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THE STUDY OF TB AND MDR-TB IN KWA-THEMA TOWNSHIP FROM 2000-2004

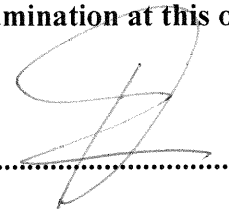
Azwinaki Rembuluwani

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Public Health.

Johannesburg 2008

DECLARATION

I Azwinaki Rembuluwani declare that this research report is my own work. It is being submitted for the degree of Master of Public Health in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.



.....

..12TH.....day of.....MAY....., 2008

To my wife Thabile

ABSTRACT

THE STUDY OF TB AND MDR-TB IN KWA-THEMA CLINICS FROM 2000-2004

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BACKGROUND

Kwa-Thema Township is situated in the far eastern part Ekurhuleni Metropolitan Municipality. It has a population of 99515 with an unemployment rate of over 50%. As a medical practitioner working in the area one noticed an apparent increase in the patients with TB and MDR-TB.

RESEARCH QUESTION

Is MDR-TB becoming a problem among TB patients at Kwa-Thema clinics?

OBJECTIVES

To describe trends, profile, types and treatment outcomes of newly diagnosed TB and MDR-TB cases in Kwa-Thema clinics (2000-2004)

METHODS

Permission for the study was sought and obtained from the Gauteng department of health and from Ekurhuleni Metropolitan Municipality. The study was a cross-sectional descriptive study. The records of all patients who were diagnosed with and received TB treatment at Kwa-Thema clinics between January 01 2000 and December 31 2004 were reviewed. The age and sex profile of TB and MDR-TB patients was described. Linear regression test was used to describe trends. Treatment outcomes over the five year period were described.

RESULTS

Number of TB patients increased from 426 to 520(2000-2004). This was a 22% increase over the study period. 44% were smear positive and 55% were aged between 25 and 44. 56.6% were males

Smear conversion rate improved from 39% to 70% whereas treatment success improved only slightly from 57.4% to 67% from 2000-2004. MDR-TB incidence increased from 1% to 5% during the study period. 80% of MDR-TB patients who were tested for HIV during the study period were positive.77% of patients with MDR-TB had never had TB before.

CONCLUSION

The results reflect a poor TB control. The recommendation from this study would be the adoption of the expanded strategic framework of DOTTS with adaptations to the local conditions.

ACKNOWLEDGEMENTS

I would like to thank my supervisor Dr Francis Akpan for his guidance and patience and his willingness to sacrifice even his private time. I would also like to thank my sister Ntshengedzeni Rembuluwani for her assistance with the statistical analysis of data.

TABLE OF CONTENTS

List of figures	ix
List of tables	x
List of acronyms	xi
1.0 Introduction	1
1.1 Background	1
1.2 National tuberculosis control program (NTCP)	2
1.3 Problem statement	3
1.4 Study justification and motivation	3
1.5 Literature review	4
1.6 Aim of the study	10
1.7 Study objectives	10
2.0 Materials and methods	12
2.1 Study design	12
2.2 Study population and sample	12
2.3 Measurement	12
2.4 Data processing and analysis	13
2.5 Ethical consideration	14
2.6 Possible study limitation	14
3.0 Study results	16
3.1 Trends of patients	16
3.2 Diagnosis	19
3.3 Treatment outcome	21

4.0 Discussion 30

4.1 Trends of patients 30

4.2 Profile of TB patients 32

4.3 TB treatment outcomes 32

4.4 MDR-TB and its impact on the community 33

5.0 Conclusion 35

6.0 Recommendations 36

References 39

Appendices

APPENDIX A: Ethics approval

APPENDIX B: Approval letter from Gauteng Department of Health

APPENDIX C: Approval letter from Ekurhuleni Department of Health and Social services

APPENDIX D: Data record form

APPENDIX E: Census 2001 results for Kwa-Thema

LIST OF FIGURES

1.1. Type of TB diagnosed at all clinics

2.1. Treatment success for TB patients

2.2. Unfavouvarable TB treatment outcomes

3.1. MDR-TB cases 2000-2004

3.2. MDR-TB treatment outcomes

LIST OF TABLES

1.1. Total number of all patients seen at Kwa-Thema clinics 2000-2004

1.2. Number of smear positive TB patients seen at Kwa-Thema clinics 2000-2004

1.3. Gender Profile of new TB cases 2000-2004

1.4. Age profile of all new TB cases

1.5. Types of TB diagnosis

2.1. Three month smear conversion at Kwa-Thema clinic

2.2. Three month smear conversion at Thembelitsha clinic

2.3. Three month smear conversion at White City Clinic

2.4. Outcome of patients at the 3 clinics per year 2000-2004

3.1. MDR-TB results

LIST OF ACRONYMS

AIDS	**: Acquired Immunodeficiency Syndrome**
DALY	**: Disability Adjusted Life Years**
DOTS	**: Directly Observed Treatment Therapy**
HIV	**: Human Immunodeficiency Virus**
KZN	**: Kwazulu-Natal**
MDR-TB	**: Multi-drug Resistance TB**
SAMRC	**: South African Medical Research Council**
TB	**: Tuberculosis**
WHO	**: World Health Organisation**
XDR-TB	**: Extensively drug-resistant tuberculosis**

The study of TB and MDR-TB in Kwa-Thema township from 2000-2004

1.0 INTRODUCTION

1.1 BACKGROUND

Kwa-Thema Township is situated in the Ekurhuleni Metropolitan Municipality in Gauteng Province, South Africa. The township covers an area of 15.6 km^2. It was established in the 1950's for the black community that was uprooted from Payneville which was considered a white area during the forced removals.

The official population from Census 2001 stands at 99 515 although there are a lot of mushrooming informal settlements on the periphery of the township with unstable populations. The level of poverty is very high as reflected by the high unemployment rate of 57% (Census 2001). The main source of formal employment is the industrial area in Brakpan and Springs.

The township is served by three Primary Care Clinics namely Kwa-Thema, White City and Thembelitsha which are exclusively for the Kwa-Thema population. It shares Pholosong hospital which is situated about 6km from Kwa-Thema with the neighbouring townships of Tsakane and Duduza.

All **TB (tuberculosis)** patients are diagnosed or referred from hospitals to these clinics for treatment. Each of the clinics treats patients from specific areas of the township although some of the patients prefer taking treatment far from their nearest clinic for fear of stigmatisation. HIV testing at the clinics is voluntary and not encouraged as there is insufficient numbers of counsellors. Treatment is administered by a registered Nurse at each clinic with one of them also serving as the co-ordinator for all three clinics and reports to the district office situated in Springs Town. Data about new TB diagnosis, treatment and treatment outcome are recorded daily by each clinic. Data is the sent to the district office where statistics are produced quarterly to

monitor performance of the district as a whole and to measure it against the targets of the National Tuberculosis Control Programme (NTCP) and the Medium Term Development Plan (MTDP) of the National Department of Health[1]

Cases that do not respond favourably or are still smear positive after 3 months of treatment are referred for culture and sensitivity. Those with drug resistance are referred to Sizwe Tropical Hospital in Edenvale, which is a dedicated provincial MDR-TB (multi-drug resistance TB) treatment centre for initial workup, access to treatment and registration in the DOTS plus(directly observed treatment therapy) electronic register. If they respond to MDR-TB treatment they are then discharged to the clinics for continuation of treatment and monitoring.

1.2 THE NATIONAL TUBERCULOSIS CONTROL PROGRAMME (NTCP)

Before one continues, a brief outline of the National Tuberculosis Control Programme (NTCP) of the National Department of Health is important.

This programme was established with the overall objectives of reducing TB mortality and morbidity, prevention of the development of drug resistance and to ensure accurate measurement and evaluation of programme performance.

It set targets of a cure rate of 85% of newly sputum smear positive TB cases detected detection of 70% of TB cases and to reduce interruption rates to less than 5%.

The Medium Term Development Plan was adopted in 2001 to devise strategies to meet these targets. The National Department of Health committed itself to reach these targets by 2005 by signing the Amsterdam declaration in 2000

The NTCP operates on four levels:

The central unit or national level which serves to co-ordinate, facilitate and evaluate tuberculosis services countrywide.

The provincial level which is responsible for implementation.

The district level which is the most peripheral unit of health administration

and oversees the activities at hospitals, clinics and dispensaries.

The health unit level which comprises hospitals, health centres, dispensaries, and clinics in a particular area and is responsible for delivering services to the community.

1.3 PROBLEM STATEMENT

There has been an apparent rise in the numbers of patients with TB and MDR-TB in the population of Kwa-Thema Township. No study to ones knowledge has been conducted to evaluate the problem of TB and MDR-TB in this community which would also serve as an indicator of the success of the NTCP and the MTDP of the Department of health.

1.4 STUDY JUSTIFICATION AND MOTIVATION

The forty-fourth World Health assembly revised TB control outcome targets were: To achieve a case detection rate of 70% under DOTS and to cure at least 85% in the DOTS cohorts by 2005[2]. These outcome targets were originally set in 1991 for achievement by year 2000. The target date was revised to 2005 in view of the slow progress in many high burden countries.

The impact targets are to halt and reverse TB incidence by 2015 and to halve prevalence and death rate by 2015 compared with the baseline of 1990. Primary drug resistance provide an indication of the effectiveness of treatment regimens, while acquired drug resistance can point out to failures in the management of diseases.[2,3] The study in Cape Town has shown that patients with a previous history of TB treatment have three times the risk of presenting with drug resistance(Risk Ratio2,6)[4].

The study of TB and MDR-TB in Kwa-Thema township from 2000-2004

MDR-TB hot spot is defined an area with MDR-TB of more than 3%[2]. Although South Africa is not regarded as a hot spot for MDR-TB, the difference between Mpumalanga (2.7%) and Western Cape (1%)[6] shows the potential impact of poor TB control and the importance of doing region specific surveys so as not to obscure the extent of problems in regions in a country regarded as having lower numbers of MDR-TB. New York City has been reported to have a drug resistance rate of 19% where as the US national average is 3.5%.[7]

As a medical practitioner working in Kwa-Thema, one had noticed an apparent rise in patients with TB and MDR-TB. Where as one only occasionally came across MDR-TB patients in the previous five years , in the last year alone one came across four such patients. i.e. MDR-TB.

Given the above, it was important to know whether TB and MDR-TB in Kwa-Thema had remained stable or whether they were on the increase. MDR-TB also serves as an indicator of TB control programme success.

This would have implications on the current treatment regimens and the way they are administered. It would also help in the formulation of recommendations on the way treatment should be administered.

This study will thus seek to compare the situation in Kwa-Thema with the national picture and to measure it against the targets of the NTCP.

1.5 LITERATURE REVIEW

TB is responsible for 2.8% of the world s' **DALY (disability adjusted life years)** burden similar to that of malaria and lies 10th in the global disease table. Nearly one third of global population is infected with TB and at risk of developing the disease. More than 8 million people develop

active TB every year and about two million die on an annual basis worldwide. 95% of the cases occur in developing countries where 98% of TB deaths occur.[8]

The rate in Africa was 216/100 000 with Southern Africa contributing 275 000 to this case load. South Africa reports more than 100 000 TB cases annually which is almost half of the case load for Southern Africa[9].

A TB account for more than 80% of all communicable diseases notified in South Africa and is regarded as one of the most serious problems affecting the country[10]. The 2003 WHO Report on Global TB control ranked South Africa 3rd in the world in terms of reported TB incidence (495 per 100 000)[11] whilst the 2008 WHO Global report on TB control ranked South Africa 4th in terms of absolute numbers of TB cases reported placing it just behind Indonesia and ahead of Nigeria.[2]

The latest successful treatment rates recorded in 2002 are 68% with interruption rates of 13%[1]

TB AND HIV

HIV has fundamentally altered the epidemiology of TB. In the absence of HIV infection, only 10% of the people infected with TB will develop TB in their lifetime. In the presence of HIV, TB is reactivated in 5-10% of infected people per year and 50% will become sick during their lifetime.[1] In sub-Saharan Africa 40% of TB cases are attributable to HIV and about 55% of TB patients are co-infected with HIV.[1]

HIV not only increases the numbers of TB cases but also alters the clinical picture with increasing numbers of smear negative pulmonary TB and extra pulmonary TB cases. It is also more likely to be disseminated and more difficult to diagnose as the disease progresses and thus leading to increased mortality[1].

The study of TB and MDR-TB in Kwa-Thema township from 2000-2004

Although HIV infection has not been shown to be an independent risk factor for MDR-TB [12], it however reactivates previously treated TB. Previously treated cases are not only more likely to be drug resistant, but also to have resistance to more drugs than untreated patients [13]. HIV is also thought to contribute to an increase in MDR-TB indirectly by increasing the TB case load beyond the capacity of existing health services, resulting in lower cure rates and increased acquired resistance.[6] It has been associated with extremely high mortality, higher rates of adverse reactions and mal-absorption of MDR-TB drugs from HIV related enteropathology.[14] The global proportion of MDR-TB is around 1-2% of all cases[15], with a global disease burden of 185 000-414 000.[7]

MDR-TB

Before one goes any further, an understanding of MDR-TB is important.

MDR-TB occurs when *M. tuberculosis* undergoes spontaneous, slow but constant mutation, resulting in resistant mutant organisms[17]. This phenomenon varies according to different anti-TB treatments and is genetically determined.[5] Selection of these mutants is facilitated by inadequate treatment, with susceptible bacilli being killed rapidly and resistant mutants being selected over time. A high bacterial load and several cycles of inappropriate treatment are therefore needed for significant numbers of MDR-TB bacilli to emerge. These strains can also be transmitted to individuals who have never before had TB and they can present with MDR-TB (primary MDR).[5] MDR-TB is always a laboratory diagnosis, requiring in-vitro confirmation of resistance.

Although the term MDR-TB has been used to describe resistance to any two or more anti –TB drugs, the correct definition is resistance to at least isoniazid and rifampicin.[5]

The study of TB and MDR-TB in Kwa-Thema township from 2000-2004

The results of the WHO/IUATLD Global Working Group on TB drug resistance Surveillance confirmed that initial resistance to first line drugs is relatively low in Southern Africa (i.e. Lesotho, Swaziland, Botswana and South Africa) as compared to other regions in Africa and Asia where the problem is up to five times more common.

MDR-TB should be suspected under the following conditions:[5]

-Retreatment patients who remain sputum smear positive after three months of intensive therapy.

-Treatment failure or defaulter cases.

-Close contacts of MDR-TB patients especially those who are immuno-compromised.

-In patients who remain sputa positive at the end of treatment or those who do not show adequate clinical response.

It occurs mostly in patients with reactivated TB, to a lesser extent in patients who fail a single course of first line treatment. It only rarely occurs in patients who have never taken anti-TB treatment.[5]

TYPES OF MULTI-DRUG RESISTANCE

Drug resistance among new cases (Primary resistance)

This is defined as the presence of resistant isolates in patients who, in response to direct questioning, deny having had prior anti-TB` treatment for more than a month, and where adequate documentation is available, in a patient for whom there is evidence of such a history[20].

The study of TB and MDR-TB in Kwa-Thema township from 2000-2004

Drug resistance among previously treated cases (Acquired resistance)

Resistant isolates in patients who admit having been treated for TB for one month or more, in countries where adequate documentation is available, in a patient for whom there is evidence of such a history[20].

Combined prevalence of drug resistance

Where recording does not indicate whether it is primary or acquired resistance.[20]

It is thus clear that MDR-TB like any other form of drug resistance is man made and results from human error such as poor management of drug supplies, poor patient management, inadequate prescription of chemotherapy and poor patients' adherence to treatment.

THE EXTENT OF MDR-TB

A survey conducted in South Africa between 2001 and 2002 showed MDR-TB prevalence of 1%-2.7% in South Africa with Mpumalanga having the highest prevalence. MDR-TB in Mpumalanga increased from 1.5% to 2.7% between 1997 and 2001 while re-treatment patients increased from 8.1% to 13.9% during the same period.[6] A recent MRC survey indicated an overall MDR-TB prevalence of 2.9% (with 1.6% of new TB cases and 6.6% of previously treated cases) with a total disease burden of at least 6000 per year.[20] The economic impact of MDR-TB is huge as the cost of treatment is 100 times higher than an uncomplicated drug susceptible case.[20] Patients with MDR TB require prolonged treatment which at best will only cure half of them[9].

THE THREAT POSED BY MDR-TB

Cure rates for patients with MDR-TB ranges from 6%-59%[5] owing to the complex nature of second line drug treatment in terms of cost, toxicity, availability and delivery of appropriate regimen. In 2003 the cost of full treatment of MDR-TB was estimated to be $3400(R23 800) per patient [20] and for a developing country like South Africa grappling with so many health challenges this is very expensive. MDR-TB thus presents a real threat to TB control in the South African setting.

Untreated MDR-TB patients can infect large numbers of HIV-positive individuals leading to significant outbreaks of MDR-TB with high case fatality rates. Nosocomial outbreaks of MDR-TB associated with HIV infection have been documented while HIV positive patients being treated for drug susceptible TB HIV have been re-infected with MDR-TB strains[1].

Poor TB control programmes together with HIV are contributing to the emergence of MDR-TB and most recently (2006) to XDR-TB. The outbreak of the latter poses the greatest threat to public health because of the associated high mortality [22]. The median of survival from time of sputum collection was 16 days for 52 of the 53 infected individuals in the Tugela Ferry in Kwazulu-Natal (KZN) [22].

XDR-TB is forcing public health officials to confront the issue of involuntary detention as the current WHO guidelines [22] place the responsibility on the patient with MDR-TB to refrain from mixing with the general public and susceptible individuals and is silent on the steps to be taken if the infected individual fails to act responsibly. This raises the question of whether it is appropriate, for the public good, to restrain or detain MDR-TB patients to curb the spread of MDR-TB which contributes to XDR-TB. This has human rights and ethical implications.

Recognising that MDR-TB poses a considerable challenge to public health, WHO now recommends that established DOTS programmes consider implementation of MDR-TB treatment using second line reserve drugs through the so called DOTS-Plus programmes.[20] South Africa currently has one of the largest DOTS-Plus programmes in the world which encompasses a standardised approach to MDR-TB management through dedicated provincial MDR-TB centres[26]. This entails collaborative activities for TB/HIV control, rigorous infection control and improvement of data quality as well as improvement in laboratory infrastructure.

In conclusion, it is clear that TB and MDR-TB are posing the most serious threat to health care service delivery in our country. It is putting stress on the already poor health infrastructure and forcing health care service providers to re-examine the established ethical and human rights boundaries about the treatment of patients. It is clear that the successful combating of TB and MDR-TB is dependent on the successful implementation of the NTCP and MTDP. One would thus want to know whether these programmes are being implemented successfully which would be reflected by whether TB and MDR-TB are getting better or worse in the communities.

1.6 AIM OF THE STUDY

To investigate whether TB and MDR-TB are becoming a problem among patients attending clinics in Kwa-Thema Township

1.7 OBJECTIVES

-To describe the trend of newly diagnosed TB cases in Kwa-Thema clinics

-To describe the profile (age and sex) of patients with TB

-To describe the trend of newly diagnosed MDR-TB at the Kwa-Thema clinics over a five year period.

-To describe the types of MDR-TB presenting at Kwa-Thema Clinics.

-To describe the treatment outcomes of patients with TB and those with MDR TB.

2.0 MATERIALS AND METHODS

2.1 STUDY DESIGN

This was a cross sectional descriptive study. It was in the form of a record review of all TB and MDR-TB cases presenting at 3 clinics in a South African township. (i.e. Thembelitsha, White City and Kwa-Thema) between January 01 2000 and December 31 2004. Thembelitsha clinic serves the areas of Interland, Rest In Peace and Vergenoeg. White City clinic serves the areas of White City, Extension 7 and Deep Levels whereas Kwa-thema clinic serves the areas of Tornado and Highlands. These are different suburbs of Kwa-Thema.

2.2 STUDY POPULATION AND STUDY SAMPLE

The study population comprised all patients who were diagnosed with and received TB treatment at the clinics in Kwa-Thema in the period 1st January 2000-31st December 2004.

2.3 MEASUREMENT

Only the researcher was responsible for collecting data. Data collection involved the use of routine data forms used by the provincial health authorities and the national TB control programme as captured in the patient files as well as from the electronic TB register at the district office. The patients' records included age, date of diagnosis, method of diagnosis and type of TB and MDR-TB as well as treatment outcomes. Smear conversion results and treatment outcomes were obtained from the electronic TB register at the district office.

The information relating to MDR-TB was obtained only from the three clinics as it is not captured at the district office.

The study of TB and MDR-TB in Kwa-Thema township from 2000-2004

Number of newly diagnosed cases of TB and MDR-TB were enumerated for each clinic.. Smear positive cases for each clinic and for the entire township were analysed

The profile of patients with respect to age and sex was compared among all the clinics.

Types of MDR-TB i.e. primary, acquired or mixed were determined over the five year period.

Treatment outcomes were evaluated with successful outcome being treatment completion and patient having being cured. Unsuccessful outcome was regarded as patient having died, defaulted, failure of treatment, not evaluated or transferred to another institution for further treatment.

Cure: a patient who is sputum smear negative in the last month of treatment and at least on one previous occasion.

Treatment completed: a patient who has completed treatment but does not meet criteria to be classified as cured or failure.

Treatment failure: patient who is sputum smear at five months or later during treatment.

Died: a patient who dies for any reason during treatment

Defaulter: patient whose treatment was interrupted for 2 consecutive months or more.

Transfer out: a patient who has been transferred to another recording unit and for whom the treatment outcome is not known.

Treatment success: sum of patients cured and those who completed treatment

2.4 DATA PROCESSING AND ANALYSIS

Number of new TB, smear positive and MDR-TB cases over the study period was established. The number of cases as a percentage of the total TB population over the study period was calculated. The percentages for the three clinics were compared to determine any difference

among the three clinics. The linear regression model was used to establish trends over the 5 year period (APPENDIX F)

The profile of patients with respect to age and sex were calculated and compared for each clinic.

Types of MDR-TB were determined, counted and compared for each clinic and for the whole township.

Treatment outcomes between various clinics were compared.

2.5 ETHICAL CONSIDERATION

Permission to review the records was sought and obtained from the Gauteng Department of Health and from the Ekurhuleni Metropolitan Municipality (APPENDICES B,C). The identity of the individuals was protected by not revealing their names and by assigning them new study numbers. Only the researcher was able to link the numbers with the records.

2.6 POSSIBLE STUDY LIMITATIONS

It is important to consider factors that could have influenced the outcome of the study. These factors will need to be taken into account in interpreting the results.

The following are some of the factors with a brief explanation of how they could have affected the study.

Selective migration

The picture of the TB and MDR-TB might be inaccurate as some of the patients with TB, especially re-treatment cases, might have preferred to get their TB treatment out of their area for fear of stigmatisation i.e. selective migration.

Observation and information bias

Distinguishing between new cases and previously treated cases depends on the willingness of the patients to disclose disease history and on the training and motivation of the staff.

Incomplete records

Some of the records of patients with TB and MDR-TB were incomplete, as they were not compiled for research purposes. Some of the records might even have been missing as patients are moved from the TB clinic to the TB hospital for treatment of MDR-TB. The records at the district office also showed some discrepancies compared with the clinic data which might have resulted from human error when capturing the results.

The other problem was that treatment outcomes were determined by following a cohort of patients. The 2004 cohort was skewed by the fact that the outcomes of some of the patients were not determined as some of them had not completed treatment by cut of date of 31st December 2004.

The following chapter shows the study results.

3.0 STUDY RESULTS

Data collection was done between February and May 2006. This was done by reviewing patient's records for the 3 clinics. The total population of Kwa-Thema during the study period was 99515 according to the latest census figures from STATS SA (Census 2001 (APPENDIX E).

3.1 TRENDS OF PATIENTS

The total number of patients seen at the clinics between January 2000 and December 2004 was 2779(table 1.1). This included patients transferred from other clinics and patients who started treatment in other clinics and continued with treatment at the three clinics under study i.e. old and new patients.

Table 1.1 Total number seen at all the clinics

YEAR	KWA-THEMA	THEMBELITSHA	WHITE CITY	TOTAL
2000	148	126	152	426
2001	152	130	130	412
2002	193	165	166	524
2003	162	165	144	471
2004	192	182	146	520
TOTAL	847	768	738	2779

Table 1.2 Smear positive cases seen at all the clinics

The study of TB and MDR-TB in Kwa-Thema township from 2000-2004

YEAR	KWA-THEMA	THEMBELITSHA	WHITE CITY	TOTAL
2000	61	58	74	193
2001	74	59	80	213
2002	129	74	99	302
2003	104	80	69	253
2004	104	80	77	261
TOTAL	472	351	399	1222

The total number of smear positive TB cases seen during the study period was 1222(table 1.2). **This comprised both the new and old patients**. The rate of smear positive TB cases rose significantly from 193/100000 in 2000 to 261/100000 by 2004 ($p<0.001$).

The number of smear positive cases seen at Kwa-Thema clinic ranged from 61 in 2000 to 129 in 2002.

The smear positive cases at Thembelitsha clinic were 351 and ranged from 58 in 2000 to 80 per year by 2004.

The total number of smear positive cases at White City Clinic was 399 and ranged from 69 in 2003 to 99 in 2002 with a yearly average of 79 patients.

The trend analysis test revealed that there was a significant increase in the number of smear positive cases seen at Kwa-Thema and Thembelitsha clinics over the study period($p<0.001$) APPENDIX F. The increase at white city clinic over the study period was not significant ($p>0.4$) APPENDIX F.

Table 1.3 Gender Profile of New TB cases

ALL TB CASES	2000	2001	2002	2003	2004	TOTAL	%
MALE	173	184	189	214	239	999	56
FEMALE	148	146	152	163	189	791	44
TOTAL	321	330	341	377	428	1790	100

SMEAR +VE	2000	2001	2002	2003	2004	TOTAL	%
MALE	110	137	115	118	122	602	57
FEMALE	79	91	96	90	93	449	43
TOTAL	189	228	211	208	215	1051	100

RETREATMENT CASES							
MALE	20	20	21	31	39	131	64
FEMALE	14	15	14	16	15	74	36
TOTAL	34	35	35	47	54	205	100

The total number of new TB cases for all the clinics during the study period was 1790 (table 1.3). This comprised only patients diagnosed at and treated at Kwa-Thema clinics and excludes

patients referred or transferred to these clinics. About 56% of patients were males and only 44% were females and this trend was observed for all the years.

This ratio was replicated in the smear positive cases as well (i.e. (57% and 43% for males and females respectively) There was also no clear increase in the number of new smear positive cases during the study period

Table 1.4 Age profile of all new TB patients

AGE GROUP	0-14	15-24	25-34	35-44	45-54	55-64	65-74	>74	TOTAL	%
MALE	101	100	251	283	194	44	11	6	999	56
FEMALE	92	132	262	189	71	32	8	5	791	44
TOTAL	193	232	513	472	165	76	19	11	1790	100

Most of the patients seen at the clinics were between the ages of 25 and 44. There were more males (56%) than females (44%) in the total group.

3.2 DIAGNOSIS

Table 1.5 Types of TB diagnosis

YEAR	2000	2001	2002	2003	2004	TOTAL
PULMONARY SMEAR +VE	189	228	211	208	215	1051

PULMONARY SMEAR -VE	49	47	33	61	83	273
PULMONARY NO SMEAR	70	41	43	26	53	233
EXTRA PULMONARY	13	14	44	82	77	230
TOTAL	321	330	341	377	428	1790

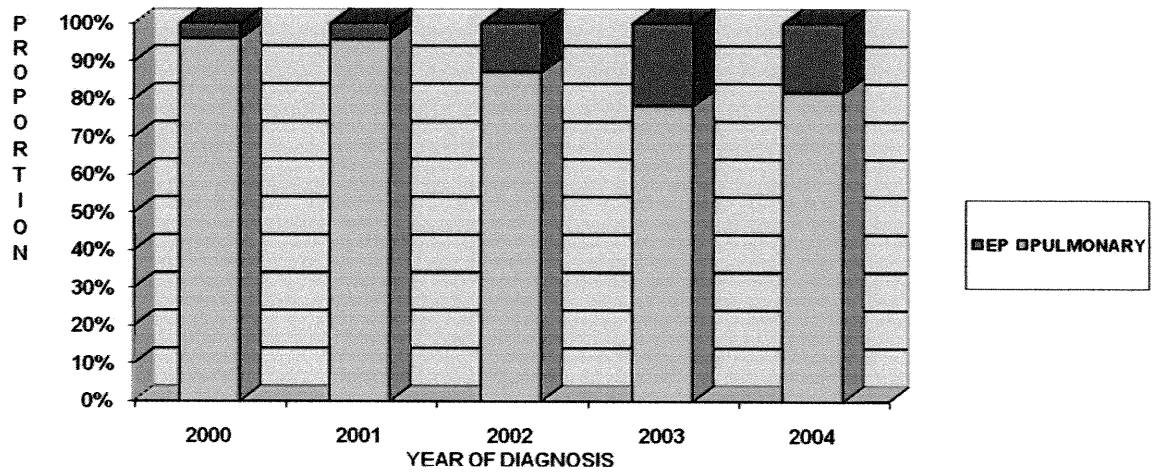


Fig. 1.1 type of TB diagnosed all clinics

More than 70% were pulmonary of which the majority were smear positive. The smear negative TB cases remained fairly steady during the study period. There was a steady decline in the

number of patients diagnosed without a smear result. The number of patients with extra-pulmonary TB increased from 4.2% in 2000 reaching a peak in 2003 at 27.7 %(fig1.1).

3.3 TREATMENT OUTCOMES

KWA-THEMA CLINIC

The smear conversion rate at 3 months increased from an average of 50.8% in 2000 to 81.7 in 2004. There was a corresponding decline in the proportion of patients who remained positive at 3 months from 18% in 2000 to 1.9% by 2004(table 2.1).

Table2.1 Smear conversion at 3 months Kwa-Thema (%)

YEAR	2000	2001	2002	2003	2004
CONVERTED TO -VE	50.8	55.4	51.2	59.6	81.7
STILL +VE	18	21.6	14.7	9.6	1.9
RESULTS NOT AVAILABLE	8	5.4	9.3	15.4	1.9
DIED	8	6.8	9.3	3.8	2.9
TRANSFERRED	12	5.4	13.2	9.6	7.7
DEFAULTED	3.2	5.4	2.3	1.9	3.8

THEMBELITSHA CLINIC

The smear conversion rate at 3 months also increased from an average of 43% in 2000 to 78.8% in 2004. There was decline in the proportion of patients who remained positive at 3 months from

a peak of 20.38% in 2001 to 8.8% by 2004. The number of patients whose results were not available reduced during the study period (table 2.2).

Table2.2 Smear conversion at 3 months- Thembelitsha (%)

YEAR	2000	2001	2002	2003	2004
CONVERTED TO -VE	43	62.7	57.9	63.8	78.8
STILL +VE	17	20.3	7.9	10	8.8
RESULTS NOT AVAILABLE	9	0	2.6	3.8	0
DIED	7	5	2.6	5	2.5
TRANSFERRED	17	7	23.7	13.8	7.5
DEFAULTED	7	5	5.3	3.8	2.5

WHITE CITY CLINIC

The smear conversion rate at 3 months increased from 39% in 2000 to 74.4% in 2004. There was just a moderate decline in the percentage of patients who remained positive at 3 months from a peak of 22% in 2000 to 11.5% by 2004. The number of patients whose results were not available reduced from 9% in 2000 to 1.3% by 2004(fig 2.3).

Table 2.3 Smear conversion at 3 months-White City Clinic: 200-2004

YEAR	2000	2001	2002	2003	2004
CONVERTED TO -VE	39	43.8	55.6	69.6	74.4
STILL +VE	22	27.5	14.1	17.4	11.5
R NOT AVAILABLE	9	4.2	7.1	5.8	1.3
DIED	7	6.8	0	1.4	5.1
TRANSFERRED	15	10.9	23.2	5.8	6.4
DEFAULTED	7	6.8	0	0	1.3

The outcome in patients with TB was done by following a cohort of patients seen for that particular year. As explained before, the 2004 cohort could have skewed the results as some had not completed treatment by the cut-off date of 31st December 2004.

Table 2.4 Outcome of patients at the 3 clinics per year 2000-2004

YEAR	2000	2001	2002	2003	2004
NOTIFICATION RATE/100 000	195	209	303	250	261
CURED (%)	63.5	60	50.8	58.8	69
TX COMPLETE (%)	12.3	10.5	7.9	12.8	3
DEATH (%)	7.1	6.6	7.9	7.6	9.2

TX FAILURE (%)	2.5	4.3	1.6	2.4	2.3
DEFAULTED (%)	5.6	.6.2	5.9	4.4	6.1
TRANSFERED (%)	10.7	9	24.1	11.2	10.3
NOT EVALUATED (%)	3.5	2.8	1.9	2.8	0

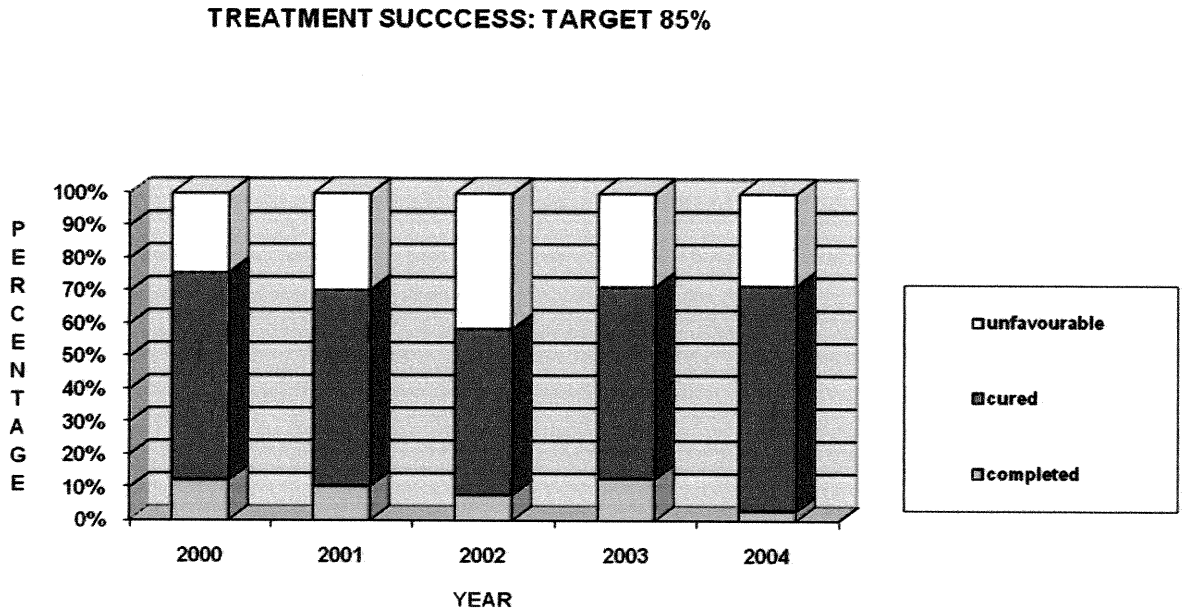


Fig2.1 treatment success

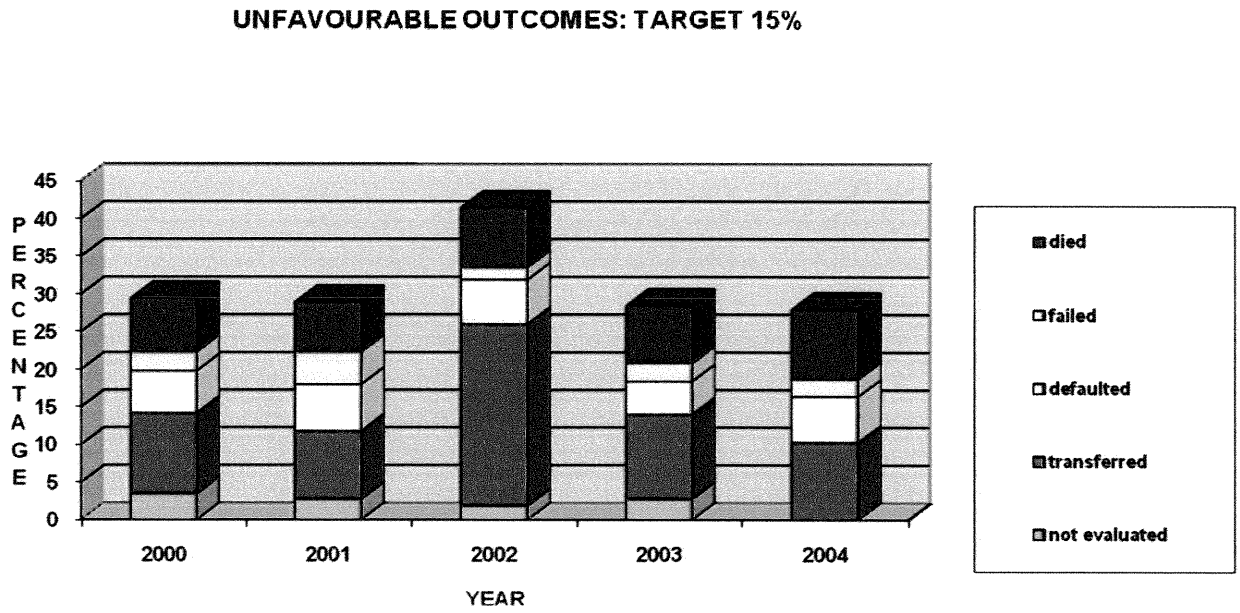


Fig 2.2 Unfavourable outcome target 15%

Table 3.1 MDR results

CLINIC	THEMBELITSHA	WHITE CITY	KWA-THEMA	TOTAL
SEX				
M	1	1	2	4
F	3	1	5	9

YR OF DX				
2000			1	1
2001	-	-	1	1
2002	1	-	1	2
2003	1	1	2	4
2004	2	1	2	5

TB TX HX				
PREV TX	1	0	2	3
NO PREV TX	3	2	5	10
UNKNOWN	-	-	-	0

HIV STATUS				
POSITIVE	2	1	5	8
NEGATIVE	1	0	1	2
UNKNOWN	1	1	1	3

TX OUTCOME				

CURED	-	0	2	2
DEATH		0	1	1
STILL UNDER TX	4	2	4	10

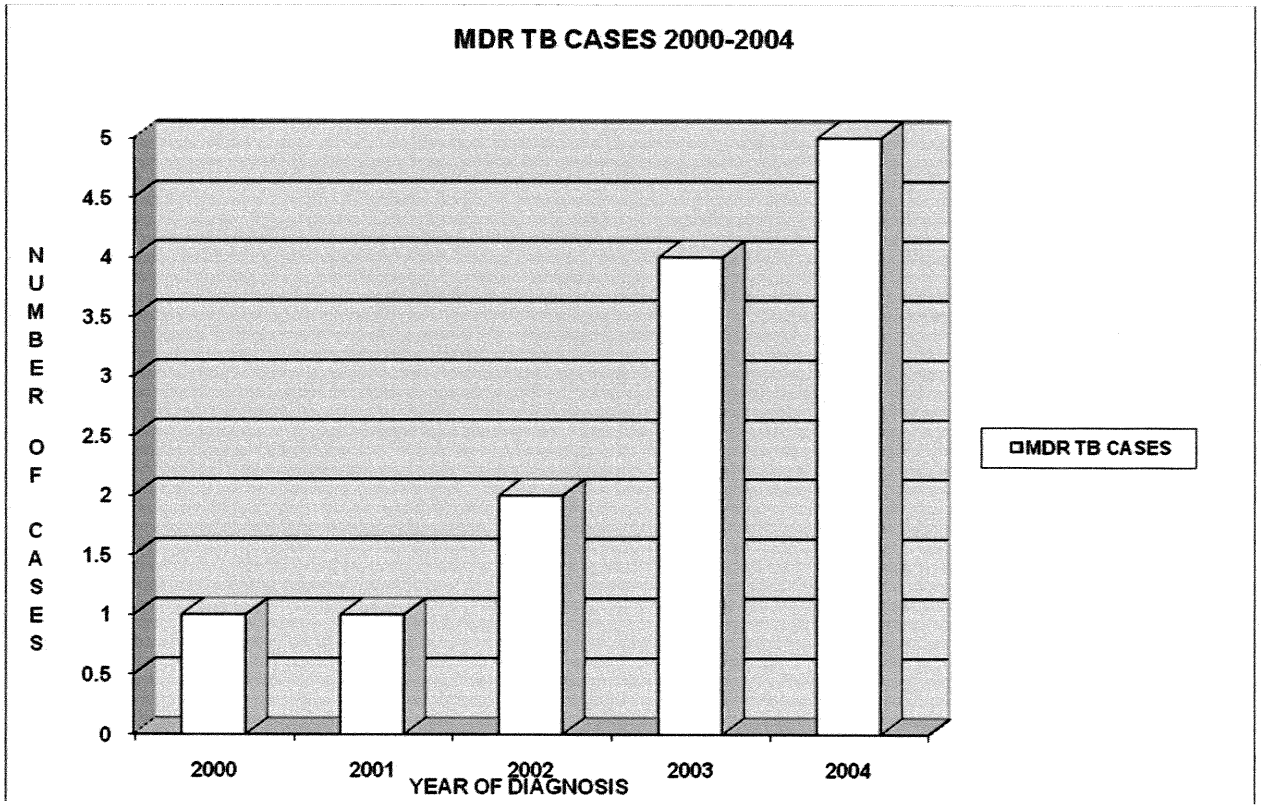


Fig.3.1 MDR-TB cases 2000-2004

The total number of patients with MDR-TB over the study period was 13. There were 4 males and 9 females. There was a rise in MDR-TB cases from 2000-2004 **(fig.3.2)** Most of the patients with MDR-TB had not been previously treated for TB i.e. 10**(table 3.1)** Most of the patients were HIV positive (8) and 2 patients were HIV negative whilst 3 patients' status was unknown.

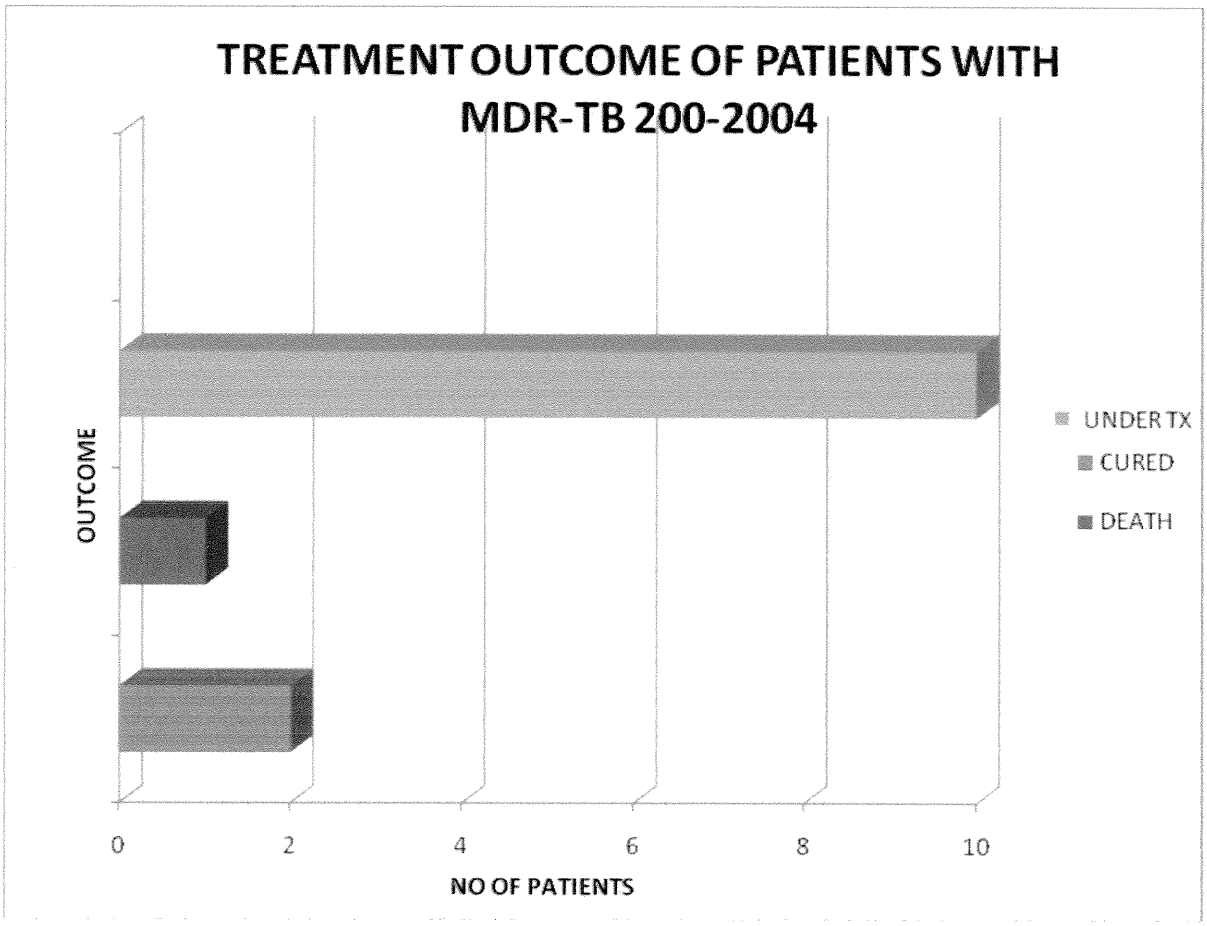


Fig.3.3 Treatment outcome for patients with MDR-TB

The majority of patients with MDR-TB were still under treatment by the 31st December 2004-(10), 2 were cured and 1 patient died during the study period. Of the two patients diagnosed in 2000 one died and one was cured.

In the following chapter the results are discussed with possible explanations for the observed trends.

4.0 DISCUSSION

The revised outcome targets set by World Health Assembly in 1991 in the context of the millennium development goals(MDG) and NTCP are: To detect 70% of smear positive TB patients and to cure at least 85% of them by 2005.[14,2] The results of this study have to be looked at within this context.

In interpreting and discussing the study results, one must take into account the possible effects on the results of biases outlined in the methodology i.e. selective migration, observation and information bias as well as incomplete records. It also important to note small size of the MDR-TB sample which could also have affected the study.

4.1 TRENDS OF TB PATIENTS

The study also set out to investigate the trend of TB patients with respect to number of cases over 5 years, smear positive cases over the same period and to compare them with the national picture.

The results indicate that TB notification rose significantly from 426/100000 in 2000 to 520/100000 by 2004 ($p<0.001$).This was a 22% increase over this period of 5 years. It started off being worse than the national average which was 193/100 000 in 2000 to be on par with the national average which was 544/100 000 by 2004. This shows that the burden of TB in the community of Kwa-Thema has increased. This could mean that patients are starting TB treatment late thereby infecting other members of the community. It could be due to an increase in the population especially in the informal settlements where overcrowding and poverty which are known TB risk factors, are rife.

The study of TB and MDR-TB in Kwa-Thema township from 2000-2004

The number of patients seen at Kwa-Thema and Thembelitsha clinics showed a significant increase over the five years ($p< 0.001$-trend analysis test). The patient numbers at White City clinic did not show a significant increase over the study period ($p>0.1$) (APPENDIX F) The disproportionate increase in Kwa-Thema and Thembelitsha could be ascribed to their proximity to informal settlements. It could also be due to selective migration bias of TB cases or patients preferring these facilities to White city Clinic.

The number of new smear positive cases showed a significant increase over the study period from 193/100 000 to 261/100 000($p<0.001$). This figures corresponded with the national ones which increased from 137/ 100 000 in 2000 to 242/100 000 by 2004(Global TB Control 1119, 2005)[14]. This reflected the increased rate of new TB infections. This might also be caused by observation or information bias which might have caused an underestimation of retreatment and overestimation of new cases.

Of concern is the increase in the number of patients with extra-pulmonary TB which has seen a dramatic increase from 4.2% in 2000 reaching a peak in 2003 at 27.7% (Fig1.1). One would not know whether a slight decrease in 2004 to 22.4% represents a turnaround.

The target of the MDG & Stop TB Partnership is to diagnose 70% of people with sputum smear positive TB (ss+ve). In areas with low HIV prevalence it is expected to be between 65% and 80%. In this study the ss+ve rates have fluctuated between 52% and 80%. This reflects the poor quality of diagnosis. This is most probably the paucity of AFB in sputum among HIV positive patients.

The focus on ss+ve cases is because they are the principal sources of TB infection to others and because they suffer higher rates of morbidity and mortality than ss-ve patients.

4.2 PROFILE OF TB PATIENTS

The study set out to determine the profile of TB patients with respect to age and sex. The findings indicate that TB infection was highest in 15-44 age groups for all the study years. This was also observed in the smear positive rate. This group represents the most economical active persons in the community which could have an effect on the economic wellbeing of the community. It also represents the group which is at the prime of its reproductive life which might have an effect on the attention given to children as they grow up. This category also has the largest number of people (census 2001) APPENDIX F. There were more males than females infected 56% against 44%. The trend was also reflected in the smear positive cases at 57% against 43%. This is in spite of our population being slightly more female (50 386) than male (49 129).

4.3 TB TREATMENT OUTCOME

Smear conversion showed a dramatic improvement from a low of 39% to over 70% for all the clinics reaching a high of 81% at white city clinic by 2004.

The treatment success (new ss+ve) for Kwa-Thema showed a moderate improvement from 57.4% in 2000 to 67% by 2004. This improvement was in line with the national average which was 66-67% over the same period. This could be ascribed to the expansion of the DOTS which had reached 85% by 2004. Cure rate increased from 63.5% by 2000 to 69% by 2004(Table 2.5). The death rate also increased to 9.2% with default rate remaining stubbornly high at 6.1% by 2004 from 7.1% in 2000(Table 2.5), (Fig 2.2). Treatment failure remained steady during the study period at just over 30%.

The target in the MDG is 85% cure rate and less than 15% treatment failure rate. This means that Kwa-Thema area still falls short of that target. This could be due to:

-Poor staff motivation resulting in lack of proper counselling and motivation of patients.

-Unstable populations and increasing poverty due to unemployment.

-The possible effects of HIV/AIDS.

4.4 MDR-TB AND ITS IMPACT ON THE COMMUNITY

Drug resistance occurs where there is poor TB control programme. This results from improper administration of drugs by healthcare professionals and poor patients' compliance.

One must also take into account the possibility of selective migration of patients with MDR-TB seeking treatment outside the area as well as the bias of incomplete records which might have lead to an underestimation of MDR-TB cases

MDR TB increased from 1% in 2000 to 5% by 2004. This was much higher than the national average which stood at 1.8% by 2004[14]. This is reflective of ineffective implementation of the NTCP.

The majority of MDR-TB patients where HIV positive (8/13). Although the numbers MDR-TB are small it suggests that HIV might be a major contributing factor in the increasing numbers of MDR-TB. The revised estimates of global TB/HIV epidemiology reveal that 11% of all new TB cases in adults (15-49) were attributable to HIV infection by 2000 and the figure for Africa was 31%. The co-infection of HIV/TB by 2000 was estimated to be 1.9 million adults.[14]

HIV/TB co-infection currently stands at 55 % (2005) in South Africa and could thus be contributing to the increased burden of TB cases. This would also increase the incidence of MDR TB as facilities might struggle to cope with the patient load and thus be unable to manage TB cases properly.

Most of the patients with MDR TB had never had TB treatment before. This raises the possibility that patients with MDR-TB are passing the MDR-TB strain to other members of the community.

It also suggests that MDR-TB in the community is being diagnosed late and poorly managed thereby allowing patients to transmit it to others.

5.0 CONCLUSION

In analysing the results the following observations were made:

Case detection improved from 2000 to 2004.The TB infection rate was highest in the age group 15-44.Smear conversion rate improved from 39% to 70% over the study period. The cure rate improved slightly from 57.4% to 67% and failure rate remained unchanged at 30%. This still falls short of the MDG and NTCP target of 85% cure and 15% failure rates. MDR-TB incidence increased from 1% in 2000 to 5% in 2004 which was much higher than the national average which stood at 1.8% by 2004. The majority of patients with MDR-TB were HIV positive. Most patients with MDR-TB had never had TB treatment before.

The results reflect poorly on the implementation of NTCP and MTDP in the community of Kwa-Thema. They also reflect the possible influence of HIV as a causative factor for the increase in TB incidence and of MDR-TB and also on TB mortality and morbidity.

6.0 RECOMMENDATIONS

In the light of smear conversion and cure rates falling short of MDG and NTCP goals, increasing rates of MDR-TB and the fact that the majority of MDR-TB patients were HIV Positive, one would recommend the adoption of the Expanded Strategic Framework which re-enforces the five elements of the DOTS strategy with adaptations to the local conditions. This strategy would include the following elements:

Enlisting Community Organisations in combating TB.

This can entail social mobilization of NGO'S working in the community. NAPWA (National Association of People living with AIDS) runs a very effective programme of counselling and home based care for HIV/AIDS patients in the community. They could be requested and be provided with resources to expand their activities. This would include raising awareness of TB, encouraging their members who are at an increased risk to go for TB screening and to complete their treatment.

Strengthening the fight against HIV/AIDS.

HIV testing of TB patients is not encouraged in Kwa-Thema. It would be advisable to expand VCT services in TB clinics. This would require additional resources to be allocated to the clinics to enable them to fulfil these tasks.

It also requires the expansion of DOTTS plus strategy to include measures to decrease HIV transmission in the community. This requires collaboration between health services and the NGO'S working in the community to step up HIV prevention such as promotion of condom

usage, treatment of sexually transmitted infections and the administration of HAART and antibiotic prophylaxis against bacterial infections.

Increasing the involvement of other service providers in the fight against TB

Patients need to be supported by people they trust for them to adhere to treatment. The enlisting of private health providers should be explored and encouraged as most patients utilise their services and go to them to seek advice. This can also lessen the burden that state facilities are under. This would entail the training and familiarisation of private providers with diagnostic and treatment protocols adopted by the public health services

Proper recording system

The clinic records were found to be very chaotic as some of the routinely collected data was missing. It will be important to provide continuous training to health personnel on the recording of routinely collected data and how it can be utilised at the local level to facilitate local decision making.

Involuntary detention

In the light of the emergence of XDR-TB, a consideration needs to be given to involuntary detention of persons with XDR-TB and certain patients with MDR-TB. Although this might clash with the bill of rights, it would however be justifiable as it is for the public good. Guidelines have been set by ECHR (European court of human rights in the case of Ehorn vs. Sweden[17]. Section 25 of the Siracusa Principles holds: public health may be invoked as a ground for limiting certain rights in order to allow a state to take measures dealing with serious threat to

the health of the population. These measures must be specifically aimed at preventing disease or injury or providing care for the sick and the injured[26]. This measures are also endorsed by the SAMRC [4,9]

I believe that such a stage has been reached and the implementation of involuntary detention can go a long way in preventing the spread of MDR-TB and XDR-TB.

Raising public awareness on TB and MDR-TB

Public campaigns need to be embarked upon to impress on the community the need to complete TB treatment. The rising incidence of MDR-TB needs to be brought to the attention of the community. This can take the form of leaflets placed at clinics and community centres. The results and recommendations of this study will be published in the local newspaper (African Reporter). This should go a long way in raising awareness of TB and MDR-TB in the community.

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APPENDIX A

ETHICS APPROVAL

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Rembuluwani

CLEARANCE CERTIFICATE **PROTOCOL NUMBER M050722**

PROJECT The Study of Multidrug Resistance TB in Kwa-Thema (2000-2004)

INVESTIGATORS Dr A Rembuluwani

DEPARTMENT School of Public Health

DATE CONSIDERED 05.07.29

DECISION OF THE COMMITTEE* Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 05.08.01 **CHAIRPERSON** ..... (Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor :

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX B

APPROVAL LETTER FROM GAUTENG DEPARTMENT OF HEALTH

PROVINCIAL RESEARCH COMMITTEE.

RESEARCH EVALUATION FORM FOR APPROVAL BY THE HEAD OF THE DEPARTMENT.

Submission date: 10-10-2005

Title: The study of MDR-TB in kwa-Thema 2000-2004

Principal investigator: Dr Azwinaki Rembuluwani

Research Site(s): Kwa-Thema (THEMBELITSHA CLINIC)

Type of research: Non trial

Summary:

A cross sectional study will be conducted using record review to describe the trend of newly diagnosed MDR-TB at the Kwa-Thema clinics over a five year period, the types of MDR-TB presenting at Kwa-Thema Clinics, the profile of patients with MDR-TB and the treatment outcomes of patients with MDR TB?

All the adult patients who were diagnosed with and treated for MDR-TB in the three clinics mentioned above during the study period will be studied. This is because one expects such patients to be relatively few.

The study will cover a period from 2000-2004

Motivation

This study is looking also to raise the awareness of the community of Kwa –thema about MDR-TB and to educate the community about ways to prevent MDR-Tb.
It was mentioned by other researchers that there are very few studies on MDR-TB in SA. This study will add value to the South African literature.
Furthermore, this study is been conducted for the purpose of the partial fulfillment of a Masters degree in MSC.
Permission to review the records will be sought from clinic managers.
The result of the study will be given to the clinic managers and to senior managers. Recommendations will also be included in the report. This will ensure that the recommendations are implemented speedily.
The ethics approval from the Wits ethics committee is herby attached.
A budget of **R17, 424** is required for the study and is attached to this letter, but no mention was made of the source of financing.
We would recommend that the study be conducted in the province pending clarity on the funding system because at this stage, the Department is not prepared to fund the study.

The Evaluator:

Dr ML Likibi
Specialist research and Epidemiology

Approved/~~not approved~~ as amended

Please ensure that the conditions of approval are made clear

Dr L Rispel
HOD
Date: 10/10/2005

APPENDIX C

APPROVAL LETTER FROM EKURHULENI DEPARTMENT OF HEALTH AND SOCIAL SERVICES

MEMORANDUM

Ekurhuleni
METROPOLITAN MUNICIPALITY

Southern Service Delivery Region
GERMISTON CUSTOMER CARE CENTRE

Health & Social Development

Civic Centre
Cnr. Queen & Cross Streets
Germiston

P O Box 145
Germiston

Tel: (011) 871-7758 / 7450
Fax: (011) 871-7527
www.ekurhuleni.com

DATE 07 11 2005

TO:: Managers
Clinic Heads

FROM: Dr S.Msiza

Email: sophiem@ekurhuleni.com

Dear Dr A Rembuluwani

Application for ethical clearance REC:The study of MDR –TB in Kwa-Thema .

Thank you for your application for ethics approval of the above study. Ethics clearance for the study was granted and the committee wishes you success in your research and you will be expected to present the findings of the study at the annual research conference.

Yours sincerely

Dr S Msiza; Dr J Sepuya; Dr A Govender and Dr Z Mabange

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

2005

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Rembuluwani

CLEARANCE CERTIFICATE **PROTOCOL NUMBER M050722**

PROJECT The Study of Multidrug Resistance TB in Kwa-Thema (2000-2004)

INVESTIGATORS Dr A Rembuluwani

DEPARTMENT School of Public Health

DATE CONSIDERED 05.07.29

DECISION OF THE COMMITTEE* Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 05.08.01 **CHAIRPERSON** ..... (Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor :

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX D

DATA RECORD FORM

MDR-TB SURVEY 2000-2004

STUDY NO					
CLINIC	W(a)	T(b)	K©		
DOB					
SEX	M		F		
DATE OF TB DIAGNOSIS					
DATE OF SMEAR AND CULTURE					
YEAR OF DIAGNOSIS OF MDR	2000	2001	2002	2003	2004

TB TREATMENT HISTORY	PREV TX	
	NO PREV TX	
	UNKNOWN	
MDR-TB TYPE	PRIMARY	
	ACQUIRED	
	MIXED	
IF PREVIOUSLY TREATED WAS TREATMENT		
	COMPLETED	
	INTERRUPTED	
	NEVER COMPLETED	
HIV STATUS	POSITIVE	
	NEGATIVE	
	UNKNOWN	
TREATMENT OUTCOME	SUCCESSFUL	
	DEATH	
	STILL UNDER TREATMENT	
	UNKNOWN	

APPENDIX E

CENSUS 2001 RESULTS FOR KWA-THEMA

Census 2001 figures for KwaThema

Main-place name	KwaThema
MP_CODE	77318
Longitude of centroid	28.40393
Latitude of centroid	-26.30103
Area size (km2)	15.6
Total Population	99515
Total Households	26712

Total population by gender

Male	49129
Female	50386

Total population by population group

African_Black	99307
Coloured	175
Indian_Asian	14
White	19
Total	99515

Number of individuals by first language

Afrikaans	234
English	214
IsiNdebele	4022
IsiXhosa	8616
IsiZulu	56568
Sepedi	8595
Sesotho	8649
Setswana	7215
SiSwati	2608
Tshivenda	403
Xitsonga	2200
Other	192

Number of individuals by age (5 year intervals)

0-4	8685
5-9	8261
10-14	8638
15-19	9233
20-24	10821
25-29	10742

30-34	8286
35-39	7743
40-44	6734
45-49	5450
50-54	4258
55-59	3144
60-64	2527
65-69	1878
70-74	1480
75-79	800
80-84	554
85+	282

Number of individuals (age 20+) by highest educational level reached

No schooling	7354
Some primary	8363
Complete primary	4222
Some secondary	25649
Std 10/Grade 12	14903
Higher	4208

Number of individuals (age 15+) by marital status

Married civil/religious	15777
Married traditional/customary	5136
Polygamous marriage	47
Living together like married partners	5222
Never married	40756
Widower/widow	4576
Separated	730
Divorced	1689

Number of individuals by religion

Dutch Reformed churches	1862
Zion Christian churches	8965
Catholic churches	6380
Methodist churches	7203
Pentecostal/Charismatic churches	11572
Anglican churches	3205
Apostolic Faith Mission	516
Lutheran churches	2947
Presbyterian churches	1281
Bandla Lama Nazaretha	362
Baptist churches	1982
Congregational churches	431
Orthodox churches	60
Other Apostolic churches	14921

Other Zionist churches	6623
Ethiopian type churches	2790
Other Reformed churches	292
Other African independent churches	2637
Other Christian churches	8116
African traditional belief	252
Judaism	6
Hinduism	32
Islam	223
Other beliefs	1325
No religion	14305
Undetermined	1227

Number of individuals by mode of transport

On foot	20246
By bicycle	680
By motorcycle	231
By car as a driver	1897
By car as a passenger	2336
By minibus/taxi	17972
By bus	1147
By train	1767
Other	209
Not applicable	53030

Number of individuals (age 15-65) by employment status

Employed	19904
Unemployed	26621
Not Economically Active	22858

Number of employed individuals (age 15-65) by occupation

Legislators; senior officials and managers	545
Professionals	783
Technicians and associate professionals	2123
Clerks	2506
Service workers; shop and market sales workers	2226
Skilled agricultural and fishery workers	84
Craft and related trades workers	3009
Plant and machine operators and assemblers	3061
Elementary occupations	4504
Undetermined	0

Number of employed individuals (age 15-65) by industry

Agriculture; hunting; forestry and fishing	155

Mining and quarrying	725
Manufacturing	4805
Electricity; gas and water supply	90
Construction	732
Wholesale and retail trade	3556
Transport; storage and communication	1069
Financial; insurance; real estate and business services	1498
Community; social and personal services	4467
Other and not adequately defined	0
Private households	1309
Undetermined	1498
Total	19904

Number of employed individuals (age 15-65) by individual income (monthly)

No income	440
R 1 - R 400	1349
R 401 - R 800	3142
R 801 - R 1600	6187
R 1601 - R 3200	5651
R 3201 - R 6400	2480
R 6401 - R 12800	507
R 12801 - R 25600	88
R 25601 - R 51200	36
R 51201 - R 102400	10
R 102401 - R 204800	6
R 204801 or more	8
Average Income (Rands)	2291

Number of households by dwelling type

House or brick structure on a separate stand or yard	17818
Traditional dwelling/hut/structure made of traditional materials	163
Flat in block of flats	108
Town/cluster/semi=detached house (simplex; duplex; triplex)	100
House/flat/room in back yard	3124
Informal dwelling/shack in back yard	743
Informal dwelling/shack NOT in back yard	4302
Room/flatlet not in back yard but on shared property	293
Caravan or tent	56
Private ship/boat	6
Total	26712

Number of households by fuel used for lighting

Electricity	20549
Gas	37
Paraffin	456
Candles	5593
Solar	43
Other	35
Total	26712

Number of households by fuel used for cooking

Electricity	18990
Gas	139
Paraffin	4153
Wood	93
Coal	3229
Animal dung	28
Solar	53
Other	28
Total	26712

Number of households by fuel used for heating

Electricity	17846
Gas	118
Paraffin	2449
Wood	110
Coal	5783
Animal dung	14
Solar	21
Other	371
Total	26712

Number of households by refuse disposal

Removed by local authority at least once a week	24719
Removed by local authority less often	240
Communal refuse dump	196
Own refuse dump	1159
No rubbish disposal	397
Total	26712

Number of households by toilet facilities

Flush toilet (connected to sewerage system)	24973
Flush toilet (with septic tank)	76
Chemical toilet	10
Pit latrine with ventilation (VIP)	40
Pit latrine without ventilation	350

Bucket latrine	100
None	1163
Total	26712

Number of households by telephone facilities

Telephone in dwelling and cell-phone	2708
Telephone in dwelling only	4881
Cell-phone only	4841
At a neighbour nearby	691
At a public telephone nearby	12569
At another location nearby	464
At another location; not nearby	144
No access to a telephone	415
Total	26712

Number of households by water supply

Piped water inside dwelling	9352
Piped water inside yard	14906
Piped water on community stand: distance less than 200m from dwe	1045
Piped water on community stand: distance greater than 200m from	1243
Borehole	11
Spring	0
Rain-water tank	3
Dam/pool/stagnant water	3
River/stream	3
Water vendor	3
Other	147
Total	26715

Number of households by derived annual household income

No income	7229
R1 - R4 800	1089
R4 801 - R 9 600	4192
R9 601 - R 19 200	5025
R19 201 - R 38 400	5006
R38 401 - R 76 800	2719
R76 801 - R153 600	1057
R153 601 - R307 200	256
R307 201 - R614 400	47
R614 401 - R1 228 800	38
R1 228 801 - R2 457 600	39
R2 457 601 and more	15
Average Income (Rands)	28108

Number of households that have access to household goods

Total Households	26712
Radio	19408
Television	16701
Computer	622
Refrigerator	16698
Telephone	7589
Cell Phone	7549

Figures greater than 0 and less than 4 are randomised to preserve confidentiality
Users of these data should refer to the extract from the SA Stats Council Census sub-committee report at http://www.statssa.gov.za/extract.htm
Household tables exclude collective living quarters

Income: Users are warned to use this variable with caution and to be aware of its limitations. Census 2001 collected income information from one question on individual income without probing about informal income, enterprise profits or income in kind. As a result, the census income is understated for most of the population. Further direct comparisons with other data sets cannot be made. The main reason for releasing this variable in the data is to show patterns and trends, rather then precise estimates.

APPENDIX F

LINEAR REGRESSION MODEL

http://davidmlane.com/hyperstat/B1133
24.html

$$L = \sum M_i a_i$$

$$SL \sqrt{\sum \frac{a_i^2}{N_i}} \; MSE$$

TREND ANALYSIS FOR KWA-THEMA CLINIC 2000 – 2004 (ALL TB CASES)

$$L = 148(-2) + 152(-1) + 198(0) + 162(1) + 192(2)$$
$$= 98$$

$$SL = \sqrt{\frac{(-2)^2}{148} + \frac{(-1)^2}{148} + \frac{(0)^2}{148} + \frac{(1)^2}{148} + \frac{(2)^2}{148}} \qquad (5)$$

$$= 1.299$$

$$t = \frac{98}{1.299} = 75.44$$

$$DF = 588$$

$$P < 0.001$$

TREND FOR KWA-THEMA CLINIC IS SIGNIFICANT

http://davidmlane.com/hyperstat/B1133

TREND ANALYSIS FOR THEMBELITSHA CLINIC

(ALL TB CASES)

$$L = 126(-2) + 130(-1) + 165(0) + 165(1) + 182(2)$$

$$= 147$$

$$S_L = \sqrt{\frac{(-2)^2}{126} + \frac{(-1)^2}{126} + \frac{(0)^2}{126} + \frac{(1)^2}{126} + \frac{(2)^2}{126}(5)^2}$$

$$= 1.395$$

$$t = 105.37$$

$$DF = 500$$

$$p < 0.001 \text{ (SIGNIFICANT)}$$

TREND ANALYSIS FOR WHITECITY CLINIC

(ALL TB CASES)

$$L = (152)(-2) + 130(-1) + 166(0) + 144(1) + 146(2)$$

$$= 2$$

$$S_L = \sqrt{\frac{(-2)^2}{152} + \frac{(-1)^2}{152} + \frac{(1)^2}{152} + \frac{(0)^2}{152} + \frac{(2)^2}{152}}\,(5)^2$$

$$= 1.276$$

$$t = \frac{2}{1.276} = 1.567$$

$$DF = 604$$

$$P = 0.2 \quad \text{ie NOT SIGNIFICANT}$$

TREND ANALYSIS FOR KWA-THEMA CLINIC

(SMEAR +VE CASES)

$$L = 61(-2) + 74(-1) + 129(0) + 104(1) + 104(2)$$

$$= 116$$

$$S_L = \sqrt{\frac{(-2)^2}{61} + \frac{(-1)^2}{61} + \frac{(0)^2}{61} + \frac{(1)^2}{61} + \frac{(2)^2}{61}}$$

$$= 2.023$$

$$t = \frac{116}{2.023}$$

$$= 57.34$$

$$DF = 240$$

$$P < 0.001 \text{ (SIGNIFICANT)}$$

TREND ANALYSIS TEST FOR THEMBELIHLE CLINIC (5 YEAR POSITIVE CASES)

$$L = 58(-2) + 59(-1) + 80(1) + 80(2)$$

$$= 65$$

$$S_L = \sqrt{\frac{(-2)^2}{58} + \frac{(-1)^2}{58} + \frac{(0)^2}{58} + \frac{(1)^2}{58} + \frac{(2)^2}{58}(5)^2}$$

$$= 1.86$$

$$t = \frac{65}{1.86}$$

$$DF = 228$$

$$P \leq 0.001 \text{ (SIGNIFICANT)}$$

TREND ANALYSIS FOR WHITE CITY CLINIC

(SMEAR POSITIVE CASES)

$$L = 74(-2) + 80(-) + 69(1) + 77(2)$$

$$= -1$$

$$S_L = \sqrt{\frac{(-2)^2}{74} + \frac{(-1)^2}{74} + \frac{(0)^2}{74} + \frac{(1)^2}{74} + \frac{(2)^2}{74}(5)^2}$$

$$= 1\ 651$$

$$t = -0.06$$

$$DF = 292$$

$$P > 0.4 \quad \text{(NOT SIGNIFICANT}$$