 39 (95% C.I. 34.3-44.1).

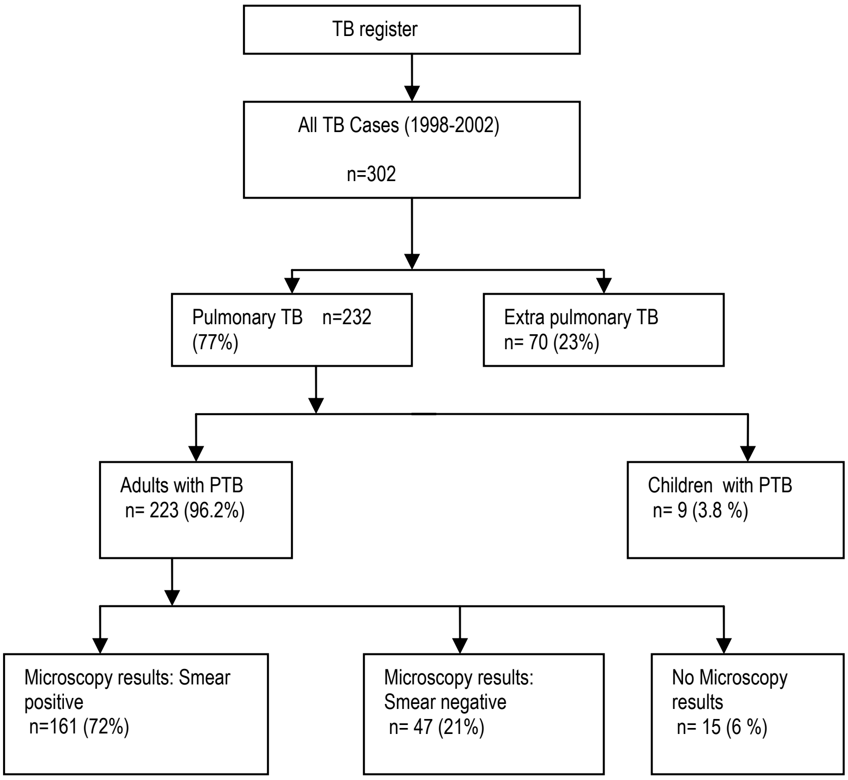

Figure 1: Flow chart of case finding

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Analyses presented in this report are based on 223 adults with pulmonary TB only. Children's data was not analysed due to the small numbers. Of these 223 patients, 161 (72 %) had smear positive PTB and 47 (21%) had smear negative PTB diagnosed on the basis of sputum smear examination, clinical and radiological findings. Fifteen (7%) were diagnosed as PTB but not documented as either smear positive or smear negative case in the TB register. The patients' clinical profiles are summarized in Tables 2 and 3. Out of the one hundred and sixty one patients who were smear positive, 129 (80%) were new cases made up of 109 (85%) males and 20 (16%) females.

3.2 Diagnosis category of PTB cases

Majority of cases, 167 (75%) were new cases for PTB, that is they had not undergone previous anti-TB treatment lasting more than a month. PTB had been previously diagnosed in 42(19%) cases as shown in Table 2.

3.3 Treatment regimen

Among all the cases of PTB, majority, 161(72%), were put on short course therapy while 24 (11%) were put on standard treatment. The remaining 38 (17%) were put on re-treatment therapy.

Table 2: Characteristics of PTB patients in KND: 1998 to 2002.

Variable		All PTB cases n = 223	Smear positive cases n=161
Sex	male	179 (80.3) [a]	133 (82.6)
	female	44 (19.7)	28 (17.4)
Age (years)	< 20	9 (4.0)	5 (3.1)
	20-39	70 (31.4)	52 (32.3)
	40-59	85 (38.1)	60 (37.3)
	≥ 60	59 (26.5)	44 (27.3)
	Mean age	47.4	47.5
	Median age	46	47
Diagnosis category	New case	167 (74.9)	129(80.1)
	Relapse	10 (4.5)	6 (3.7)
	Failure	7 (3.1)	4 (2.5)
	Default	13 (5.8)	8 (5.0)
	Transfer in	3 (1.3)	2 (1.2)
	Others	9 (4.0)	4 (2.5)
	Not available	14 (6.3)	8 (5.0)
Treatment regimen	Short course	161 (72.2)	137 (85.1)
	Standard course	24 (10.8)	3 (1.9) [b]
	retreatment	38 (17.0)	21 (13.0)

[a] Figures in parentheses are percentages.

[b] 3 cases of smear positive were put on standard course instead of short course treatment.

Table 3: **Characteristic of PTB patients in KND by year: 1998 to 2002.**

Variable		1998 n = 65	1999 n=50	2000 n=32	2001 n=43	2002 n=33
Sex	male	57 (87.7) [a]	36 (72.0)	22 (68.8)	36 (83.7)	28 (84.8)
	female	8 (12.3)	14 (28.0)	10 (31.3)	7 (16.3)	6 (15.2)
Age (years)	< 20	1 (1.5)	2 (4.0)	4 (12.5)	2 (4.7)	0 (0)
	20-39	18 (27.7)	15 (30.0)	15 (46.9)	11 (25.6)	11 (33.3)
	40-59	27 (41.5)	18 (36.0)	9 (28.1)	17(39.5)	14 (42.4)
	≥ 60	19 (29.2)	15 (30.0)	4 (12.5)	13 (30.2)	8 (24.2)
	Mean age	49	47.8	41.3	48.8	48.0
	Median age	50	47	38	49	46
Diagnosis category	New case	53 (81.5)	34 (68.0)	20 (62.5)	35 (81.4)	25 (75.8)
	Other [b]	12 (18.5)	16(32.0)	12 (37.5)	8 (18.6)	8 (24.2)
Treatment regimen	Short course	55 (84.4)	41 (82.0)	22 (68.8)	17 (39.5)	26 (78.8)
	Other [c]	10 (15.4)	9 (18.0)	10 (31.3)	26 (60.5)	7 (21.2)

[a]Figures in parentheses are percentages.

Other [b] : comprises relapse, failure, default, transfer in and not available

Other [c] : comprises standard course and retreatment

3.4 Sputum smear conversion

After two months of treatment, 125 (78%) out of the 161 smear positive cases had converted to smear negative, 9 (6%) still remained positive while smear results were not available for the remaining 27 (17%). There was no significant association between treatment regimen or diagnosis category and sputum conversion at 2 months. (P values of 0.16 and 0.93 respectively).

One of the 47 smear-negative cases diagnosed, 2%, had turned smear positive after two months. At five months of treatment, only 101(63%) of the smear positive cases had information on sputum smear microscopy results. Three (2%) cases were still positive.

3.5 Treatment Outcome in all PTB patients

Overall there was a successful outcome of treatment in 106 (48 %) of all PTB cases. The overall defaulter rate and death rate were 20% and 23% respectively. Failure rate was low at 1% among all the cases (Table 4). Overall the treatment regimen on which a patient was put on was significantly associated treatment outcome (P=0.00). There was a tendency of patients put on short course therapy having a successful outcome (Odds=1.26; 95% C.I. 0.80-1.49). Patients put on short course (OR=3.27; 95% C.I. 1.21-8.84) and those put on re-treatment therapy (OR=2.18; 95%C.I. 0.69-6.91) were more likely to have a successful outcome than those put on standard treatment. Females had a tendency towards more successful outcome compared to males, though this did not reach statistical significance (OR=1.21; 95% C.I. 0.66-2.17).

Cure was achieved in 82 (51%) of all smear positive PTB and 68 (51%) of new smear-positive cases. Nineteen percent of the new smear-positive cases interrupted their treatment. The average death rate was 21%. Of the smear positive patients on a re-treatment regimen, the cure rate was (57%). Forty percent success rate was achieved in smear negative PTB and almost a third of the smear negative PTB (30%) defaulted as shown in Table 4.

Table 4: Treatment outcome in all PTB and smear-positive cases

	Number of cases [n (%)]			
Outcome	All PTB n = 223	New smear positive n = 129	Smear positive put on retreatment n = 21	Smear negative PTB n = 47
Successful [a]	106 (47.5)[b]	68 (52.7)	12 (57.1)	19 (40.4)
Died	52 (23.3)	27 (20.9)	5(23.8)	10(21.3)
Failure	3 (1.3)	3 (2.3)	0(0)	0(0)
Defaulted	45(20.2)	24(18.6)	2 (9.5)	14(29.8)
Transfer out	7 (3.1)	2 (1.6)	1 (4.8)	1 (2.1)
Not evaluated (Not known)	10 (4.5)	5 (3.9)	1(4.8)	3(6.4)

[a] In smear- positive cases: smear negative microscopy results one month prior to or the end of treatment and at least one other occasion. In smear- negative cases: treatment completed with no evidence of sputum conversion.
[b] Figures in parentheses are in percentages.

Smear- positive patients had a better success rate (cured and completed) than smear-negative patients (52% versus 40%). Default rate was much higher in the smear–negative cases (30%) compared to smear positive cases (19%) although statistically there was no significant difference in the treatment outcome between smear positive and smear negative cases. (Fisher's exact = 0.44, P = 0.43). Treatment outcome was unknown in 5(4%) cases of smear positives and 4(8%) cases of smear negative cases.

3.6 Treatment outcome in new smear-positive cases

Treatment outcome in the new smear- positive in relation to age group is shown in Table 5. Success rate was less than 75% in all the age groups. There was no statistical significance in the treatment outcomes between the various age groups (p= 0.86). In relation to sex, success rate was 65% in females and 51% in males though this was not statistically significant (p = 0.69).There was a higher death rate and interrupter rate in males compared with females (Figure 2).

Table 5: Treatment outcome of new smear-positive TB patients in relation to age

Age group (years)	n =129	Successful n (%)	Death n (%)	Other n (%)
< 20	4	2 (50.0)	1(25)	1(25)
20-39	42	21(50.0)	12(28.6)	9(21.4)
40-59	48	26(54.7)	8(16.6)	14(29.2)
≥ 60	35	19(54.3)	6(17.1)	10(28.8)

Other: defaulted, failure, transferred out and not evaluated

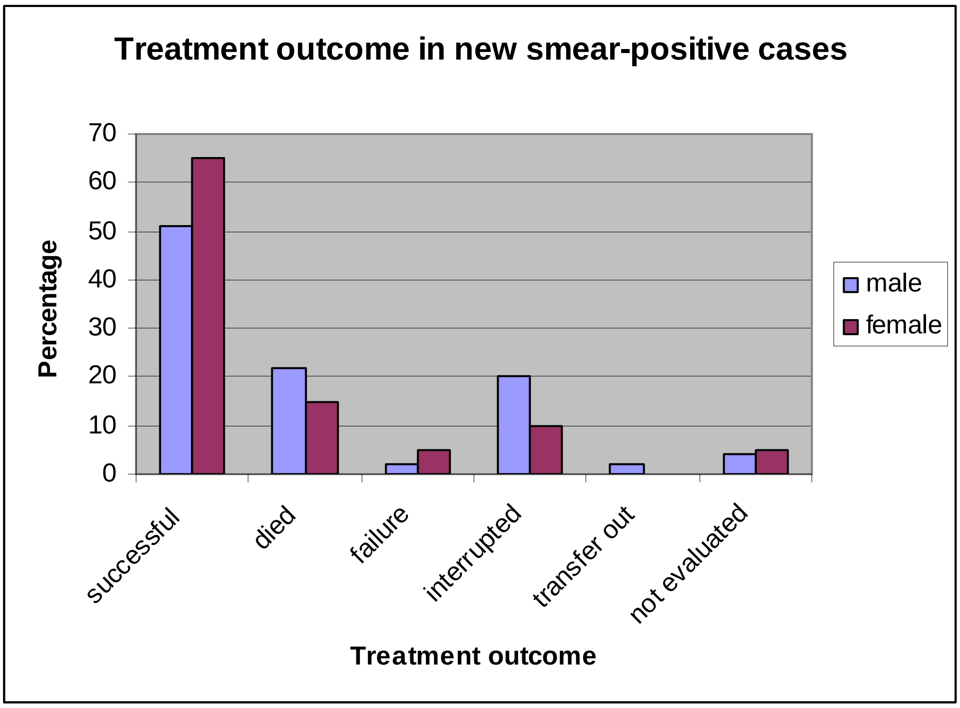

Figure 2: Treatment outcome in new smear-positive cases by sex (males n=109 and females n= 20)

Table 6: Treatment outcome of all PTB cases by year

OUTCOME	1998 n=65	1999 n=50	2000 n=32	2001 n=43	2002 n=33
Successful	39 (60.9)	30 (60.0)	14 (43.8)	12 (27.9)	10 (30.3)
Died	13 (20.3)	12 (24.0)	10 (31.3)	12(27.9)	5 (15.2)
Failure	1 (1.6)	0 (0)	0 (0)	1 (2.3)	1 (3.0)
Treatment interrupted	10 (15.6)	8 (16.0)	4 (12.5)	15 (34.9)	8 (24.2)
Transfer out	1 (1.6)	0 (0)	4 (12.5)	1 (2.3)	1 (3.0)
Not evaluated	0 (0)	0 (0)	0 (0)	2 (4.7)	8 (24.2)

The majority of “not available” outcomes come from 2002.Between 1998 and 2002, it was 0% and in 2002 it was 24% (Table 6). This was a retrospective study and data was extracted from the TB register. The available information obtained from the register could not explain the high number of “not available” outcomes in 2002.

3.7 Factors associated with unsuccessful treatment outcome

Using logistic regression techniques (automatic selection), the only factor that was associated with an unsuccessful treatment outcome was unavailable sputum smear microscopy results at two months of treatment (OR =9.77, 95% CI: 2.02-47.13, P= 0.005). Standard course regimen and unavailable sputum smear microscopy results before treatment were identified in univariate analysis as predictors of unsuccessful outcome (table 6). However, after adjusting for age, sex, and sputum microscopy after two months of treatment, these were no longer statistically significant. The adjusted odds ratios are (OR = 2.38, 95% CI: 0.58-9.73, P= 0.227) and (OR = 1.67, 95% CI: 0.33-8.56, P= 0.538) for standard course and unknown pre-treatment sputum microscopy results respectively (table 7).Variables of sputum microscopy results at five, eight and twelve months results were not used in the automatic selection of variables in the logistic regression because of very few numbers of smear positive cases. The only significant factor for the aggregated data over the five-year period could not be looked at for each year due to very few numbers in the standard course of treatment and smear positive cases after two months of treatment.

Table 7: Univariate and multivariate analysis of factors associated with unsuccessful treatment outcome (logistic regression models)

Variable		n	Univariate Crude odds Ratio (95% CI) [g]	Univariate P-value	Multivariate Adjusted Odds Ratio (95% CI)	Multivariate P-value
Age group (years)	12-21	14	1			
	22-31	28	0.87 (0.23- 3.21)	0.828	0.54 (0.11-2.64)	0.450
	32-41	47	1.01 (0.30-3.42)	0.984	1.19 (0.28-4.98)	0.816
	42-51	49	0.72 (0.21-2.41)	0.593	0.66 (0.16-2.79)	0.573
	52-61	36	0.67 (0.18-2.37)	0.533	0.68 (0.15-2.94)	0.607
	62-71	33	0.79 (0.22-2.85)	0.727	0.95 (0.21-4.19)	0.941
	>71	16	0.96 (0.22-4.220)	0.961	0.56 (0.10-3.26)	0.520
Sex	male	179	1			
	female	44	0.70(0.36-1.37)	0.297	0.60 (0.26-1.38)	0.229
Regimen	SC [a]	161	1			
	ST [b]	24	3.27(1.21-8.84)	0.013	2.38(0.58-9.73))	0.227
	RTR [c]	38	1.50(0.73-3.08)	0.265	1.49 (0.63-3.52)	0.365
Sputum smear microscopy before treatment [d]	Smear- positive	161	1			
	Smear- negative	47	1.61(0.83-3.12)	0.157	0.34(0.11-1.01)	0.053
	not available [f]	15	4.36(1.16-16.46)	0.018	1.67 (0.33-8.56)	0.538
Sputum smear Microscopy after two months [e]	Smear positive	11	1			
	Smear negative	146	0.47(0.14-1.65)	0.230	0.56 (0.15-2.07)	0.382
	not available	66	6.04(1.37-26.57)	0.007	9.77 (2.02-47.13)	0.005

[a] Short course chemotherapy , [b] Standard course chemotherapy, [c] Retreatment course
[d] Lab diagnosis (pre-treatment): Sputum smear microscopy examination before treatment with anti TB drugs
[e] Lab at 2 Months Sputum smear microscopy after two months of treatment with anti TB drugs.
[f] Not available no documentation of Sputum smear examination in TB register (sputum smear not done)

3.8 Case notification and trends in treatment outcome

From 1998 to 2000, case notification rate of PTB cases registered at the hospital decreased from 46 to 23 per 100 000 population in all PTB cases. There was a sharp decrease in the new smear positive within the same period (1998 to 2000). However, from 2000 to 2002, the notification rate began to rise steadily in new smear-positive cases (Figure 3).

The success rate from 1999 to 2001 of PTB cases continued to deteriorate substantially, though case notifications were also decreasing. Treatment success rate decreased from 61% in all PTB cases in 1998 to only 30% in 2002 (Figure 4). In new smear positive cases, success rate have also been deteriorating. It plummeted from 63 % in 1999 to 32 % in 2002 while the percentages of treatment interrupters have been increasing, 12.5% in 2000 to 24% in 2002. Death rates also increased from 20% in 1998 to 28% in 2001. In 2002, death rate was relatively lower (15%) compared with 2001 death rate of 28%.

Significance testing to assess the observed differences in case notification year on year and successful PTB outcome were p= 0.16 and p=0.08 respectively. These were statistically not significant.

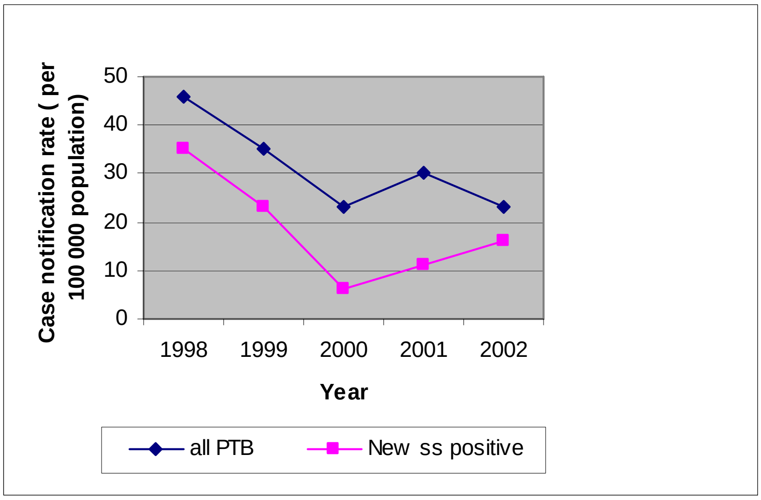

Figure 3: Case notification of PTB in KND: 1998-2002

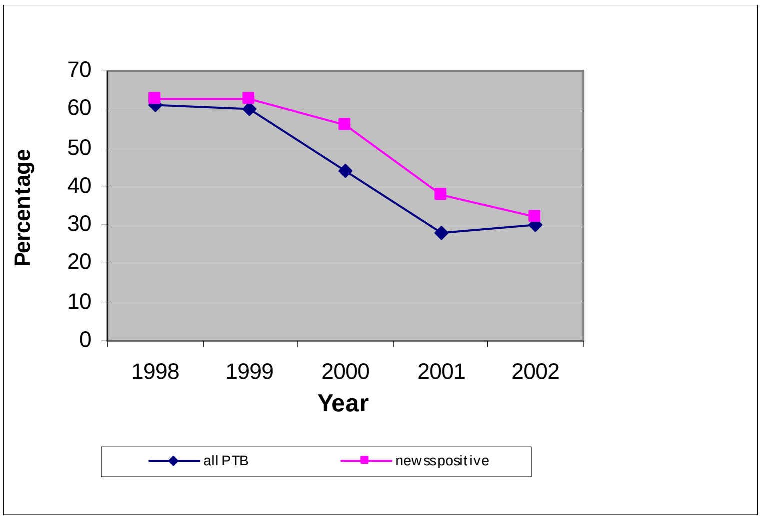

Figure 4: Successful PTB outcome in KND: 1998-2002

4.0 DISCUSSION

This study is the first that could be identified to investigate treatment outcomes for pulmonary tuberculosis cases in the Kassena Nankana district of northern Ghana. Overall, the proportion of cases successfully treated is not encouraging. It falls far below the WHO target for success rate of 85 percent. Death rate and treatment interrupters were very high. `There was a decreasing trend in success rate over the five year period. In new smear positive which serves as a proxy for the success of a TB program, the success rate was better compared to overall success rate among all PTB cases.

In this study a greater proportion of the PTB patients were men (80%) though men formed only 40% of the total admissions to the hospital over the study period. This could be due to stigma associated with TB, which is much greater for women than men as reported in Nigeria. The social stigma for women may be so strong with serious consequences such as abandonment by the husband, divorce or husband taking a second wife and loss of social and economic support.[11] A study in rural South Africa showed that patients and community beliefs play very important role in the control of tuberculosis and the time they even present to the health facility for diagnosis.[31]

Overall, the proportion of cases successfully treated (48%) is not encouraging. It falls far below the WHO target for success rate of 85%. Death rate and defaulters were very high. In new smear positive cases which serve as a proxy for the success of a TB program, the success rate was better compared to overall success rate among all PTB cases. However, the success rate in the new smear positives decreased over the years from 63% in 1999 to 32% in 2002. This is unlikely to be due to case over load since notification rate also decreased over the years. These results are comparable to findings in a study in rural Kiboga district in Uganda prior to the implementation of DOTS [32]. In contrast, the success rate in this district is much lower than the reported figures for national treatment outcome in new smear positives over the period, 55% in 1999 and 42% in 2001.[33-35]

Smear-positive patients had a better success rate compared with smear negative cases. In all age groups, there was a higher success rate in smear positives than smear negatives. Similar findings were reported in a study done in Malawi which showed poorer treatment outcomes in smear negatives compared to smear positives PTB patients.[15, 36]

The majority of smear positives cases were put on short course therapy. This conforms to expectations of the national treatment guideline. Short course chemotherapy for smear positive TB is one of the most cost-effective health interventions in a developing country in terms of costs per death averted and per year of life saved. This is however only the case when compliance and cure rates are high.[37- 39]

The higher rate of defaulters among male patients compared to female patients may be due to higher migration rate of males than females to the southern part of the country in search for jobs. Long distance from patients' home to the hospital has been reported in some studies to be risk factor for interrupting treatment but this could not be analysed in this study due to lack of data.[37]

One of the most important factors limiting the success of any TB program is treatment interruption. Failure to complete treatment regimen has been historically cited as one of the most challenging problems in TB treatment. [40] In this study the default rate or treatment interrupters was very high and suggests gaps exist in the TB control program.[13] Greater attention needs to be paid to the supervision of direct observation of therapy after two months of treatment. Patients are left to come monthly to the hospital for their drugs and take them on their own. This is at variance with expectations under DOT.[41,42] It therefore appears that direct observation exists only in the first two months of treatment in this district. The five health centres in the KND do not play any role in administering drugs to patients, not even in the continuation phase of treatment though they are situated in the communities.

There are community health and family planning services in KND which make primary health care delivery at the door step of the rural dwellers in the communities through community-based nurses and village health volunteers. The trained community health workers are equipped with motorcycles to facilitate outreach activities. Numerous studies have shown that this group of health workers are effective in educating patients, contact tracing, and addressing some stigmatising factors that may be a barrier to detection and effective treatment of TB patients[43, 44]

The high death rate in the PTB patients during the five year period was alarming, ranging from 15% in 1998 to as high as 36% in 2001 (average of about 23 %).The contribution of HIV/AIDS to the high death rate among TB patients in the KND has not been explored. The proportion of TB patients with HIV in KND hospital is not known. However, a 2003 sero-prevalence survey among pregnant women attending antenatal clinic documented a prevalence rate of 5.8%.This was much higher than the national seroprevalence of 3.3% among pregnant women attending antenatal clinic. HIV infection markedly increases the susceptibility to TB and as well may influence treatment outcome due to immunosupression.[15] Some studies in sub-Saharan Africa have reported very high death rate in TB patients with HIV co- infection due to low CD4 count and other opportunistic infections. A reduction in mortality may be possible with better clinical supervision of patients and the introduction of voluntary confidential counselling and testing (VCT) for all TB patients.[45 46] Knowing HIV status of TB patients will help in the clinical management of TB patients. This includes replacing thiacetazone with ethambutol. Thiacetazone is associated with severe drug reactions in HIV positive patients and sometimes fatal.[15] The clinician can also decide when to put TB patients with HIV co-infection on prophylaxis against opportunistic infections.[38]

Patients without two months sputum smear examination were more likely to have an unsuccessful treatment outcome. Close monitoring of all patients who refuse to do sputum smear examination is therefore very essential to achieve a successful outcome. However, caution should be taken here since this factor was not looked at yearly and year could be a potential confounder. The limitation was that small number of cases for each year did not allow disaggregated analysis.

There was a decrease in success rate over the five year period. Over the period the total number of cases notified decreased and this raises questions on efficiency and effectiveness of the health services including laboratory infrastructure and human resources. According to the estimated incidence in Ghana, a district of about 100 000 population should expect about 200 new cases of tuberculosis every year.[19] There are only three qualified laboratory technician in the district hospital serving a population of 142 000, resulting in enormous workload. Usually they get overwhelmed during the raining season when there are numerous cases of malaria. The dry season is not better either because of increased number of cerebrospinal meningitis cases. It is therefore not too surprising to have a very low notification rate and a lot of missing values for sputum smear microscopy for TB patients in the continuation phase. In 2000, the total number of patients admitted to the hospital was more than the previous years and this did not change in parallel to the proportion of TB patients admitted to the ward.

Limitations

This study was an analysis of existing data, thus data on variables that are important correlates such as HIV status of patients were not available for analysis. HIV infection which is common in Tuberculosis patients could confound the treatment outcome results. HIV testing is not routinely done for tuberculosis patients in the Kassena Nankana District and within the national control program. No data was also available on smoking, alcohol intake, and occupation of TB patients. These are important correlates of the disease, on which data is needed to assist in explaining patterns and trends of the disease in the district.

Previous studies in health seeking behavoiur have found that most of the people of the Kassena-Nankana district patronize the service of traditional healers. The study used hospital data. It is thus likely that the number of cases as presented in this report may constitute an underreporting of TB cases within the district. Thus, the patients included in this report may be biased towards people with access to formal health services.

Another limitation of the study is that potential misclassification bias could not be evaluated. Misclassification in the diagnosis of smear negative cases was a potential bias in the study. The diagnosis of smear negative cases was based on clinical symptoms and chest x ray findings. This was done by different clinicians and therefore there was an element of subjectivity depending on what the attending clinician found on the chest x-ray. This was not standardized and could have lead to misclassification of cases.

5.0 CONCLUSION AND RECOMMENDATION

In this study success rate of treatment outcome among pulmonary tuberculosis cases in Kassena Nankana district is low. Death and treatment interrupter rates are very high. The success rate is deteriorating especially among smear positive cases with a decreasing case detection rate. Case notification among females is very low compared to males however females on anti-tuberculosis treatment are more likely to have a better success rate. Sputum smear examination before diagnosis of pulmonary tuberculosis and during treatment is unsatisfactory with a lot of patients failing to return during the continuation phase. A comprehensive review of the DOTS program that goes beyond the scope of this study is called for.

Patients who did not have two months sputum examination were more likely to have an unsuccessful outcome therefore it is imperative that each patient should have two months sputum examination done after completing two months of intensive phase before discharge from the hospital. Nurses at the health centres should be purposefully trained and involved in the follow-up of TB patients during the continuation phase. There should be a channel of communication between the hospital and the health centres.

The high default rate requires urgent attention. It is recommended that the DOTS program in KND involve community health workers and volunteers. The hospital should discharge TB patients with Direct observed treatment directly to the health centres for continued care.

The high death rate has implications on the ability of the TB programme in KND to achieve the TB control programme goal of 85% success rate. Detail assessment of the cause of death should be done including autopsy to know the exact cause of death. This might be helpful to institute appropriate management to reduce the death rate.

A program of public education on the toll that TB is taking in the district will help sensitise the community and generate greater community participation which might help to improve both case reporting to the health facility and treatment outcome.

Review of treatment outcomes and the overall DOTS program in the district should be conducted regularly to help monitor progress in the various outcome indices.

Qualitative studies that investigate further the causes of treatment interruptions and default should be conducted and the findings used to inform improvement in the DOTS program. Issues such as gender differences in case notification and default rates should be explored.

The TB program in the KND faces formidable challenges. Most of the outcome indicators are unsatisfactory. To a large measure, the district can optimise the limited resources to improve the DOTS program. There is a need to improve case finding, treatment monitoring using sputum-smear microscopy and rigorous supervision (recording and reporting). The research centre should develop an agenda in TB operational research to compliment the work of the district health management team.

PLAN FOR UTILIZATION AND DISSEMINATION OF RESULTS

Copies of the final report will be given to the district hospital, Kassena Nankana District Health Management, Navrongo Health Research Center, the regional TB coordinator and Upper East Regional Health Administration. Advantage will also be taken of community durbars in the district to disseminate the findings of the study.

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APPENDIX 1:

QUESTIONNAIRE:

RE-FORMATTED DISTRICT TUBERCULOSIS REGISTER

Date reg: _____ / _____/ ____ Distr TB Nr: _____ _____ _____

1. Initials: _____ _____
2. Sex: ____- ____
   (1=Male 2=Female)
3. Age: ____ -_____
4. Health facility: ______________________________________ - _____
   (1=WMH 2= Other)
5. Regimen: ____ - _____
   (1= SC, 2=ST, 3= RTR, 8=Not available)
6. Class: ____ - _____
   (1= P, 2 = EPT, 8 = Not available)
7. Category: ____ - ______
   (1=N, 2=R, 3=F, 4=D, 5=T, 6=O, 8=Not available)
8. Lab- Pre-treatment: ___________________________________ - ______
   (1=P, 2=N, 3=X'Ray, 4=Wound swap, 8= Not available)
9. Lab- 2M: ____ - _______
   (1=P, 2=N, 8= Not available)
10. Lab- 5M: ____ - _______
    (1=P, 2=N, 8= Not available)
11. Lab- 8M: ____ - _______
    (1=P, 2=N, 8= Not available)
12. Lab- 12M: ____ - _______
    (1=P, 2=N, 8= Not available)
13. Date treatment ended: ______ / _______ / ______
14. Outcome: ____ - _______
    (1= Cured, 2=Compl, 3=Died, 4=Failure, 5=Default, 6=Tr out, 8=Not available)

Definitions

Smear positive case: A case with at least two sputum smear-positive for acid fast bacilli or one sputum smear positive and chest X-ray abnormalities consistent with active TB.

Smear negative case: A case whose sputum smear examination were negative for acid fast bacilli but clinical symptoms and X- ray findings were suggestive of pulmonary tuberculosis.

Treatment regimen:

Short course is for new smear positives and who seriously ill sputum smears negative PTB cases. It consists of 2 months of SHRZ and 6 months of HT.

Standard course is for smear negative PTB and consists of 2 months of SHT and 10 months of HT.

Re-treatment course is for relapse cases and treatment failures. It consists of 2 months of S, 3 months of HRZE and 5 months of HRE

Key:

S=Streptomycin H=Isoniazid R=Rifampicin Z=Pyrazinamide T=Thiacetazone E=Ethambutol

Diagnosis case definition by previous treatment:

New Case: Patient has never had TB treatment or has taken TB drugs for less than one month.

Relapse: Patient has been cured before of TB after a full course of chemotherapy but now has become sputum smear positive.

Treatment failure: Patient remains positive or has become positive after five months of treatment.

Default: A new TB patient who completed at least one month of treatment and returned after at least two months interruption of treatment.

Transfer in: A TB patient already registered for treatment in one district who transfers to another district where he continues treatment.

Others: A TB patient who does not easily fit into one of the above case definitions. An example is a chronic case who remains smear-positive after completing a supervised re-treatment regimen.

Not available: no documentation of diagnosis category in the TB register.