TUBERCULOSIS AMONG HEALTH CARE WORKERS WORKING IN HOSPITALS IN THE ETHEKWINI MUNICIPALITY OF KWAZULU-NATAL

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DECLARATION

This study represents original work by the author and has not been submitted in any form for any degree to any university. Where use has been made of the works of others, it has been duly acknowledged.

Signature:

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Tuberculosis is a disease of global importance and remains the leading cause of death in the developing world. In South Africa a weak notification system and poor occupational health services for health care workers has resulted in little information being available about the incidence of tuberculosis and the groups at highest risk of contracting tuberculosis amongst health care workers, the clinical presentation and management of workers infected with tuberculosis. The purpose of this study was to describe the incidence of tuberculosis, and the clinical and public health aspects of the management of tuberculosis among health care workers in eight public sector hospitals in the Ethekwini Municipality of KwaZulu-Natal. Data was collected through a retrospective review of hospital records for the study period January 1999 to June 2004. Study findings: Five hundred and eighty three (N=583) health care workers were diagnosed with tuberculosis for the period under review. The mean age of the HCWs was 38 years (95% CI: 37-39). The mean cumulative incidence for the study period was 1040 / 100 000 HCW population (95% CI: 838-1242). The mean cumulative incidence of TB was highest in males (1544 / 100 000 HCW population; 95% CI 1228 -1859), the age group 25 to 34 years (1043 / 100 000 HCW population; 95%CI: 650 -1436) and in paramedical staff (1675 /100 000 HCW population; 95%CI: 880-2470). The majority of health care workers presented with pulmonary tuberculosis (77%, n=322) and 3% (n=13) had multi-drug resistant tuberculosis. Successful treatment outcomes were achieved in 63% (n=334) of health care workers. Only one hospital has a work place policy with regard tuberculosis in health care workers. Compensation for this occupational disease was sought as follows. Submissions of a first medical

report were made in 107 (18%) of the 583 health care workers. In the 107 cases initially reported submission of progress reports (n=75; 70%) and final reports (n=60; 56%) decreased considerably. In conclusion, the incidence of tuberculosis in health care workers has increased annually since 1999 and the treatment outcomes among health care workers do not reach the targets set by the National Tuberculosis Control Programme. Recommendations based on the study findings include establishing a uniform provincial policy for the prevention and reduction of tuberculosis infections among health care workers for implementation in hospitals; the implementation of a medical surveillance system for health care workers with respect to tuberculosis and a provincial training programme for staff on the clinical and administrative management of TB in health care workers.

LIST OF ABBREVIATIONS

AIDS:	Acquired Immune Deficiency Syndrome
CDC:	Centres for Disease Control and Prevention
CI:	Confidence Interval
COIDA:	Compensation for Occupational Injuries and Disease Act
DHS:	District Health System
DOTS:	Directly Observed Treatment Short-course
HCWs:	Health Care Workers
HIV:	Human Immunodeficiency Virus
HEPA:	High Efficiency Particulate Air Filtration
KZN:	KwaZulu-Natal
MDR TB:	Multi drug-resistant tuberculosis
NTBCP:	National Tuberculosis Control Programme
OHS:	Occupational Health and Safety
PPE:	Personal Protective Equipment
RR:	Relative Risk
TB:	Tuberculosis
UV:	Ultraviolet
USA:	United States of America
UN:	United Nations
VCT:	Voluntary counselling and testing
WHO:	World Health Organization

CHAPTER ONE

INTRODUCTION

Tuberculosis (TB) is a disease of global importance and remains the leading cause of death in the developing world. [1-3] In developed countries such as the United States of America (USA) TB has re-emerged as a major public health problem while in most developing countries including South Africa it persists as a significant public health problem.[4-7] Contributing factors to the increasing incidence of TB include poverty, Human Immunodeficiency Virus infection and Acquired Immunodeficiency Syndrome (HIV/AIDS).[1,2,5,6] It is estimated that a third of all TB cases in sub-Saharan Africa may be directly attributable to HIV.[6,8]

Historical neglect of health care, fragmented health services, migration of people and limited political commitment to TB control has fuelled the epidemic in South Africa.[8] The overall incidence of TB in South Africa was estimated at 550 cases per 100 000 population in 2003, and 718 cases per 100 000 population in 2004 one of the highest in the world.[9,10] The World Health Organisation (WHO) Global TB report for 2006 estimated that the mortality from TB was 135/100 000 population and 60% of TB patients were HIV positive in South Africa.[10]

The impact of the HIV/AIDS epidemic in countries with constrained resources and poor infrastructure is likely to increase the number of hospital admissions of patients who have an associated TB infection.[7,11] Nosocomial outbreaks of TB among health care workers (HCWs) and the increased risk to health care

workers from TB in the USA during the 1990s, has been well documented.[12,13] Studies in Peru and Japan found nurses and laboratory technicians to be at higher risk for developing occupational TB than other categories of health care workers.[7,14]

Although sub-Saharan Africa has the highest rates of TB and HIV infections in the world, the rates of TB among HCWs and the risk among the different categories of HCWs is poorly documented. A country wide study of TB in HCWs conducted in Malawi in 1996 found that compared with the general population the relative risk of TB in HCWs was 11 (95% CI: 9 -14) and the overall case fatality was 24%.[15]

Using the tuberculin skin test researchers in Abidjan, Côte d'Ivoire found that HCWs were at increased risk for nosocomial transmission of TB.[16] In South Africa Wilkinson *et al* showed an increasing frequency of TB among staff in a District Hospital between 1991 and 1996.[17]

In response to the nosocomial outbreaks of TB in the USA, in the early 1990s the Centre for Disease Control and Prevention (CDC) published guidelines for "Preventing the Transmission of *Mycobacterium tuberculosis* in Health-Care Facilities". These guidelines address among other issues the implementation of workplace controls to prevent TB transmission, thereby ensuring reduced risk of TB infection in HCWs.[18, 19]

The WHO developed guidelines for the control of TB transmission in resource poor health care settings which have been implemented in some African settings.[20, 21] In South Africa guidelines for the control of nosocomial transmission of TB are absent. In developing countries increasing numbers of infectious patients, open wards and minimal or absent TB infection control measures increase the risk for the transmission of TB among HCWs.[11,22] Furthermore the measures for TB control (ultra violet (UV) lights, high efficiency particulate air filtration (HEPA) masks and extraction ventilation), proposed and used in the developed countries are beyond the economic resources of developing countries.[20]

In addition to implementing guidelines for preventing TB, there is a need for guidelines on the management of HCWs who acquire an occupational related disease. Most countries have legislation, which relates to the management of occupational acquired diseases in industry, however little is documented on the management of HCWs who acquire occupational related diseases. South Africa has progressive legislation in terms of the Occupational Health and Safety Act No 85 of 1993 (OHS) and the Compensation for Occupational Injuries and Diseases Act No 130 of 1993 (COIDA). [23, 24] The Hazardous Biological Substances Regulations promulgated in terms of the OHS Act details work place safety and controls for workers exposed to biological agents.[25] Furthermore in terms of the above mentioned legislation TB acquired due to occupational exposure is a compensatable disease.[23,24,25,26]

In South Africa, a weak notification system and poor occupational health services for HCWs has resulted in little information being available about the incidence of TB in HCWs, the groups of HCWs at highest risk of contracting TB, the clinical presentation, and the management of TB infected workers.

BACKGROUND

KwaZulu-Natal (KZN) is one of nine provinces in South Africa. It has the largest population (9.5 million in 2002) in South Africa with the highest levels of illiteracy and unemployment.[27] The estimated HIV sero-prevalence among pregnant women attending antenatal clinics in the province in 2004 was approximately 41%.[28] The infant mortality rate in the province was approximately 52 / 1000 live births in 2002.[27]

The TB incidence for the province was estimated at 782 cases per 100 000 population in 2003.[9] The TB Control Programme in the provinces follows the control guidelines developed by the National TB Control Programme (NTBCP), which are based on the TB control principles proposed by the WHO.[29, 30] KZN province is divided into municipalities, including Ethekwini municipality which has an estimated population of three million. Municipalities are responsible for the provision of environmental and primary health care services whilst hospital services are the responsibility of the provincial Department of Health.[31]

In 1997 the South African government proposed a unified but decentralized National Health System based on the District Health System (DHS) model.[32] As a result services have been progressively decentralized (including the TB Control Programme) to district hospitals and clinics in all of the provinces.

In view of the increasing incidence and number of hospital admissions of patients with TB and HIV/AIDS in the province, it is important to establish the impact that this is having on the health of HCWs.[11] In particular it is important to establish the incidence of TB in HCWs, the categories of HCWs who are at greatest risk of developing TB, and to evaluate the current management of these HCWs once diagnosed.

CHAPTER TWO

LITERATURE REVIEW

The WHO in 2006 reported that the global incidence of TB was growing at a rate of 0.6% per year.[10] This reflected the persistent problem that TB posed for countries world-wide. This literature review provides an overview of the current scale of the burden of disease in the world including drug resistant TB. It also reflects on the impact of the HIV/AIDS epidemic on the burden of TB and on the risk of occupationally acquired TB in HCWs. The epidemiological trend in TB world-wide is influenced by the effectiveness of TB control programmes.[33] The constraints to the elements of effective TB control as proposed by the WHO are discussed in this review.

The Burden of Disease

The burden of TB globally has been increasing steadily despite greater country efforts to control the disease. The WHO Global report on TB in 2006 reports that there were 8.9 million new cases of TB in 2004 (140/100 000 population) of which 3.9 million (62/100 000) were smear positive and 741 000 were co-infected with HIV. Overall an estimated 1.7 million people (27/100 000 population) died from TB in 2004, including those co-infected with HIV.[10]

TB reporting to the WHO is divided into six regions (South East Asia, Africa, Western Pacific, the Americas, Eastern Mediterranean and the European region). In these regions there are 22 (high burden) countries, which contribute

approximately 80% of the new TB cases annually to the global burden of disease.[10, 34]

The incidence of TB is generally much lower in the industrialized countries when compared to that of the developing countries of the world. However despite the lower incidence the epidemiological trends of the last decade suggests that TB is re-emerging in the industrialized countries of the world.[35] TB mortality decreased in the USA in the last two centuries largely due to socioeconomic improvements. Between 1953 and 1985 TB case rates decreased from 53 to 9.3 cases / 100 000. However since 1985 the country has seen a re-emergence of the disease as a public health problem. The increase in TB in the USA has been attributed to deterioration in the infrastructure of TB control programmes, the HIV/AIDS epidemic, drug resistance and the increase in the immigrant population in the country.[35, 36]

European countries have also reported an increase in the number of TB cases. In countries such as Greece and the Netherlands the increase in TB incidence has been attributed to the increase in the number of foreign-born nationals.[37, 38, 39] In Norway treatment defaulter rates were higher among foreign-born TB patients (n=17; 77%) than in TB patients born locally (n=5; 23%).[40] Several of the foreign-born nationals come from the twenty-two high burden countries of the world and thirteen of the high burden countries are from the African region (sub-Saharan Africa and Algeria).[10, 34]

The incidence of TB in sub-Saharan Africa has continued to increase. Limited political support for TB control programmes, migration of populations, and the HIV/AIDS epidemic all contribute to the increasing TB incidence seen in Africa.

In South Africa despite the political commitment from the government and the adoption of Directly Observed Treatment Short course (DOTS) as the TB control strategy, the true burden of the disease is unknown.[10] The available information on the incidence of all types of TB in South Africa indicates that there has been a progressive increase between 1999 and 2003 from 340 / 100 000 to 550 /100 000 respectively. The number of TB cases reported has increased from 1996 to 2003 (109 328 to 215 154 TB cases respectively) suggesting that the increased incidence may be related to an improved reporting system. [9] The cure rate of TB has remained relatively stable from 1996 to 2002 at 54%. However South Africa also has an HIV/AIDS epidemic of significant proportions.

Provincial profiles on TB incidence in South Africa indicate that the Western Cape Province has annually had the highest burden of disease (757, 810, 840, 919 and 932 per 100 000 population since 1999 through 2004). In KZN the TB incidence has increased from 386 /100 000 population in 1999 to 781 / 100 000 population in 2003. The number of TB cases reported for KZN increased from 53 016 in 2002 to 76 838 to 2003.[9] The WHO estimated the incidence of TB in KZN to be approximately 827/100 000 in 2002 [41] while South African data reported a lower incidence of 782 / 100 000 population in 2003.[9]

Drug Resistant TB

Drug resistant TB may occur in new TB cases (primary drug resistant TB) or in previously treated TB cases (acquired drug resistant TB).[34, 42] Patients may be resistant to a single TB drug or resistant to multiple TB drugs.[42]

The third phase of the Global Project on Drug Resistant TB in 2004 provided information on the extent of the problem from 77 countries in the world. The overall prevalence of TB drug resistance (any resistance = single or multiple) among new TB cases ranged from 0% (Andorra, Iceland, Malta) to 57% (Kazakhstan) with a median of 10% (95% CI: 9 -12%). The median prevalence of drug resistance (any resistance = single or multiple) in previously treated TB cases was 18%. The prevalence for multi-drug resistant (MDR) TB among new TB cases ranged from 0% (Andorra, Luxembourg, Cambodia, Iceland, Malta, New Zealand, Oman, Scotland Slovenia and Switzerland) to 14% (Kazakhstan and Israel). [41]

South Africa and Kazakhstan were estimated to have the highest number of MDR cases in the world (n=3000).[41] In South Africa in 2001 the MDR TB prevalence was estimated at 2% and Mpumalanga province had the highest prevalence (3%) for multi-drug resistant TB in new TB patients and 14% in previously treated TB patients.[8, 41] In KZN in 2001, mono-drug resistance in new TB patients was 4% and in previously treated patients was 8% while multi-drug resistance was 2% and 8% respectively.[41]

As the burden of drug resistance increases there have been reports of disease outbreaks. A TB cohort analysis of 2170 study subjects conducted between 1995 and 2001 in Houston Texas found drug resistance in 9% (n=193) of study subjects. The foreign-born patients in this study comprised 48% of the drug resistant patients and 67% of the multi-drug resistant TB.[36] Outbreaks of drug resistant TB have also been reported in health care settings.[13, 43] In an urban hospital in Florida, 29 multi-drug resistant TB cases were identified and these patients were more likely to have HIV/AIDS compared to non-drug resistant patients (OR=10.1%; %CI=3.1-85.7).[13] These outbreaks of drug resistance TB in health care facilities pose an occupational risk for HCWs.

The impact of HIV on TB

At the end of 2004, globally an estimated 39.4 million people were living with HIV/AIDS and 3 million people had died due to HIV/AIDS. Two thirds of the people living with HIV/AIDS reside in sub-Saharan Africa. HIV prevalence reaches as high as 30% in some of the African countries.[44] In the USA in 2002 16% of TB patients aged 25 to 44 years were HIV positive and factors such as being foreign-born, having TB previously and being HIV positive have been associated with an increased risk for developing MDR TB.[35]

In sub-Saharan Africa HIV infection is driving the TB epidemic. At the end of 2000, 70% of the 11 million of the people co-infected with TB and HIV resided in sub-Saharan Africa and in 2006 the WHO estimated that 81% of the 741 000 cases of TB among HIV-positive people in the world resided in Africa.[10, 37]

In South Africa estimation of national HIV prevalence have been based on the annual provincial antenatal HIV sero-prevalence surveys conducted by the National Department of Health. Population prevalence projections by organizations such as The Joint United Nations Programme on HIV/AIDS (UNAIDS) have been based on this survey's findings.[28,45] ?? In 2002 UNAIDS estimated population level HIV prevalence to be 20%[45] while more recently the national antenatal survey in 2004 estimated the prevalence among pregnant women (15-49 years) at 30% (95% CI: 29 – 31%).[28] In the 2004 antenatal survey of pregnant women the HIV prevalence in KZN was estimated at 41% (95% CI:39-43%) in pregnant women aged 15-49 years.[28]

In 2001 it was estimated that 64% of TB cases were HIV infected in KZN. [41] Studies conducted in both urban and rural settings in KZN have shown that the there has been an increase in the burden of TB/HIV co-infection in hospital admissions.[11, 46,47]. Three surveys of the prevalence of HIV in TB patients conducted in Hlabisa between 1993 and 1997 (1993=36%, 1995=59%, 1997=67%) demonstrated a progressive increase.[48]

In the absence of HIV infection, 10% of people infected with TB are expected to progress to active TB in their lifetime. Half of these individuals with active TB are likely to be smear positive.[49] Concomitant HIV infection increases the risk of reactivation TB and increases an individual's risk to progress to active TB from latent disease to about 10% per year.[50]

Extra-pulmonary TB may occur more frequently in HIV infected individuals as opposed to patients with out the HIV infection.[51] Treatment defaulter rates have been shown to be higher in HIV positive patients with TB than HIV negative patients.[52] Furthermore survival rates among co-infected TB cases are lower as compared to HIV negative TB patients.[50,51] Patients experience of seeing HIV/AIDS patients with TB dying may lead to a belief that TB is incurable and may result in a delay in seeking treatment.[53]

TB in HCWs

In the developed world acceptance of TB as an occupational hazard in HCWs has increased since the 1950s, and has been documented in a series of prospective studies of disease rates in nurses and medical students.[54] Availability of chemotherapy appeared to control the spread of TB in HCWs in the western world.[5,12] However since the late 1980s increased reports of outbreaks of TB in health care facilities have been noted. Between 1988 and 1991 36% of 26 HCWs working in a HIV/AIDS care ward in a Florida hospital reported skin test conversions for TB.[13] During a four year study period (1991 to 1994) in a New York City hospital staff had tuberculin skin conversion rates for TB of 5/ 100 person years of follow up.[55]

Since these initial reports of TB in HCWs, there has been documented evidence on TB in HCWs from the rest of the world.[7,15,56] Estimated incidence of TB in HCWs in African settings varies from 558/100 000 in Hlabisa South Africa in1991,[17] to 5780/100 000 population in Lilongwe Malawi in 2001.[57] In Hlabisa, the incidence rate in HCWs (558/100 000) was lower than that of the

community (1543/100 000) while in Lilongwe the incidence rate (5780/100 000) in HCWs was much higher than that of the community (240/100 000).[17, 57] Researchers in Hlabisa argue that the lower HIV prevalence and better socio-economic status of HCWs may account for the lower incidence of TB.[17] In Lilongwe the researchers argue that failure to adhere to diagnostic guidelines in HCWs may have led to an over diagnosis of TB and thus an over estimation of the incidence of TB in HCWS.[57]

Research conducted in the USA prior to the 1950s indicates that nurses and medical students have the greatest risk of acquiring nosocomial TB. A nurse with direct patient contact was eight to ten times more likely to develop TB than those not exposed working in the same institution.[5] Similarly in a more recent study conducted in Turkey in 2000 the risk of TB was highest among nurses (RR: 6.7) as opposed to paramedical staff (RR: 3.9) and doctors (RR: 3.1).[56]

In Africa the rampant dual epidemic of TB and HIV/AIDS and the exodus of HCWs seeking employment in Western [58] countries has far reaching implications for health care services and human resources. Owing to the shortage of trained health professionals in certain African countries like Malawi, Tanzania, Gambia and Mozambique "substitute health workers" have been introduced. These individuals receive shorter periods of training and take on roles that fully qualified professionals such as nurses and doctors would routinely undertake. In Malawi individuals who complete a three year undergraduate course with a year of internship are called "clinical officers" and are involved in clinical duties normally performed by a doctor.[59] In Malawi in

1996 the annual incidence of TB was highest among Clinical Officers and they had a significantly higher relative risk (RR: 2; 95%CI 1- 4) when compared to nurses.[15]

In Sub-Saharan Africa reports of extra-pulmonary TB in HCWs was estimated at 42%.[15,17] A twelve year review of TB in HCWs in Serbia, Yugoslavia found all confirmed HIV infected cases to have pulmonary TB.[60] Clinical presentations of TB may vary and appears to be complicated by the HIV status of an individual.[17] HCWs in South Africa dealing with an increase in the number of patients co-infected with TB and HIV may be at greater risk of developing extra-pulmonary forms of TB which could lead to long term disability affecting occupational performance and mortality. In Malawi case fatality rates ranged from 18% in Ward Attendants to 42% in Clinical Officers [15] while in Hlabisa, South Africa, the case fatality was 18% among all TB infected hospital staff (n=22). [17] All of the fatalities in Hlabisa were HIV infected. [17]

It is important to establish the epidemiological and clinical disease profile of TB in HCWs in South Africa. While there may be some difficulty in trying to differentiate nosocomial acquired TB from community acquired TB in HCWs in countries of the developing world, there is no doubt that the burden of TB infections in HCWs in these countries is increasing. The problem of TB infections in HCWs is a concern and a threat to the already depleted numbers of HCWs. Decreasing numbers of HCWs is likely to further compromise health care service delivery and can weaken programmes such as those involved in TB control.

TB Control

The continuous rise in global TB incidence, emergence of drug resistant TB and the increased occupational risk being posed to HCWs suggests that current global TB control are inadequate.

The WHO proposed the DOTS strategy for effective TB control. The key elements of the strategy are political commitment to support TB treatment, detection of TB by sputum microscopy, direct observation of short course therapy, regular supply of medicines and reporting of programme performance and treatment outcomes. [61, 62]

Between 1995 and 2003 a total of 17 million cases of TB and 9 million smear positive cases of TB and an estimated 50% of all new TB cases in 2004 were reported through TB programmes which had implemented the DOTS strategy. [10, 33] A total of 183 countries globally had implemented DOTS and all 22 of the high burden countries had used DOTS since 2000.There has been a slow rise in the case detection rate in the high burden countries from 22% in 1995 to 83% in 2004.[10]

The cure rate among all TB cases registered under DOTS was 75% and a further 7% completed treatment. The DOTS programmes of the Africa region achieved a TB cure rate of 72 % and the treatment interruption rate was 10%.[10] In South Africa treatment success had reached 54% and the treatment interrupter rate was 14% in 2004.[9,10] In KZN the cure rate was estimated at 36% in 2002. [9]

There have been numerous constraints, which have hindered the success of TB control programmes in many developing countries of the world including South Africa. These constraints can be classified into three groups namely: patient related factors, contextual factors and health system factors.[41] Contextual factors such as HIV co-infection and immigration and their impact on TB incidence have already been discussed.

Patient related factors include inability to access health services, lack of money for food and transport and perceived social stigma. Among patients, difficulties in accessing health care services are likely to increase treatment interruption. Lack of money to use public transport has been cited as a cause for failing to return to the health care facility for TB treatment on a regular basis.[63] Lack of household income to purchase food so that patients can take their medication is another reason for possible treatment interruption.[63] Lack of public awareness about TB results in a fear of social stigma and lack of family and community support in patients and can adversely influence a patient's adherence to treatment which then negatively impacts on TB control. [2, 63]

Health system factors which are affecting TB control programmes include insufficiently skilled staff to run programmes at district and central levels, staff shortages, absent or inadequate training programmes and inadequate infrastructure.[10, 62, 64] This has resulted in a failure to implement or inappropriate implementation of the principles of DOTS which have further constrained TB control.[10, 58, 65] Shortages of drugs and weak laboratory services make diagnosis and effective treatment difficult.[10]

Choice and use of DOTS supporters by health services appears to also influence treatment success rates. A study in a rural community in South Africa has shown that use of community volunteers (treatment interruption=13%) as opposed to continued management at a facility level (treatment interruption =22%) is likely to have less frequent treatment interruption.[52]

Failure of governments to address all of the above adequately and as a matter of urgency will result in an increase in the incidence of TB and drug resistant TB in years to come. The added burden of HIV will further add to this increase in incidence. As result of this the number of TB patients presenting at health care facilities is going to increase and the occupational risk to HCWs will further increase. Thus it is very important in light of current shortages in health care staff to ensure that we start to quantify and appropriately address the problem of TB in HCWs.

CHAPTER THREE

PURPOSE

The purpose of this study was to describe the incidence of TB, and the clinical and public health aspects of the management of TB among HCWs in public sector hospitals in the Ethekwini Municipality of KZN.

OBJECTIVES

The objectives of the study with regard to HCWs in public sector hospitals in the Ethekwini Municipality of KZN were:

1. To review and describe the existing information systems for HCWs diagnosed with TB.
2. To present a demographic profile of HCWs working in the Public Sector Hospitals of the Ethekwini Municipality with respect to gender, age, occupation and the service departments.
3. To describe the incidence of TB in HCWs.
4. To identify the categories of HCWs who were at greatest risk of developing TB.
5. To describe TB among HCWs in respect of the following:
    a. Clinical presentation and treatment outcomes
    b. Compliance with legislative requirements by hospital management
6. To make recommendations to reduce the incidence of TB among HCWs and to ensure compliance with occupational health legislation by hospitals in which the HCWs are employed.

DEFINITIONS

Health Care Workers: All staff employed in a hospital.[66]

Administrative Staff: All staff involved in the administrative management of a hospital

Paramedical Staff: These are registered health care professionals who are neither doctors nor nurse. They provide technical and some clinical assistance in patient care e.g. laboratory staff, radiographers and physiotherapists.

Support Staff: Staff involved in non clinical work in a hospital e.g. cleaners, laundry personnel and kitchen staff.

Doctors: Staff category involving state registered doctors and medical students

Nurses: Staff category including all state registered nurses and student nurses.

District Hospital: These hospitals provide only generalist care[67]

Regional Hospital: These hospitals provide general specialist services.[67]

Specialist Hospital: These hospitals provide specialized care such as chronic psychiatry and tuberculosis care. [67]

Central Hospital: These hospitals provide super-specialist care. [67]

Pulmonary TB: A case of TB involving the lung parenchyma

Extra-pulmonary TB: A patient with tuberculosis of organs other than the lungs e.g. pleura, lymph nodes, abdomen, genitourinary tract, skin, joint, bones and meninges.

New TB Patient: a patient who has never had treatment for TB or who has taken TB drugs for less than four weeks.[10]

Cured: A patient who has completed a full course of TB treatment and who has a negative sputum at the end of 2 or 6 months.[10]

Treatment Completion: A patient who has completed TB treatment but no sputum investigations were done at 2 and 6 / 8 months of treatment.[10]

Successfully Treated: All patients that were cured and those who completed TB treatment.[10]

Treatment failure: A patient who is smear or culture positive at the end of treatment despite completing the full course of TB treatment.[10]

Incidence of TB in HCWs: The total number of new active or reactivated cases of TB relative to the total HCW population in a specified period of time.[9,68]

Public Health aspects of TB management: This includes surveillance and containment of TB. [69]

Compliance with Legislation: Fulfilling the legal requirements as stated in an act of parliament.

Staff / Occupational Health Clinic: This is a health clinic service provided by hospital management for hospital employees on the hospital premises.

CHAPTER FOUR

METHODOLOGY

4.1 Type of Research

This was an epidemiological study.

4.2 Study Design

This was a descriptive study of TB in HCWs conducted between July 2004 and February 2005.

4.3 Target Population

This study involved all the public sector hospitals (n=11) in the Ethekwini Municipality. Three of the eleven hospitals had to be excluded at the onset of the study. Inkosi Albert Luthuli quaternary hospital was not included in the study because it had been operational for six months only. Wentworth Hospital was not included because it was in a transitional phase (from a specialist to a day hospital) and Hillcrest hospital could not be included in the study because there was no data available on the research topic.

4.3.1 Study Population

As a result eight hospitals (n=8) were included in this study. The definitions of the categories used for the hospitals in this study were those that were in use at the time of data collection.

4.3.2 Sample Population

The "Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in Health Care Facilities" published by the CDC defines HCWs as all paid and unpaid workers working in a health care setting. This would include staff in the medical, nursing paramedical and support services. [66] In this study the CDC definition of HCWs was used and the sample population consisted of all staff employed in the hospitals chosen for the study (Annexure A).

4.4 Measurement

4.4.1 Exposure Variable

The exposure variable in this study was that of being employed as a HCW in any of the hospitals included in the study.

4.4.2 Outcome Variable

The outcome variable was one of being diagnosed with TB during the study period (January 1999 to June 2004).

4.4.3 Measurement Tools

Three different data collection instruments were developed and used in this study.

4.4.3.1 Data Extraction Sheet

A data extraction sheet was developed to collect data from the records in the staff / occupational health clinic on HCWs diagnosed with TB. The variables on

which data was extracted from the records were as follows: Demographic details of the HCWs diagnosed with TB including race, age, gender, occupation, service area of employment at the time of being diagnosed with TB and one month prior to the diagnosis of TB; Disease presentation and clinical management including the site of the TB infection, the type of TB, and the treatment outcome in the HCW; Legislative compliance including notification of an occupational disease, submission of first, progress and final medical reports for an occupational disease (Annexure B).

4.4.3.2 Semi-structured Interview Schedule

A semi-structured interview schedule was developed and data was collected on the recording and reporting systems that existed in each hospital for HCWs diagnosed with TB (Annexure C).

4.4.3.3. Self-administered Anonymous Questionnaire

A self-administered anonymous questionnaire was developed to be answered by HCWs who had been diagnosed with TB during the study period. The questionnaire collected data on similar variables as those that would be extracted from the staff / occupational health clinic records (Annexure D).

4.4.3.4 Validation of Tools

All three data collection tools were piloted in a single hospital, which was part of the study, three months prior to the beginning of actual data collection. The necessary changes were made before the final versions of the data collection

tools were implemented. Data for this pilot hospital was re-collected during the data collection phase of the study.

4.4.4 Reliability

4.4.4.1 Precision

All data collection instruments were piloted prior to data collection and based on the results, amended. Following training, the field worker visited a single hospital and collected data. The principal investigator reviewed the data collected against the available records to verify the data at the end of the first day. Similarly, on completion of data collection the principal investigator took a ten percent sample of the collected data and checked it against the records available in the staff/occupational health clinic of the respective hospitals to verify the data that had been collected. This ten percent sample was included in the final analysis of the results.

4.4.4.2 Bias

4.4.4.2.1 Selection Bias

The hospitals of the Ethekwini Municipality were chosen for the purposes of convenience due to a limited research budget. However the information system in hospitals of this municipality has been of a better quality than in other municipalities of KZN. Thus in the absence of baseline information on TB in HCWs we felt it was most appropriate to conduct the study in this municipality.

4.4.4.2.2 Information Bias

The data collected in this study was based on existing records and thus we anticipated a problem of information bias in this study. The record review and the anonymous questionnaire were used as a means of data collection from dual sources for comparison in an attempt to reduce the information bias in this study.

4.4.4.3 Confounding

Gender, age and occupation were identified as possible confounders in this study. Data was collected on these variables and during analysis we stratified for these variables to control for any possible confounding effect. HIV co-infection was a possible confounder for occupational acquired TB in HCWs in this study. Unfortunately we were unable to collect data on this variable.

4.5 Ethics and Permission

Permission to visit the hospitals was obtained from the Secretary General of Health for KwaZulu-Natal (Annexure E). Individual HCWs were required to give consent to answer an anonymous self-administered questionnaire (Annexure F). Details on HCW names, identity numbers and staff numbers were not collected. All medical information remained confidential. A study protocol was submitted to the Ethics Committee at the Nelson R Mandela School of Medicine for ethical approval to conduct the study and approval was obtained (Annexure G).

4.6 Process of Data Collection

All of the hospitals included for this study were visited and a meeting was held with the hospital manager and the nurse responsible for staff / occupational health clinic. During this meeting they were informed about the study aims, objectives and methodology and the logistics of data collection was discussed. A field worker was employed and trained to use the data collection tools prior to the start of data collection.

Data collection took place between July and November 2004. Scheduled interviews were held with the nurse responsible for the staff / occupational health clinic in each hospital. During these interviews the recording and reporting system for HCWs diagnosed with TB that existed in each hospital was reviewed and a field worker collected the data. The field worker spent approximately a week in each hospital extracting data from the records on HCWs with TB in the staff/ occupational health clinic. The staff / occupational health clinic nurse assisted in ensuring the completeness of the data obtained from the records.

A notice was circulated to all staff in the hospital informing them of the study and those who were diagnosed with TB during January 1999 to June 2004 were invited to voluntarily participate in answering the self administered anonymous questionnaire. These circulars were made available to unit managers and were posted on notice boards in the hospital. HCWs were informed through the notice that they could obtain the questionnaire from the staff / occupational health clinic and a sealed box was put in the staff /

occupational health clinic into which completed questionnaires were placed. The questionnaires were available for the duration of data collection i.e. July to November 2004. Data on the annual staff complement employed in each hospital included in the study was obtained from the Directorate of Human Resources in the Provincial Department of Health, for the period January 1999 to June 2004.

4.7 Data Handling and Analysis

Data was captured using the EPIDATA package and analyzed using the SPSS 11.5 statistical package. Before conducting formal statistical analysis, preliminary analysis was performed.

Descriptive statistics and analysis was undertaken for gender, age, occupation, annual number of TB cases among HCWs, type of TB and Treatment outcome among HCWs. The Independent Samples T-Test was used to test for a significant relationship between age in male and female HCWs and the mean incidence between male and female HCWs .

The incidence of a disease is defined as the number of new cases of a disease that occurred during a specified period of time in a population at risk for developing the disease. Incidence is thus a measure of the risk of a disease.[68,70] When calculating the annual incidence rate in a dynamic population the denominator is the average size of the population i.e. the mid year population. If the period is a year this is an annual incidence rate. In follow up studies with no censoring the incidence rate is calculated by dividing the

number of new cases in a specified period by the initial size of the cohort of persons being followed. This is equivalent to the cumulative incidence rate during the study period.[71] In South Africa the incidence of TB is defined as all cases of TB reported to the National Department of Health per 100 000 population for that year.[9, 70] In this study the definition of the National Department of Health was used because using the mid year population would have presented an inflated value for the annual incidence for the variables under study. [9, 70] Mean incidences have been calculated and presented with the 95% confidence intervals.

The occupation specific incidence for TB in HCWs was stratified by gender and the risk of TB incidence for each occupational category in males was compared to those of females. The age specific mean incidence for TB in HCWs for the study period was compared to the age specific TB incidence in the general population of KwaZulu-Natal in 2004. The Chi Squared test was used to test if the age specific TB rates were similar in HCWs as compared to the general population or if they were higher.

The Relative Risk and 95% confidence interval was calculated to test for a significant relationship between age group, gender, and occupation and having a diagnosis of TB. The at risk population for the Relative Risk calculations was the sum of the annual number of HCWs employed in each of the study hospitals for the study period as these HCWs were considered to be at risk annually. The ANOVA test was used to test for a significant relationship between the mean incidence for the variables of age, race, occupation and

hospital. For all tests of significance the accepted level of significance was 0.05.

CHAPTER FIVE

RESULTS

The results presented in this chapter are based on the analysis of data obtained from the scheduled interviews with the nurse managing the staff / occupational health clinic in the hospitals and the records on TB in HCWs for the study period January 1999 to June 2004. A total of eight (N=8) public sector hospitals were included in this study. The majority were regional hospitals (n=4) and two were specialist hospitals. The remaining two hospitals were classified as central and district hospitals respectively.

The results are presented with respect to the following: the response rate and completeness of the data, the information systems for TB in HCWs, the demographic profile of HCWs employed in the Ethekwini Municipality, the incidence of TB in HCWs, disease presentation, treatment outcomes and the compensation of HCWs with TB. Annual cumulative incidence has been presented for the study period and for each of the following defining variables i.e. for age, gender, race and occupational category. Data is presented on the legislative management of the cases with respect to the Compensation for Occupational Injuries and Diseases Act No 130 of 1993.

5.1 Response Rate and Completeness of Data

Data from the self-administered anonymous questionnaire is not presented because there was a poor response rate. Four hundred questionnaires (N=400) were distributed between the eight hospitals in the study. A total of ten questionnaires were returned (n=10) for the study period. Due to the poor response rate to the self-administered anonymous questionnaires we were not able to gather data on those HCWs who had not utilized the staff /occupational health clinic in their respective hospital. Therefore the data presented below may be an underestimation of the incidence of TB among HCWs in the public sector hospitals of the Ethekwini Municipality of KwaZulu-Natal for the period January 1999 to June 2004.

All of the hospitals did not report cases of TB in HCWs for the entire study period and the annual staff complement for a particular hospital was included in the study population at the point at which the respective hospital started reporting TB cases. To include the staff from the hospitals for the entire period even though they were not reporting any cases of TB would result in a dilution of the true effect when calculating the incidence rates for the study period.

5.2 TB Information System for HCWs in Ethekwini Public Sector Hospitals

Only King George V hospital had an electronic database of all HCWs with TB in the last four years but used a manual record system as well. The seven other hospitals used a manual system to record cases of TB in HCWs. The manual record systems varied from a notebook to patient cards. The quality of the data

maintained in each hospital varied considerably. While some of the hospitals did not have data on all of the variables available in the clinic, the information was accessible from other data sources such as the human resource department. The information on HCWs with TB maintained by the staff clinic in King Edward VIII hospital was very limited. Only one of the hospitals (King George V) recorded cases of TB among HCWs in a separate TB register. This TB register is the recording system used by the National and Provincial TB Control Programme for recording TB cases.

The implementation of the information systems varied in the different hospitals. While some hospitals had recorded information on HCWs with TB since 1999 other hospitals had only started recording the information from as late as 2003. The person responsible for maintaining the records varied from hospital to hospital. The responsible person was either the infection control nurse, the occupational health nurse or the nurse in charge of the hospital's TB control programme.

5.3 Demographic Profile of HCWs in Ethekwini Hospitals

The mean age of HCWs employed in the hospitals was 41 years (Range: 17 - 70). Approximately three times more females (n = 41057, 75%) than males (n = 13954, 25%) were employed in total during the study period.

Nurses were the largest group of staff employed annually for the study period. The support services were the second largest group of employees during the

study period. The paramedical staff constituted 6% (n=3353) of the total number of employees for the study period. (TABLE I)

TABLE I: NUMBER OF HCWs CATEGORIZED BY JOB DESCRIPTION EMPLOYED IN ETHEKWINI PUBLIC SECTOR HOSPITALS AT THE START OF EACH YEAR (1999 - 2004)

JOB	YEAR						TOTAL (%)
	1999 (%)	2000 (%)	2001 (%)	2002 (%)	2003 (%)	Mid 2004 (%)	
Doctor	373 (5)	438 (6)	602 (7)	548 (5)	659 (6)	666 (6)	3286 (6)
Paramedical	287 (4)	334 (5)	382 (5)	473 (5)	939 (8)	469 (8)	3353 (6)
Administrator	530 (8)	506 (7)	545 (7)	764 (8)	881 (8)	883 (8)	4109 (8)
Support services	1971 (28)	2000 (28)	2229 (27)	2834 (28)	3209 (28)	3048 (27)	15291 (28)
Nurse	3892 (55)	3847 (54)	4457 (54)	5354 (54)	5713 (50)	5709 (51)	28972 (53)
Total	7053 (100)	7125 (100)	8215 (100)	9973 (100)	11401 (100)	11244 (100)	55011 (100)

5.4 Demographic Profile of HCWs with TB in Ethekwini Hospitals

A total of 583 cases of HCWs with TB were recorded for the study period January 1999 to June 2004 in the eight public sector hospitals in the Ethekwini, Municipality. Seven (n=7) patients seen at a regional hospital could not be categorized according to the year of diagnosis and a further 25 HCWs diagnosed with TB during the study period did not have a job description. Information on age was missing for 166 of the HCWs diagnosed with TB. Descriptive statistics were presented for the valid data (N=417). The mean age for this group of HCWs diagnosed with TB was 38 years (95%CI: 37.0 –38.7; Range: 21 - 64). When stratified for gender the mean age for female HCWs

(n=283) with TB was 37 years (95% CI: 36-39; Range: 21-64). The mean age for men (n=134) with TB was 39 years (95% CI: 37-40; Range: 23 -63). The independent samples t-test showed no significant difference in the mean age for TB in males and females ($p=0.06$, $\alpha=0.05$).

The majority of the TB cases were diagnosed among staff working in regional hospitals (55%, n=322) followed by central hospitals (30%, n=174) and specialist hospitals (14%, n=79) and the district hospital treated 1% of cases (n=8). The number of cases reported was dependent on the information system present in the hospital and the year of implementation of the information system. Employment areas in the hospital were divided into three categories in-patient, outpatient and non-patient related. The majority of the HCWs diagnosed with TB were working in the in-patient areas of the hospital (n=202; 35%). HCWs employed in the outpatient departments of the hospital accounted for 26% (n=153) of the TB cases and HCWs employed in non-patient related areas of the hospital contributed 24% (n=137) of the TB cases. We were unable to categorize 16% (n=91) of the TB cases by area of employment.

5.5 Cumulative Incidence of TB in HCWs in Ethekwini Public Sector Hospitals

The annual cumulative incidence of TB in HCWs in the hospitals under study is presented below by gender, age, race and occupation. The annual cumulative incidence of TB in HCWs increased from 879 / 100 000 HCWs in 1999 to 1333/ 100 000 HCW population in 2003. There is a drop in cumulative incidence in 2004 but this is because we collected data in the first six months of the year

only. The mean cumulative incidence for the study period was 1040 / 100 000 HCW population (95% CI: 838-1242) (TABLE II).

TABLE II: ANNUAL CUMULATIVE INCIDENCE OF TB IN HCWs IN ETHEKWINI PUBLIC SECTOR HOSPITALS (1999 - 2004)

	YEAR						Mean Cumulative Incidence (95%CI)
	1999	2000	2001	2002	2003	2004	
Number of TB cases	62	80	83	110	152	89	1040 (838 -1242)
At risk population	7053	7125	8215	9973	11401	11244	
Cumulative Incidence per 100 000	879	1123	1010	1103	1333	792	
7 HCWs who could not be classified by year were excluded							

5.5.1 Cumulative Incidence by Gender

When stratified by gender the annual cumulative incidence of TB was found to be higher in male HCWs as compared to female HCWs. The mean cumulative incidence of TB in males HCWs (Mean cumulative incidence =1544 / 100 000 HCW population; 95% CI 1228 -1859) was higher than that for female HCWs (Mean cumulative incidence =1052 / 100 000 HCW population; 95% CI 402 - 1701). No significant difference was found between the cumulative incidence of TB in male and female HCWs using the independent samples t-test ($p=0.3$; $\alpha=0.05$) (TABLE III).

TABLE III: ANNUAL CUMULATIVE INCIDENCE OF TB STRATIFIED BY GENDER IN HCWs IN ETHEKWINI PUBLIC SECTOR HOSPITALS (1999 - 2004)

GENDER	YEAR						Mean Cumulative Incidence (95%CI)
	1999	2000	2001	2002	2003	2004	
FEMALE							
Number of TB cases	32	48	51	70	101	62	1052 (402-1701)
At risk population	5279	5290	6126	7470	8477	8414	
Cumulative Incidence per 100 000	606	907	833	937	2291	737	
MALE							
Number of TB cases	30	32	32	40	51	27	1544 (1228-1859)
At risk population	1774	1835	2089	2503	2924	2830	
Cumulative Incidence per 100 000	1691	1744	1531	1598	1744	954	
$p=0.3$; $\alpha=0.05$							

5.5.2 Cumulative Incidence by Race

Annually the cumulative incidence of TB when stratified by race was highest among HCWs classified as African followed by those classified as Indian. In some of the years the hospital records did not reflect cases of TB among those HCWs classified as White (2002, 2004) and Coloured (1999, 2000 and 2001) and a cumulative incidence rate was not calculated for these years. The mean cumulative incidence ranged from 99 / 100 000 HCW population (95% CI: 7-190) in Whites to 1294 / 100 000 HCW population (95% CI: 1068 - 1519) in Africans. There was a significant difference between the mean cumulative incidences for the different race groups using ANOVA ($p<0.01$; $\alpha=0.05$) (TABLE IV).

TABLE IV: ANNUAL CUMULATIVE INCIDENCE OF TB STRATIFIED BY RACE IN HCWs IN ETHEKWINI PUBLIC SECTOR HOSPITALS (1999 - 2004)

RACE	YEAR						Mean Cumulative Incidence (95%CI)
	1999	2000	2001	2002	2003	2004	
AFRICAN							
Number of TB cases	59	74	79	102	127	77	1294 (1068 - 1519)
At risk population	4827	5627	6507	7275	7808	7838	
Cumulative Incidence per 100 000	1222	1315	1214	1402	1626	982	
INDIAN							
Number of TB cases	2	5	3	7	21	6	434 (182-686)
At risk population	878	931	1120	1484	2471	2394	
Cumulative Incidence per 100 000	228	537	268	472	850	251	
WHITE							
Number of TB cases	1	1	1	-	1	-	99 (7-190)
At risk population	1301	518	530	825	756	666	
Cumulative Incidence per 100 000	77	193	189	-	132	-	
COLOURED							
Number of TB cases	-	-	-	1	3	6	469 (-263-1200)
At risk population	47	49	58	389	366	346	
Cumulative Incidence per 100 000	-	-	-	257	820	1734	
$p < 0.01$; $\alpha = 0.05$							

5.5.3 Cumulative Incidence by Age group

In 1999 to 2001 the annual cumulative incidence of TB was highest in the age group 25-34 years. In 2001 and 2002 the TB cumulative incidence in the age group 25-34 years decreased as compared to the cumulative incidence for the same age group in 2000. However the cumulative incidence in this age group increased in 200. In the age group 15-24 there were no TB cases recorded in the hospitals during 2001 and therefore a cumulative incidence rate could not be calculated. In 2002 the cumulative incidence was highest in the age group 15-24 years. The small at risk population in this age group in 2002 as compared to that for the other age groups may account for the high cumulative incidence rate seen in this age group. The mean cumulative incidence ranged from 472/ 100 000 HCW population (95%CI: 288-656) in 55-64 year olds to 1043 / 100 000 HCW population (95%CI: 650 -1436) in the 25-34 year olds. There was a significant difference between the mean cumulative incidences for the different age groups using ANOVA ($p<0.01$; $\alpha=0.05$) (TABLE V).

TABLE V: ANNUALCUMULATIVE INCIDENCE OF TB STRATIFIED BY AGE IN HCWs IN ETHEKWINI PUBLIC SECTOR HOSPITALS (1999 - 2004)

AGE GROUP	YEAR						Mean Cumulative Incidence (95%CI)
	1999	2000	2001	2002	2003	2004	
15-24 Years							
Number of TB cases	1	1	-	7	5	4	572 (155-990)
At risk population	239	201	301	576	693	688	
Cumulative Incidence per 100 000	418	498	-	1215	722	581	
25-34 Years							
Number of TB cases	14	22	15	20	46	26	1043 (650 -1436)
At risk population	1908	1816	1939	2380	2673	2652	
Cumulative Incidence per 100 000	734	1211	774	840	1721	980	
35-44 Years							
Number of TB cases	18	21	17	27	40	33	770 (606-934)
At risk population	2680	2715	3101	3543	3989	3824	
Cumulative Incidence per 100 000	672	774	548	762	1003	863	
45-54 Years							
Number of TB cases	4	6	13	16	15	15	485 (319-651)
At risk population	1639	1758	2142	2471	2811	2810	
Cumulative Incidence per 100 000	244	341	607	648	534	534	
55-64 Years							
Number of TB cases	4	2	4	3	4	8	472 (288-656)
At risk population	581	626	725	992	1214	1250	
Cumulative Incidence per 100 000	689	320	552	302	330	640	
$p < 0.01$; $\alpha = 0.05$							

5.5.4 Cumulative Incidence by Occupation

There was no single occupational category with the highest cumulative incidence of TB annually for the entire study period. In 1999 the cumulative incidence of TB was highest among the doctors. In 2000, 2002 and 2003 the cumulative incidence was highest among the paramedical staff. In 2001 the cumulative incidence was highest among the support services staff and in 2004 it was highest among the nurses. In 2004 there were no cases of TB reported among the administrators and therefore no cumulative incidence rate could be calculated for this occupational group in 2004. The mean cumulative incidence ranged from 740 / 100 000 HCW population (95%CI: 200-1281) in doctors to 1675 / 100 000 HCW population (95%CI: 880-2470) in paramedical staff. There was a significant difference between the mean cumulative incidences for the different occupational groups using ANOVA ($p = 0.02$; $\alpha = 0.05$) (TABLE VI).

TABLE VI: ANNUAL CUMULATIVE INCIDENCE OF TB STRATIFIED BY OCCUPATION IN HCWs IN ETHEKWINI PUBLIC SECTOR HOSPITALS (1999 - 2004)

OCCUPATION	YEAR						Mean Cumulative Incidence (95%CI)
	1999	2000	2001	2002	2003	2004	
DOCTOR							
Number of TB cases	6	2	1	3	7	4	740 (200-1281)
At risk population	373	438	602	548	659	666	
Cumulative Incidence per 100 000	1609	457	166	547	1062	601	
PARAMEDICAL							
Number of TB cases	4	10	5	9	16	7	1675 (880-2470)
At risk population	287	334	382	473	939	938	
Cumulative Incidence per 100 000	1394	2994	1309	1903	1704	746	
ADMINISTRATOR							
Number of TB cases	3	7	2	9	9	-	753 (197-1308)
At risk population	530	506	545	764	881	884	
Cumulative Incidence per 100 000	566	1383	367	1178	1022	-	
SUPPORT SERVICES							
Number of TB cases	18	22	37	33	44	26	1177 (861-1492)
At risk population	1971	2000	2229	2834	3209	3048	
Cumulative Incidence per 100 000	913	1100	1660	1164	1371	853	
NURSE							
Number of TB cases	24	28	35	53	75	52	891 (633-1148)
At risk population	3892	3847	4457	5354	5713	5708	
Cumulative Incidence per 100 000	617	728	785	990	1313	911	
$p = 0.02$; $\alpha = 0.05$							

5.5.5 Cumulative Incidence by Hospital

The table below reflects the number of cases of TB and the cumulative incidence of TB per year categorized by hospital in the Ethekwini municipality for the study period. Seven cases of TB diagnosed at Addington Hospital could not be categorized by the year in which they were diagnosed and thus were excluded when calculating the cumulative incidence. The cumulative incidence rates were calculated for the years in which the hospitals reported cases of TB in HCWs. In 1999 and 2000 Prince Mshiyeni Hospital had the highest cumulative incidence of TB in HCWs while from 2001 to 2003 Mahatma Gandhi Hospital and in 2004 RK Khan Hospital had the highest cumulative incidence of TB in HCWs. The mean cumulative incidence ranged from 536 / 100 000 HCW population (95%CI: -5316-6387) in R K Khan Hospital to 1917/ 100 000 HCW population (95%CI:-363 - 4196) in King George V Hospital. There was no significant difference between the mean cumulative incidences for the different hospitals using ANOVA ($p = 0.6$; $\alpha=0.05$) (TABLE VII).

TABLE VII: ANNUAL CUMULATIVE INCIDENCE OF TB IN HCWs

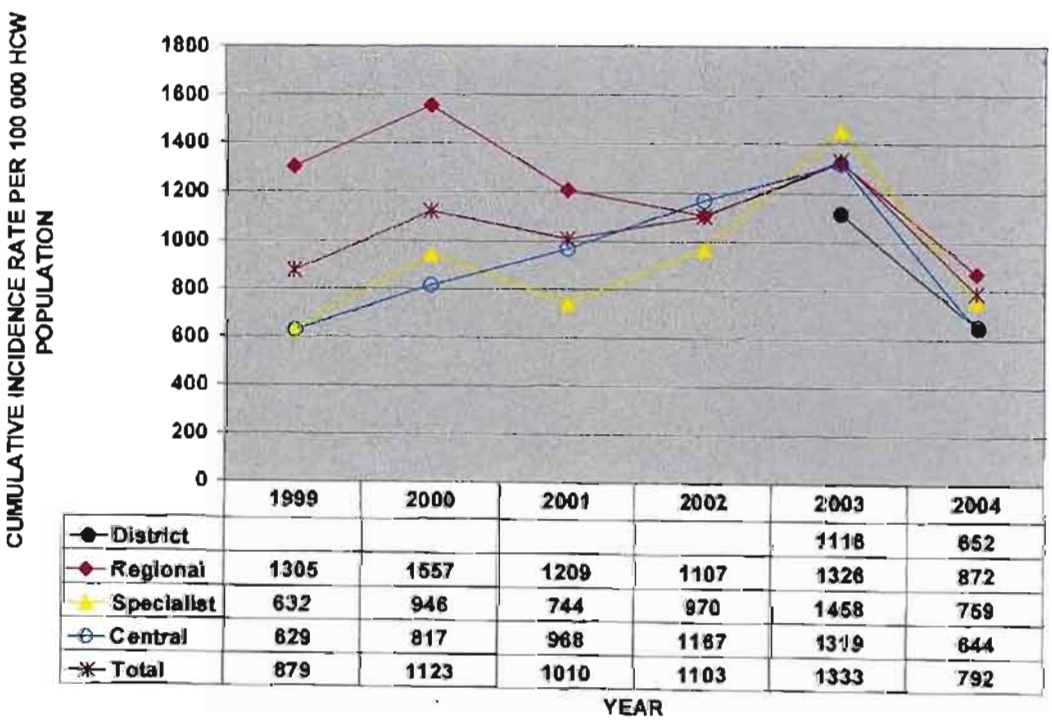
STRATIFIED BY HOSPITAL IN ETHEKWINI PUBLIC SECTOR HOSPITALS

(1999 –2004)

HOSPITAL	YEAR						Mean Cumulative Incidence (95%CI)
	1999	2000	2001	2002	2003	2004	
OSINDISWENI							
Number of TB cases	-	-	-	-	5	3	884
At risk population	-	-	-	-	448	460	(-2064-3832)
Incidence per 100 000	-	-	-	-	1116	652	
R K KHAN							
Number of TB cases	-	-	-	-	13	1	536
At risk population	-	-	-	-	1305	1340	(-5316-6387)
Incidence per 100 000	-	-	-	-	996	75	
ADDINGTON							
Number of TB cases	-	-	-	9	20	24	845
At risk population	-	-	-	2110	2075	2096	(-82-1773
Incidence per 100 000	-	-	-	427	964	1145	
CLAIRWOOD							
Number of TB cases	-	-	3	5	10	5	882
At risk population	-	-	739	696	638	598	(100-1664)
Incidence per 100 000	-	-	406	718	1567	836	
MAHATMA GANDHI							
Number of TB cases	2	3	10	12	18	7	1378
At risk population	453	449	587	659	685	698	(514-2241)
Incidence per 100 000	442	668	1704	1821	2628	1003	
KING GEORGE V							
Number of TB cases	7	10	10	11	12	6	1917
At risk population	1108	1057	1008	953	871	852	(-363 - 4196)
Incidence per 100 000	6327	946	992	1154	1378	704	
KING EDWARD VIII							
Number of TB cases	21	27	33	36	39	18	924
At risk population	3339	3306	3408	3086	2956	2794	(629-1219)
Incidence per 100 000	629	817	968	1167	1319	644	
PRINCE MSHIYENI							
Number of TB cases	32	40	27	37	35	25	1382
At risk population	2153	2313	2473	2469	2423	2406	(1104-1659)
Incidence per 100 000	1486	1729	1092	1499	1444	1039	
p =0,6; α=0.05							

5.5.6 Annual Cumulative Incidence for Type of Hospital

The trend analysis below indicates that the cumulative incidence of TB among HCWs has been increasing annually from 1999 to 2004. The annual cumulative incidence of TB in HCWs has been highest in the Regional hospitals during all years with the exception of 2002 when it was highest in the Central Hospital (King Edward VIII Hospital). Incidence of TB in HCWs is presented for the District hospital (Osindisweni Hospital) for the years in which it had started recording TB in HCWs. There was no significant difference between the four hospital types with regard to the annual cumulative incidences using ANOVA ($p = 0.2$; $\alpha=0.05$) (Fig. I).



	1999	2000	2001	2002	2003	2004
District					1116	652
Regional	1305	1557	1209	1107	1326	872
Specialist	632	946	744	970	1458	759
Central	629	817	968	1167	1319	644
Total	879	1123	1010	1103	1333	792

FIGURE I: TREND OF TB INCIDENCE IN HCWs PER HOSPITAL TYPE (1999 – 2004)

5.6 Relative Risk for Developing TB

5.6.1 Gender as a Risk for developing TB

Individual Relative Risks were calculated for each gender category to test for a significant association with being diagnosed with TB in HCWS. The at risk population used was the sum of the total annual number of HCWs employed in each study hospital over the entire study period (N=55011). Being male (RR: 1.4; 95% CI: 1.7 - 2.0) had a significant association with being diagnosed with TB while being female (RR: 0.5; 95% CI: 0.6 - 0.7) appeared to be protective against having TB. The population at risk among females is much larger than among males because three times more females (n= 41057; 75%) than males (n=13954; 25%) were employed in hospitals during the study period. This may account for the protective association being seen with being female and being at risk for developing TB (TABLE VIII).

TABLE VIII: GENDER AS A RISK FOR DEVELOPING TB IN HCWs IN ETHEKWINI PUBLIC SECTOR HOSPITALS (1999 - 2004)

GENDER	TB PRESENT	NO TB	RR (95%CI)	P value
MALE	212	13742	1.4 (1.7 – 2.0)	<0.01
FEMALE	371	40686	0.5 (0.6 – 0.7)	<0.01
TOTAL	583	54428		

5.6.2 Occupation as a Risk for developing TB

Individual Relative Risks were calculated for each occupational category to test for a significant association with being diagnosed with TB in HCWS. The at risk population used was the sum of the total annual number of HCWs employed in each study hospital over the entire study period (N=55011). Working as Paramedical staff (RR: 1.6; 95% CI: 1.2 - 2.1) and Support Service staff (RR: 1.3; 95% CI: 1.1 - 1.5) in the hospital was found to have a significant association with being diagnosed with TB. While being a Doctor (RR: 0.7; 95% CI: 0.5 -1.0), Administrator (RR: 0.7; 95% CI: 0.5 -1.0) or Nurse (RR: 0.9; 95% CI: 0.7-1.0) had a relative risk of less than one suggesting that these occupations were protective against being diagnosed with TB. However these were not considered as significant because the 95% CI included one in all cases (TABLE IX).

TABLE IX: RISK OF OCCUPATIONAL CATEGORY FOR DEVELOPING TB IN HCWs IN ETHEKWINI PUBLIC SECTOR HOSPITALS (1999 - 2004)

STAFF CATEGORY	TB PRESENT	NO TB	RR (95% CI)	P value
PARAMEDICAL	51	3302	1.6 (1.2 - 2.1)	<0.01
SUPPORT SERVICES	183	15108	1.3 (1.1 - 1.5)	<0.01
NURSE	271	28701	0.9 (0.7 - 1.0)	0.05
ADMINISTRATOR	30	4079	0.7 (0.5 - 1.0)	0.06
DOCTOR	23	3263	0.7 (0.5 - 1.0)	0.06
Total	558*	54453		

* 25 HCWs with TB unclassified by occupational category were excluded from the analysis

5.6.3 Age as a Risk for developing TB

Individual Relative Risks were calculated for each age group to test for a significant association with being diagnosed with TB in HCWS. The at risk population used was the sum of the total annual number of HCWs employed in each study hospital over the entire study period (N=55011). Belonging to the age group 25 - 34 years was significantly associated with a diagnosis of TB in HCWS (RR: 1.7; 95% CI: 1.4-2.0). Belonging to the age groups 15 - 24 and 35 -44 while having an relative risk of more than one were not significantly associated with a diagnosis if TB. Belonging to the older age groups 45 - 54 (RR: 0.6; 95% CI: 0.5-0.8) and 55 - 64 (RR: 0.6; 95% CI: 0.4 -0.9) appeared to be protective against being diagnosed with TB. This may be a reporting bias because we did not have information on age for 166 HCWs diagnosed with TB. Alternatively HCWS in the older age groups are more likely to be in management positions and thus have minimal patient contact reducing their risk for developing TB (TABLE X).

TABLE X: RISK OF AGE GROUP FOR DEVELOPING TB IN HCWS IN ETHEKWINI PUBLIC SECTOR HOSPITALS (1999 - 2004)

AGE GROUP	TB PRESENT	NO TB	RR (95%CI)	P value
15-24	20	2334	1.0 (0.6 - 1.5)	0.9
25-34	145	11897	1.7 (1.4 - 2.0)	<0.01
35-44	157	17783	1.1 (0.9 - 1.3)	0.5
45-54	69	12157	0.6 (0.5 - 0.8)	<0.01
55-64	26	4737	0.6 (0.4 - 0.9)	<0.01
65+	0	64	-	-
TOTAL	417*	48972		
* 166 HCWs with TB unclassified by age category were excluded from the analysis				

5.6.4 Occupation stratified by Gender as a Risk for developing TB

Occupational category was stratified by gender and the relative risk for each category was calculated. The "at risk population" used was the sum of the total annual number of HCWs employed in each study hospital over the entire study period (N=55011). The risk ratio for each occupational category stratified by gender showed that male HCWs in the occupational categories of nursing (RR: 6.9; 95%CI 1.86-3.72), paramedical work (RR: 5.2; 95%CI 1.32-3.92) and the support services (RR: 3.7; 95%CI 1.42-2.58) had a higher risk for having TB than female HCWs in the same categories. While the risk for having TB in male administrators (RR: 0.9; 95%CI 0.44-1.83) and doctors (RR: 0.8; 95% CI 0.36-1.86) was less than their counterparts (TABLE XI).

TABLE XI: RISK OF TB IN HCWs STRATIFIED BY GENDER AND OCCUPATION IN ETHEKWINI PUBLIC SECTOR HOSPITALS (1999 - 2004)

OCCUPATION*	GENDER								
	MALE				FEMALE				Risk Ratio
	Number of TB cases	At risk population	RR (95% CI)	P Value	Number of TB cases	At risk population	RR (95% CI)	P Value	
NURSE	36	1597	2.63 (1.86 - 3.72)	< 0.01	235	27375	0.38 (0.27 - 0.54)	< 0.01	6.9
PARAMEDICAL	24	943	2.27 (1.32 - 3.92)	< 0.01	27	2410	0.44 (0.26 - 0.76)	< 0.01	5.2
SUPPORT SERVICES	114	7085	1.91 (1.42 - 2.58)	< 0.01	69	8206	0.52 (0.39 - 0.70)	< 0.01	3.7
ADMINISTRATOR	15	2164	0.9 (0.44 - 1.83)	0.8	15	1945	1.11 (0.55 - 2.27)	0.8	0.8
DOCTORS	14	2165	0.81 (0.36 - 1.86)	0.6	9	1121	1.24 (0.54 - 2.86)	0.6	0.7

* 25 HCWs with TB unclassified by occupational category were excluded from the analysis

5.6.5 Comparison of TB Risk in HCWs to TB Risk in the General Population

The cumulative incidence of TB in HCWs recorded for 2004 stratified by age was compared to the cumulative incidence of TB in the general population in KZN stratified by age in 2004 to determine if the TB incidence rate was similar. The age specific cumulative incidence rates for TB in HCWs was greater than that of the general population (X^2 =22; df =4; α=0.05) for (TABLE XII).

TABLE XII: AGE SPECIFIC CUMULATIVE INCIDENCE OF TB IN HCWs IN ETHEKWINI PUBLIC SECTOR HOSPITALS COMPARED TO AGE SPECIFIC CUMULATIVE INCIDENCE OF TB IN THE GENERAL POPULATION IN KZN FOR 2004

AGEGROUP	TB CASES IN HCWs	AT RISK HCWs	TB CASES IN THE GENERAL POPULATION	GENERAL POPULATION AT RISK	EXPECTED NUMBER OF TB CASES IN HCWS	CHI SQUARED VALUE
15-24	4	688	5974	2067186	2.0	2.0
25-34	26	2652	9837	1448811	18.0	3.5
35-44	33	3824	5830	1095886	20.3	7.9
45-54	15	2810	2744	741635	10.4	2.0
55-64	8	1250	1240	464422	3.3	6.5
X^2 = 22; d =4; α=0.05						

5.7 Clinical Presentation among HCW Diagnosed with TB in Ethekwini Public Sector Hospitals

Information on the type of TB that HCWs presented with was missing for 28% (n=162) of the HCWs (n=583) diagnosed with TB during the study period. The valid percentages[a] for all those HCWs (N=421) with available information on their disease profile are presented. HCWs presented mainly with Pulmonary TB (77%, n=322) while 24 % of HCWs (n=99) were diagnosed with Extra-pulmonary TB. MDR TB accounted for 3% (n=13) amongst HCWs (N=421) with available information on their disease profile.

Multidrug- resistant TB

More females presented with MDR TB than males (F: M=9:4). Approximately 69% (n=9) of cases with MDR TB (N=13) were over the age of thirty. Of the HCWs diagnosed with MDR TB (N=13), 62% (n=8) were nurses followed by 31% (n=4) of staff working in the support services. Information on occupational category was missing for one (7%) person. The majority of the staff (n=5; 39%) with MDR TB worked in the in-patient areas of the hospital, followed by the outpatient (n=4; 31%) and the non-medical areas (n=3; 23%) of the hospital. Information on the area of employment was missing for one (8%) of the HCWs diagnosed with MDR TB (N=13). Treatment outcomes among those HCWs diagnosed with MDR TB were as follows: Still on treatment = 39% (n=5); Cured =31% (n=4); Death due to TB =15.4% (n=2); Completed treatment, 8% (n=1) and Death not due to TB, 8% (n=1).

[a] For valid percentage calculations use the number of values present instead of the total number of cases in the study sample[73]

Re-Treatment TB

The data was reviewed to establish the level of re-treatment among HCWs with TB. Data was missing for 28% (n=163) of the cases. The valid percentages[b] for all those HCWs (N=420) with available information on re-treatment is presented. Re-treatment for TB occurred in approximately 13% (n=56) of the cases of the HCWs (N=420). The majority of HCWs presented for the first time with TB (n=364: 87%).

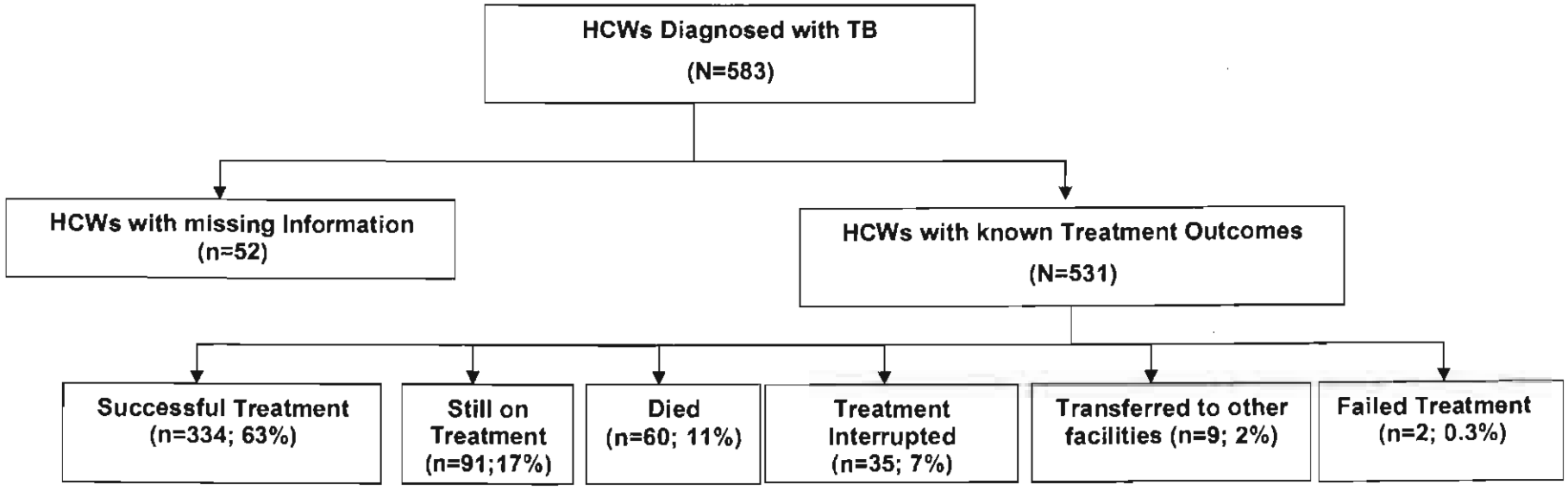
The majority of re-treatment cases were either nurses (n=25; 45%) or worked in the support services (n=18; 32%). There was an almost equal gender distribution (M: F=26:30). Of those HCWs who required re-treatment 8% (n=5) had MDR TB.

5.8 Treatment Outcomes for TB in HCWs

Information on treatment outcomes was missing for 9% (n=52) of cases. Among the HCWs (N=531) with known treatment outcomes, successful treatment outcome was achieved in 63% (n=334). Treatment failure occurred in 0.4% (n=2) and 11% (n=60) had died. Approximately 7% (n=35) did not complete their treatment (treatment interrupters). At the time of the study approximately 17% of HCWs (n=91) were still on treatment, less than two percent (n=9) were transferred to other facilities for treatment. (Fig. II)

[b] For valid percentage calculations use the number of values present instead of the total number of cases in the study sample[73]

FIGURE II: TREATMENT OUTCOME ALGORITHM FOR TB IN HCWs IN ETHEKWINI PUBLIC SECTOR HOSPITALS



5.9 Policy and Compliance with Legislative Requirements in Ethekwini Public Sector Hospitals

Only one of the eight hospitals under review namely King George V had a workplace policy on the management of HCWs with TB. This policy provided guidelines for the treatment of HCWs who had confirmed TB but there was limited policy guidelines on preventive controls and surveillance of TB in HCWs (Annexure H). Seven hospitals (88%) reported the cases of HCWs diagnosed with TB as required by the National and Provincial TB Control Programmes. Two hospitals report to the Provincial TB Control Programme directly and the other five hospitals inform the Local Authority of the TB cases. Only one hospital kept a separate TB register for HCWs diagnosed with TB (King George V Hospital). The other hospitals report HCW TB as part of all other cases of TB treated in the hospital. Six hospitals (75%) report cases of TB in HCWs as an occupational disease and these hospitals also submit first medical, progress and final medical reports as required by COIDA. These reports are completed and submitted to the Human Resource Departments of the Hospital. These reports are then sent to the Directorate for Human Resource in the Provincial Department of Health. Progress medical reports are submitted when the HCWs are reviewed at the staff facility. To date (2005) none of the HCWs, for whom compensation claims were submitted, have received any compensation for their occupational disease. Very little is known about the processing of the documents submitted to the Provincial Department of Health.

Submissions of a first medical report (WCL22) seeking compensation for an occupational disease were made in 18% (n=107) of the 583 cases of TB in HCWs. In the 107 cases initially reported submission of progress reports

(WCL26) (n=75; 70%) and final reports (WCL26) decreased considerably (n=60; 56%). There was no information available on the outcomes of the submissions to the Compensation Commissioner at a facility level (Fig III).

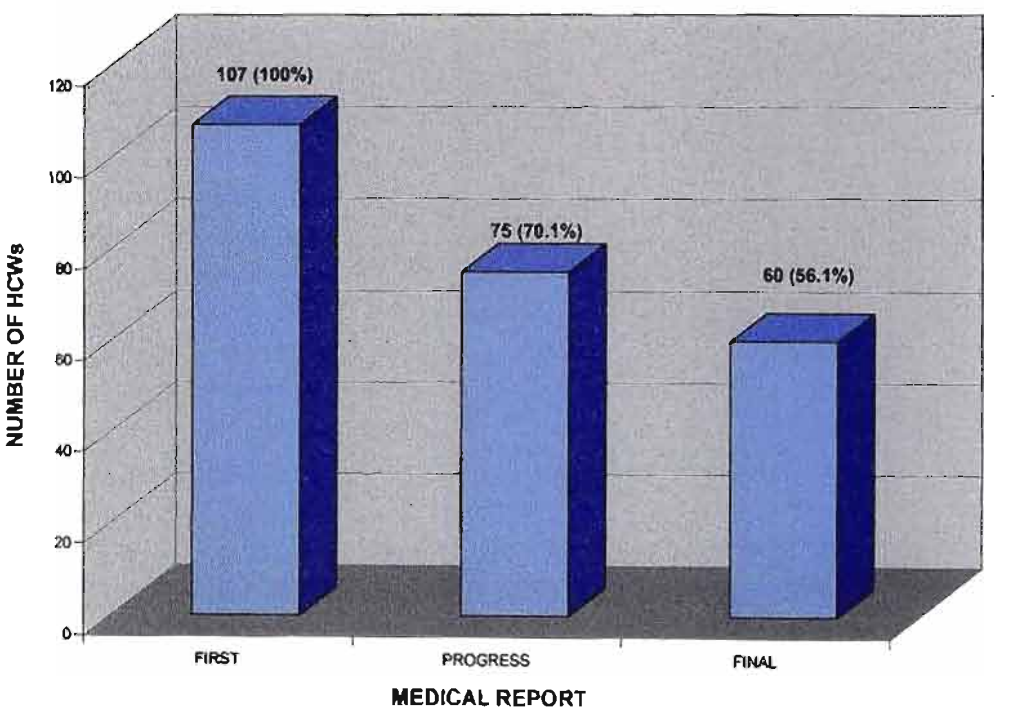


FIGURE III: COMPENSATION SUBMISSIONS FOR HCWs DIAGNOSED WITH TB IN ETHEKWINI PUBLIC SECTOR HOSPITALS (1999 - 2004)

5.10 Summary of Key Results

A total of 583 HCWs were diagnosed with TB during the study period January 1999 to June 2004. The mean age of the HCWs was 38 years (95% CI: 37-39). The mean cumulative incidence for the study period was 1040 / 100 000 HCW population (95% CI: 838-1242). The mean cumulative incidence of TB was highest in males (1544 / 100 000 HCW population; 95% CI 1228 -1859), the age group 25 to 34 years (1043 / 100 000 HCW population; 95%CI: 650 -1436) and in paramedical staff (1675 /100 000 HCW population; 95%CI: 880-2470). Successful treatment outcome was achieved in 63% (n=334) of the 583 HCWs while 17% (n=91) were still on treatment. There was no information available on the outcomes of compensation claims for the reported cases of TB in HCWs.

CHAPTER SIX

DISCUSSION

6.1 Completeness of the Data

The results of this study were dependent on the quality of the data and record system within each of the study hospitals. Missing data on key variables such as age, occupation and treatment outcomes possibly lead to an underestimation of the true burden of disease in the study population. Currently in the published literature there are only two sources of information on the burden of TB in HCWs in South Africa. The first, a study conducted in a rural hospital in Hlabisa, KZN and the other a communiqué on TB in HCWs in four dedicated TB hospitals in Mpumalanga. These studies provide information on disease burden for 1991 to 1996 and 1987 to 1997 respectively.[17, 74] Information on the problem in the Ethekwini Municipality is non-existent. Therefore despite the poor quality of the data collected, the study findings provide valuable information on the incidence and management of TB in HCWs in the Ethekwini Municipality.

6.2 Information Systems

The maintenance of uniform information systems in health services is critical and contributes to improved patient management.[75] Inaccuracies in reporting at a facility level results in an inaccurate estimation of health programme performances.[76]

One of the key elements of the DOTS strategy is the establishment and maintenance of a standard recording and reporting system which allows for assessment of treatment results in TB patients.[10, 61, 62] The National

Department of Health introduced the electronic TB register to provinces in South Africa for the standardised reporting of TB cases at the end of 2003.[77] Hospital managers and provincial managers can use the information gathered from the TB register as a useful management tool to plan and intervene in addressing the problem of TB in HCWS.

6.3 Demographics, Incidence and Risk Groups

Traditionally tuberculosis has been a disease infecting the very young and old and the immunocompromised. Studies in the published literature describe a wide variation in the mean age of those HCWs who are diagnosed with TB. In Turkey the mean age of HCWs diagnosed with TB was 25 years while in Malawi the mean age was 38 years. [56, 57] A historical review of TB in HCWs in the USA reported that tuberculin skin conversions occurred in nursing students within four months of starting employment.[5]

In this study the incidence of TB was much higher than that which was reported for community acquired TB in KZN and nationally in 2003.[8] A retrospective review conducted over a fifteen year period in Turkey found the mean incidence of TB in HCWs (199/100 000 population) to be approximately five times higher than that in the general population (41/100 000).[56] Similarly in Malawi the reported incidence of TB in HCWs (3550 / 100 0000 population) was 11.9 times higher than that of the general population (307/100 000 population).[15] Studies in South Africa present a different picture. They report TB incidence rates in HCWs as less (Hlabisa: Incidence of TB in HCWs =558/100 000 population; Community TB Incidence= 1543/100 000) or almost equivalent

to rates of community acquired TB (Mpumalanga: HCWs=275/100 000 population; Community TB Incidence= 286/100 000).[17, 74]

The increasing annual incidence of TB seen in this study is in keeping with the increase in TB incidence seen globally.[10] The impact of the HIV/AIDS epidemic on the increasing incidence of TB may be a possible contributor to the increasing incidence of TB seen in HCWs in this study. HIV infection has been shown to be the most significant risk factor for the progression from latent TB infection to TB disease.[37, 78] In 2002 it was estimated that in 2005 HIV infected patients would account for as much as 40% of adult admissions to medical wards and among children as much as 60%.[78] In 2004 the estimated prevalence of HIV in HCWs in South Africa was 15.7%.[76] The younger age group (18-35years) was found to have a HIV prevalence of 20%. [79]

Studies have shown that the risk of developing TB among HCWs varies and is dependent on several factors. These include among others occupational category, age and TB infection control measures in place.[5,12, 80] Occupational category and age were significantly associated with a diagnosis of TB among HCWS in this study.

Paramedical staff in this study included physiotherapists, radiographers and laboratory technicians. Laboratory personnel are often exposed to infectious TB material during slide preparation putting them at increased risk of acquiring TB. Similarly physiotherapists are at greater risk during chest physiotherapy and radiographers when taking x-rays of infected TB patients. Being a nurse appeared to make one less vulnerable to TB in this study. This result is possibly a reporting bias considering that nurses have the greatest exposure of all HCWs to TB patients. Usually they are the first line of contact with patients

in the outpatient departments and are continuously in contact with patients in the wards of hospitals. They may also take sputum samples from infectious patients increasing their risk of acquiring TB. In other studies nurses have been found to have a higher risk for developing TB.[56, 57]

6.4 Clinical Presentation and Treatment Outcomes among HCWs diagnosed with TB in Ethekwini Public Sector Hospitals

In 2003, 16% of all reported cases of TB in South Africa were classified as extra-pulmonary TB, which is much lower than the proportion of extra-pulmonary TB seen among HCWs in our study.[9]

The poor treatment outcomes seen in this study are, of concern, and reflect the current statistics available overall for TB treatment outcomes in South Africa. [9] This also increases the risk for HCWs developing MDR TB. Poor treatment adherence among TB patients has been related to "feeling better", lack of knowledge about the benefits of treatment and running out of treatment.[81] Studies among HCWs in the USA have shown poor compliance with seeking prophylactic treatment and treatment completion among those who were TB positive.[82, 83] Non-adherent HCWs pose a health risk to the patients whom they treat. Educating HCWs about TB and the importance of adhering to treatment must be part of a complete health promotion strategy, which aims to bring about overall behaviour change ensuring treatment compliance.

6.5 Policy and Compliance with legislative requirements in Ethekwini Public Sector Hospitals

At a facility level, appropriate national policy and guidelines are required for the prevention and control of nosocomial transmissions of TB. In this study we found that only one hospital had a workplace policy to address TB in HCWs and it was quite clear that the current monitoring and management of HCWs diagnosed with TB is inadequate. In 1994, following a series of TB outbreaks in hospitals, the CDC in the USA published "Guidelines for Preventing the Transmission of *Mycobacterium tuberculosis* in Health Care Settings".[19] The implementation of the interventions proposed by the CDC has shown a decrease in nosocomial transmission of TB in the USA.[84] South Africa must as a matter of urgency develop and implement uniform guidelines for the prevention of nosocomial transmission of TB. The proposed programme for South Africa should make use of the universal principles of hygiene control i.e. administrative, environmental and the use of personal protective equipment (PPE) as suggested by the CDC.[19, 21, 66] While all of the interventions proposed by the CDC may not be possible in a resource constrained environment there are several practical measures which can be implemented in South African hospitals to reduce the TB transmission rate.[18] Administrative controls should include a risk assessment of the hospitals to identify high-risk areas, which can be targeted for interventions. Environmental controls must be tailored to the level of care being offered at a hospital and the nature of risk posed by the disease presentation of patients to the different types of hospitals, including interventions aimed at decreasing the bio-aerosol levels of the TB bacillus. These controls should be area specific i.e. local exhaust ventilation can be

used in laboratories while in wards the air can be diluted by ensuring that there is sufficient natural ventilation by having open windows.[19, 21, 66] According to the WHO the simplest and cheapest form of reducing the number of aerosolized infectious droplets is to maximize natural ventilation through open windows.[21] Where natural ventilation through open windows is insufficient ceiling fans maybe used to increase air circulation. These ceiling fans must be used in the presence of open windows so as to dilute the air and not just mix the air.[21] Respiratory protection can be used to reduce the risk for TB infection in those areas of the hospital where there is a relatively high exposure to the TB bacillus. However the use of PPE should be the last line of defense for HCWs.[19, 21, 66] Surgical masks do not protect a HCW from inhaling air contaminated with the TB bacillus. If respiratory protection is used then the respirator must have the capacity to filter a 1micron particle.[21] The high costs of such respirators means that only HCWs in high risk environments may be provided with them in resource constrained environments.

An important part of any TB control programme is the early detection of people with TB. This includes both patients and staff.[19, 66, 84] This should be coupled with guidelines for the effective management of patients suspected of being infected with TB, the institution of a medical surveillance programme, which will allow for screening for TB, and the diagnosis and management of HCWs with TB. Screening for TB can follow an "epidemiological" or "nature of work" approach. The "epidemiologic" approach bases the frequency of HCW testing on the number of cases of TB diagnosed in a facility. [19, 66, 85] This can only be effective if all cases of TB are identified.[85] The "nature of work" determines the

frequency of testing on the exposure risk associated with various jobs. [19, 66, 85] Deciding on the frequency of screening for TB in HCWS in a resource-constrained environment may be problematic. One may have to combine both methods depending on the available information systems and management commitment. In addition the choice of screening tool in a medical surveillance programme must be seen to be cost-effective. Basic tools such as weighing HCWs and administering a cough questionnaire have been previously proposed as screening tools for identifying HCWs with TB.[20] The use of tuberculin skin testing in countries, which immunize with BCG and have a high HIV burden, has limited value. Immunization with BCG increases the likelihood of a positive skin test and in the presence of HIV the tuberculin skin test has been shown to have a low specificity. [86, 87] Diagnostic tools of a surveillance programme for TB in HCWs must be the same as those proposed by the NTBCP.[29] Likewise notification and reporting of TB in HCWs should follow national guidelines.[29]

TB in HCWs is a compensatable disease in South Africa.[24, 26] In this study a lack of knowledge among HCWs and absence of procedural protocols resulted in a failure to comply with the legislation. This can have serious implications in those situations where HCWs suffer serious disabling complications as a result of TB and are unable to continue in their employment. Failure to record occupational acquired TB would mean that the workers would not be able to claim compensation for their disabilities. This was further aggravated by poor communication between the Provincial Health Service and the National Department of Labour, to whom the compensation claims were submitted, and

the staff in the respective hospitals. This break in the information cycle is likely to further negatively impact on the reporting system for compensation. HCW education on TB, in particular the importance of treatment adherence and their rights under the current compensation legislation in South Africa should receive attention. Furthermore staff in charge of occupational health services must also be trained with regards to compensation legislation in the public hospitals.

The findings of this study show that TB among HCWs is a serious public health problem. In the face of the HIV epidemic, poor control of community acquired TB and the absence of adequate policies and guidelines for preventing and controlling the transmission of nosocomial TB, it is likely that the incidence of TB among HCWs will escalate in future years. To properly address TB among HCWs in South Africa, interventions must address TB control at two levels: the reduction of TB incidence in the community and within the hospital. Solutions for hospital control have already been proposed.

The DOTS strategy provides a framework, which has been shown to reduce the transmission of TB by identifying TB patients when they present at a health care facility and ensuring their cure. This has been the basis of TB control in South Africa. However prevalence studies in several countries suggest there may be large numbers of undiagnosed TB cases in the community. [64] Hence, the DOTS strategy in South Africa must be adapted to complement its passive case finding with an active element. Community health workers can be used to

assist in active case finding since they have been shown to be successful as DOTS supporters.[65]

Furthermore HIV is one of the most significant risk factors for developing TB.[5] In the presence of the HIV epidemic integrating TB control and HIV reduction strategies in South Africa may also assist in reducing the prevalence of TB. The ProTEST initiative is one such project, which integrates HIV and TB control strategies. This initiative uses voluntary counseling and testing (VCT) as an entry point to reduce HIV and TB rates in communities.[88]

TB persists in communities of the developing world largely because of the poverty that exists. Studies have shown that nutritional deficiency, overcrowding and lack of education hamper TB control.[89] Failure of governments to adequately address poverty means that despite the efforts of TB control programmes the disease burden persists. In South Africa the government has made a concerted effort to reduce poverty in the last ten years however the problem persists.[90]

In order that appropriate interventions succeed government commitment to ensuring that TB control remains a national priority is required. Partnerships with non-governmental organizations and the private sector, including industry are also needed. In reducing the prevalence of TB in the community one would expect a decrease in the number of TB patients presenting at a facility level and the risk of HCWs developing TB would decrease.

6.6 Limitations of the Study

In this study we chose the hospitals of the Ethekwini Municipality as a means of convenience due to a limited research budget and thus the incidence of TB in HCWs in this study may not be a true reflection of the burden of disease in HCWs in KZN.

Reliance on hospital records for data resulted in an information bias. Absence of a uniform information system in the hospitals for the staff clinics meant that multiple data sources had to be used to obtain information on HCWs diagnosed with TB. As a result we did not have information on certain variables for several HCWs which undermined the quality of the data in this study.

It has been shown that HCWs not involved in TB control tend to have a negative attitude toward TB patients.[91] The perception of rejection by fellow staff may result in HCWs who have TB seeking treatment outside of their hospital of employment. HCWs who sought treatment outside of the hospital were lost to the study and the poor response rate to the anonymous questionnaires meant that there was an under-estimation of the prevalence and incidence of occupational acquired TB in the hospitals. A good response rate to the questionnaires would have enhanced the quality of the information in this study.

Further more our inability to establish the HIV status if HCWs diagnosed with TB meant that we were unable to control for the confounding effect of HIV co-infection on occupationally acquired TB.

CHAPTER SEVEN

7.1 Conclusion

Despite the limited quality of the data available this study has shown that the incidence of TB among HCWs in public sector hospitals is much higher than that of the general public and has shown an annual increase among the different categories of staff for the study period. Job description and age have been significantly associated with a diagnosis of TB. Of further concern is the absence of institutional guidelines for the clinical and administrative management of HCWs diagnosed with TB and a surveillance system to adequately monitor the disease trends among HCWs.

7.2 Recommendations

The following recommendations have been made in response to the study findings and take into consideration the guidelines and requirements of the National TB Control Programme[29] the Occupational Health and Safety Act (No. 85 of 1993) [23] and Regulation 1390: Hazardous Biological Agents[25], and the Compensation for Occupational Injuries and Diseases Act (No. 55 of 1995).[24]

- Specific Policy on the Prevention and Control of TB IN Health Care Facilities at National and Institutional Level

The Occupational Health and Safety Act (No. 85 of 1993) [23] states that in all workplaces the employers are required to develop and implement a written policy concerning the protection of the health and safety of his employees with respect to hazards. In the instance of TB exposure the health of

workers is put at risk and hence a workplace policy to address TB in health care facilities is necessary. The workplace policy has to address all issues relating to TB control within the hospital. These include the frequency of risk assessments to evaluate the risk posed by TB to HCWs, strategies for control of HCW exposure to TB, medical surveillance, clinical and administrative management of HCWs diagnosed with TB and education and training of HCWs with regard to TB. This policy like that in the USA[19, 66] is best developed at a National or a Provincial Department of Health level and uniformly applied in all health care settings.

- Risk Assessments and Workplace Controls

Regulation 1390: Hazardous Biological Agents[25] of the Occupational Health and Safety Act[23] classifies TB as a group three biological hazard. According to the above mentioned regulation, a risk assessment of each health care facility must be undertaken every two years[25]. This should be addressed in all health care facilities. There are general environmental controls which can be applied to all hospitals however more specialized environmental controls may have to be considered for different types of hospitals and the level of care they offer. Ultraviolet light may be the appropriate choice for controlling TB bacilli in specialist TB hospitals but it may not be cost-effective in a district facility. If used in specialist TB hospitals then ultraviolet light should be located in the wards. Extractor ventilation is useful in ensuring clean air supply in wards but may only be an economic viability in dedicated TB wards. Personal protective devices in the form of HEPA masks have been proposed and used in the USA[19, 66] as means of preventing TB spread. In a

resource constrained setting such as South Africa one would need to target specific high risk HCWs for the use of PPE.

- Intended Medical Surveillance

All HCWs exposed to a hazardous biological substance such as TB must be included in a medical surveillance programme.[25] The initial health examination as part of the medical surveillance programme must be conducted within fourteen days of employment and following counselling of the HCW. Periodic examinations and tests must be conducted on HCWs where it is known that the hazardous biological substance causes persistent or latent infections. All of these examinations must be conducted in accordance with a written medical protocol.[25] Currently there are no medical protocols for the medical surveillance of TB in HCWs. Protocols should be developed and implemented. Piloting of a medical surveillance programme before uniform implementation in all hospitals is advisable.

In addition all cases of suspected TB infection in HCWs must be investigated and managed according to the guidelines of the National TB Control Programme.[29]

As part of the routine medical surveillance programme HCWs diagnosed with TB should have access to voluntary counselling and testing services for HIV. These services be carefully planned so as to ensure the confidentiality of a HCWs HIV status.

- Information and Training Programme

All HCWs are required in terms of the Occupational Health and Safety Act[23] and the relevant regulation to be trained on the potential health risks that they face in their workplace. They should also know about the precautions, which they need to take to protect themselves. Furthermore HCWs must be made aware of the fact that occupationally acquired TB is a compensable disease. Further training is also required of those staff members who manage the occupational health services with regards occupational TB, compensation thereof and the notification of TB as an infectious disease. A training programme addressing these issues should be developed in conjunction with the Department of Health and the relevant occupational health practitioners. The target audience for such a programme should be HCWs involved with infection control and occupational health and safety in hospitals. These key HCWs would then be responsible for providing in service training at regular intervals for all other HCWs employed in hospitals.

- Intended Surveillance System

All assessments of medical surveillance and monitoring with regard to hazardous biological agents must be maintained for forty years.[23, 25] All hospitals should have a uniform information system for maintaining this information. With respect to TB in HCWs there are two issues to be considered namely: (1) the recording of routine medical surveillance data for exposure to hazardous biological agents and (2) the recording of data for confirmed cases of TB in HCWs. Health information systems currently exist

in hospitals and can be adapted for routine surveillance purposes. However for confirmed cases of TB in HCWs reporting should be done using the TB register as required by the National TB Control Programme. For this to be a useful surveillance tool cases of TB in HCWs should be recorded in a separate TB register from that of cases of community acquired TB at a hospital level.

TB in HCWs must be reported as an occupational (compensatable) disease and as an infectious (notifiable) disease. Identifying source patients as being responsible for TB exposure in hospitals is difficult in the absence of confirmatory diagnostic tests. Hence all cases of TB in HCWs should be considered as occupational acquired TB and compensation claims should be submitted on behalf of HCWs. The submissions of claims should be done on accordance with legislated compensation requirements.[24]

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ANNEXURE:A

List of participating hospitals:

DISTRICT	REGIONAL	CENTRAL	SPECIALIST
Osindisweni	Mahatma Gandhi	King Edward VIII	Clairwood
	Addington		King George V
	Prince Mshiyeni		
	R K Khan		

ANNEXURES

ANNEXURE B:

TB IN HEALTH CARE WORKERS DATA EXTRACTION SHEET

Hospital Name: _____ Year: _____

Research ID Number	Sex M / F	Age	Job Description	Area of Employment		Dx Mx					Legislative Compliance			
				At time of Diagnosis	1 month before diagnosis	Rx Regimen	New Px	MDR	Leave of Work	Rx outcome	Notific of Occ Dx Y / N	1st Med Y / N	Prog Med Y / N	Final Med Y / N

ANNEXURE C: SEMI STRUCTURED INTERVIEW

TB IN HCWS: SYSTEMS REVIEW: Date: _____

1. Hospital Name:_____
2. Is there a written work place policy for TB in HCWs? **yes =1 no=2**
3. From what date was it implemented? _____
4. Do all HCWs use the staff clinic? **yes=1 no=2**
5. If answered no above, what % uses the facility? _____
6. Do you have separate TB register for HCWs? **yes=1 no=2**
7. Do you have any other system for recording of the information

   yes=1 no=2
8. If answered yes above describe (type/date of implementation/location)

_____

_____

_____

9. Do you notify the diagnosis? **Yes=1 no=2**
10. Whom do you notify?

    _____

    _____
11. Do you fill in the following for HCWs?

    Notification of Occupational Disease **yes=1 no=2**

    First Medical Report to CC **yes=1 no=2**

    Progress and Final Medical Report to CC **yes=1 no=2**

12. Where do you send these forms to?

13. For what time period do you submit progress reports?

14. What response have you had from the CC?

ANNEXURE D

Health Care Workers Questionnaire:

Questionnaire Number: _____

DEMOGRAPHIC INFORMATION:

1. Hospital Name: _____

2. Gender: M ☐ Female ☐

3. Age: _____

4. In which staff category do you currently fall:

Administrator	☐
Nurse	☐
Doctor	☐
Support Services (e.g. radiographer, physio)	☐
Housekeeping (e.g. laundry, kitchen, workshop)	☐
Other	☐

5. If answered "other" above please explain

6. To which staff category did you belong at the time when your TB was diagnosed

Administrator	☐
Nurse	☐
Doctor	☐
Support Services (e.g. radiographer, physio)	☐
Housekeeping (e.g. laundry, kitchen, workshop)	☐
Other	☐

7. If answered "other" above please explain

8. In which service department of the hospital were you stationed at the time of diagnosis of your TB?

9. In which service department of the hospital were you on duty in the month prior to the diagnosis of your (TB):

CLINICAL MANAGEMENT OF HCW:

10. Where did you first seek treatment for your TB?

The hospital where you are employed	☐
Another Public Sector Hospital	☐
The Durban Chest Clinic	☐
Another public sector clinic	☐
A Private Physician	☐
Other	☐

11. If answered "other" above please explain

12. What type of TB was diagnosed?

13. For how long did you take TB treatment?

Six Months ☐

Nine Months ☐

Eighteen Months ☐

Other ☐

14. If answered "other" above please explain

15. What was the outcome of your treatment?

Cured / completed ☐

Did not complete ☐

Treatment failure ☐

Required re-treatment ☐

16. Did you develop any medical complications as a result of the TB?

Yes ☐ No ☐

17. If answered yes above please explain

18. Did you have any side-effects from your TB treatment?

Yes ☐ No ☐

19. If answered yes above please explain

20. Did you have a DOT supporter who observed you taking the treatment?

Yes ☐ No ☐

21. If answered yes above, where was the DOT supporter?

At the hospital ☐

Outside of the hospital ☐

ADMINISTRATIVE MANAGEMENT:

1. Did you take leave when you were diagnosed with TB?

Yes ☐ No ☐

☐

2. Type of leave: Sick

Special ☐

3. Was your case notified?

YES ☐ NO ☐ Do not Know ☐

4. Was the Compensation Commissioner notified?

YES ☐ NO ☐ Do not Know ☐

6. Were you reallocated work duties in another service department of the hospital after your TB was diagnosed?

YES ☐ NO ☐

ANNEXUR E: PERMISSION FROM THE PROVINCIAL DEPARTMENT OF HEALTH

19. APR. 2004 11:46 DEPT OF HEALTH NO.273 P.2

PROVINCE OF KWAZULU-NATAL
HEALTH SERVICES

ISIFUNDAZWE SAKWAZULU-NATALI
EZEMPILO

PROVINSIE KWAZULU-NATAL
GESONDHEIDSDIENSTE

PRIVATE BAG X9051
PIETERMARITZBURG
3200

390 LONGMARKET STREET
PIETERMARITZBURG
3200

TELEPHONE (033) 395 2111
TELEFOON (033) 395 2111

FAX (033) 395 2592

ENQUIRIES: Mr G.J. Tromp
EXTENSION: 2761
REFERENCE: 9/2/3/R

19 APR 2004

Dr S. Naidoo
C.O.E.H.
Nelson R Mandela School of Medicine
Private Bag 7
CONGELLA
4013

Dear Dr Naidoo

REQUEST TO CONDUCT STUDY: TB IN HEALTH CARE WORKERS IN PROVINCIAL HOSPITALS IN THE ETHEKWINI MUNICIPALITY

Please be advised that authority is granted for you to undertake a research regarding "TB in health Care Workers in Provincial Hospitals", provided that;

(a) Prior approval is obtained from the Heads of the relevant Institutions;

(b) Confidentiality is maintained

(c) The Department is acknowledged;

(d) The Department receives a copy of the report on completion; and

(e) The staff of the hospital are not disturbed and/or inconvenienced in their work and that patient care is not compromised.

Yours sincerely

SUPERINTENDENT-GENERAL
HEAD: DEPARTMENT OF HEALTH
NPE/dr s naidoo research tb

ANNEXURE F:

Health Care Worker Information Sheet and Consent Form

The burden of Tuberculosis infection in communities is increasing. As a result there are more patients with the infection presenting at hospitals. We believe that healthcare workers exposure to the infective organism is increasing and as a result more healthcare workers are developing tuberculosis. However there is no documented evidence of this for KwaZulu-Natal. The **PURPOSE** of this study is to describe the prevalence, clinical and public health aspects of the management of TB among HCWs in hospitals in the Ethekweni Municipality of KZN. We are conducting this research in collaboration with the Directorate of Institutional Support, in the KwaZulu-Natal Provincial Department of Health. Documenting the trend of tuberculosis infection among health care workers will assist the Directorate in developing workplace controls to reduce the exposure of health care workers to tuberculosis. This will serve to reduce the burden of occupational acquired tuberculosis among health care workers in KwaZulu-Natal. We are thus requesting your participation in this study. By participating in this study you will be asked to answer a questionnaire on you illness and give permission for the researcher to peruse your personal medical files. You also have the option to participate in this study and answer a questionnaire only and refuse permission for your medical files to be reviewed. You also have the option to refuse to participate in this study. Should you choose to participate in this study then all information concerning you will remain confidential. The information obtained from you file will only relate to the diagnosis and treatment

of TB. All information will be anonymous as health care worker names will not be extracted from the files.

Consent Form:

I _____ (First name & Surname) fully understand the nature of the information given to me about the study.

Part A: Questionnaire

I _____ (First name & Surname) consent to answering a health questionnaire only.

_____ (Signature)

1. _____(witness 1)
2. _____(witness 2)

Part B: Questionnaire and Medical Records

I _____ (First name & Surname) consent to answering a health questionnaire and give permission for my medical file to be perused (only in relation to my TB management).

_____ (Signature)

3. _____(witness 1)

4. _____(witness 2)

ANNEXURE G: ETHICS COMMITTEE APPROVAL

UNIVERSITY OF
KWAZULU-NATAL
Nelson R Mandela School of Medicine

9 March 2004

Professor C C Jinabhai
Community Health
Nelson R Mandela School of Medicine
MEDICAL SCHOOL

Dear Professor Jinabhai

PROTOCOL : TB in health care workers in the eThekweni Municipality of KwaZulu-Natal. S Naidoo, COEH. Ref.: H207/03

The Research Ethics Committee and the Higher Degrees Committee considered the abovementioned application and made various recommendations. These recommendations have been addressed and the protocol was approved by consensus at a full sitting of the Research Ethics Committee at its meeting held on 9 March 2004. This approval is valid for one year from this date. To ensure continuous approval, an application for recertification should be submitted a couple of months before the expiry date.

Yours sincerely

PROFESSOR A DHAI
Chair : Research Ethics Committee

c.c. Dr S Naidoo : Centre for Occupational and Environmental Health
Mrs L Acenderff, Postgraduate Education

ANNEXURE H: POLICY: KING GEORGE V

KGV MANAGEMENT

TB STAFF CLINIC MANAGEMENT GUIDELINES

ONLY PATIENTS WITH CONCLUSIVE EVIDENCE OF TB ARE TO ATTEND THIS CLINIC. STAFF AWAITING RESULTS ARE TO ATTEND THE REGULAR STAFF CLINIC.

1ST VISIT

1 Confirm the diagnosis
--- check sputum results
--- examine CXR

2 If unable to confirm diagnosis
----sputum x 3, smear, culture, sensitivity
----sputum for secondary organisms

3 Serology
FBC/ U&E/LFT/ ESR
HIV (optional)

2ND VISIT

1 Notify
2 enter details in register --issue a TBS no.
3 issue green card to be kept by patient
4 make a 'TB Blue' file.
5 comply with the KZN TB control program guidelines as far as possible
i.e. Intensive phase: *Rif, INH, PZA, EMB* (weekdays only)either singly or in combination form
Continuation phase: when patient is smear negative after at least 2 months of the intensive phase
Rif & INH 3x per week

IN-PATIENT MANAGEMENT

If the patient is too ill for outpatient treatment, then admit

OUT-PATIENT MANAGEMENT BUT ON SICK LEAVE

Identify a treatment supporter. Counsel the supporter.
Patient to attend the TB staff clinic weekly (Friday a.m) and the green card to be checked by the sister
Medication to be issued on a weekly basis

OUT-PATIENT MANAGEMENT – PATIENT ON DUTY

ALL categories of staff (doctors, consultants, GA's, nurses etc) must attend the staff clinic daily in order to effect DOT. (Unless the staff member is being treated elsewhere). On off days, arrange medication for the period that the person is off e.g. If off for one day only supply one days meds.

SUBSEQUENT VISITS

1. Patient to be assessed monthly by an MO at the TB STAFF CLINIC.
2. At the beginning of the 3rd month, repeat sputum smear culture.
   If smear is -VE, then change to the continuation phase.
   If smear is +VE, then continue with the intensive phase and repeat smear after a further 1 month.
3. CXR's are to be ordered at the discretion of the M O

IOD

Forms to be filled in when necessary and submitted for approval.
NOTE: Not all staff TB cases are regarded as IOD. This is decided by the Workmans Compensation Commission.