

UNIVERSITY OF CAPETOWN

HEALTH ECONOMICS UNIT

**A COST-EFFECTIVENESS ANALYSIS OF ALTERNATIVE TUBERCULOSIS CONTROL
PROGRAMS IN RURAL ZAMBIA**

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**A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTERS OF ARTS IN HEALTH ECONOMICS,
SEPTEMBER 1997.**



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ABSTRACT

This study reviewed community-based directly observed treatment (DOT) and the conventional approach to tuberculosis management in order to find the most cost-effective approach. Both patient and health system cost data were used. Hospital cost data were collected from a mission hospital in rural Zambia for the periods 1989 and 1997. Patient cost data were collected from a sample of 50 patients in terms of time and travel costs. The cure rate was used as the measure of effectiveness. Results showed that community-based DOT is the most cost-effective approach because of its reduced costs to the patients and health system. Finally, it was also found that community-based DOT is the most viable economic option given the existing resource constraints. Suggestions for future study are offered and limitations of research are explored.

ACKNOWLEDGEMENTS

The preparation of this work was eased by the assistance, advice and friendship of a number of people. I extend my sincere gratitude to my creator, parents, family members and Debo for supporting me with their unconditional love throughout the months in which this work has been in the making. My main intellectual debt lies with the group of advisors and scholars around the Masters Program in Health Economics at the University of Capetown. I would also like to express my appreciation to my advisors in particular Mr. B. Makan and the entire staff in the Department of Economics for their scholarly advice.

University of Cape Town

TABLE OF CONTENTS

LIST OF TABLES.....	VII
LIST OF ABBREVIATIONS.....	VIII
INTRODUCTION	1
CHAPTER ONE.....	2
BACKGROUND INFORMATION.....	2
1.1 COUNTRY SETTING.....	2
1.2 STATEMENT OF THE PROBLEM	3
1.3 OBJECTIVES OF THE STUDY.....	5
1.4 JUSTIFICATION AND SIGNIFICANCE OF THE STUDY	5
1.5 ORGANISATION OF THE STUDY	6
CHAPTER TWO.....	8
CHARACTERISTICS AND EPIDEMIOLOGY OF TUBERCULOSIS AND MEASURES OF ITS CONTROL	8
2.1 BASIC CHARACTERISTICS OF TUBERCULOSIS	8
2.2 EPIDEMIOLOGY OF TUBERCULOSIS IN ZAMBIA	9
2.2.1 HIV seroprevalence and tuberculosis	9
2.2.2 Tuberculosis cases and case rates.....	9
2.2.3 Smear-positive tuberculosis case rates	10
2.2.4 Age and sex distribution of smear-positive cases.....	10
2.2.5 Hospital morbidity and mortality.....	11
2.2.6 Types of tuberculosis.....	11
2.2.7 Sputum analysis among pulmonary cases	11
2.2.8 Outcome of treatment.....	12
2.3 MEASURES OF TUBERCULOSIS CONTROL IN ZAMBIA.....	12
2.3.1 Conventional care.....	12
2.3.2 Directly observed treatment (DOT)	13
2.3.2.1 <i>Immunisation with BCG</i>	13
2.3.2.2 <i>Case finding and contact tracing</i>	14
2.3.2.3 <i>Case holding and supervision of treatment</i>	15
2.3.2.4 <i>Health education</i>	16
2.4 SUMMARY	16

CHAPTER THREE.....	17
CONCEPTUAL FRAMEWORK FOR COST-EFFECTIVENESS ANALYSIS.....	17
3.1 PREMISE OF ECONOMIC EVALUATIONS.....	17
3.2 FORMS OF ECONOMIC EVALUATION.....	18
3.2.1 Cost and cost-minimisation analysis (CMA).....	18
3.2.2 Cost-benefit analysis (CBA).....	18
3.2.3 Cost-utility analysis (CUA).....	19
3.2.4 Output-maximisation analysis (OMA).....	19
3.2.5 Cost-effectiveness analysis (CEA).....	19
3.3 COST-EFFECTIVENESS ANALYSIS (CEA).....	19
3.3.1 Types of costs.....	20
3.3.2 Measurement of costs.....	21
3.3.3 Allocation of shared costs.....	22
3.3.5 Measures of effectiveness.....	22
3.3.6 Obtaining effectiveness data.....	23
3.3.7 Uncertainty and sensitivity analysis.....	24
3.3.7.1 Risk averse strategy.....	24
3.3.7.2 Sensitivity Analysis.....	24
3.4 LIMITATIONS OF COST-EFFECTIVENESS ANALYSIS.....	26
3.5 METHODOLOGICAL ISSUES IN ECONOMIC EVALUATIONS ESPECIALLY CEA.....	27
3.5.1 Appraisal of published cost-effectiveness articles.....	28
3.6 SUMMARY.....	30
CHAPTER FOUR.....	31
METHODOLOGY.....	31
4.1 SETTING.....	31
4.2 PERSPECTIVE OF THE STUDY.....	32
4.3 DOT DATA COLLECTION.....	32
4.3.1 Population sample.....	32
4.3.2 Data collection for costing.....	34
4.4 CONVENTIONAL APPROACH DATA COLLECTION.....	34
4.4.1 Population sample.....	35
4.4.2 Data collection for costing.....	35
4.5 EFFECTIVENESS MEASURE.....	35
4.6 COST ANALYSIS.....	35
4.7 COST-EFFECTIVENESS ANALYSIS.....	37
4.8 SUMMARY.....	37

CHAPTER FIVE	39
RESULTS	39
5.1 AVERAGE HEALTH SYSTEM, PATIENT AND TOTAL COSTS	39
5.2 AVERAGE HEALTH SYSTEM COSTS	41
5.3 AVERAGE PATIENT COSTS.....	42
5.4 COST-EFFECTIVENESS DATA	45
5.5 RESOURCE USE DATA	45
5.6 SUMMARY	45
CHAPTER SIX	47
DISCUSSION AND CONCLUSION	47
6.1 DISCUSSION.....	47
6.1.1 Average health system costs	47
6.1.2 Average patient costs	48
6.1.3 Cost-effectiveness analysis.....	49
6.1.4 Resource use analysis	50
6.1.5 Application of study results to other districts in Zambia	50
6.1.6 Policy implications.....	50
6.2 LIMITATIONS OF STUDY AND DIRECTIONS FOR FUTURE RESEARCH	51
6.3 CONCLUSION	51
REFERENCES	53
BIBLIOGRAPHY	56
APPENDIX	I

LIST OF TABLES

TABLE 1: METHODOLOGICAL ISSUES IN ECONOMIC EVALUATIONS	27
TABLE 2: A REVIEW OF PREVIOUS COST-EFFECTIVENESS STUDIES.....	29
TABLE 3: AVERAGE HEALTH SYSTEM, PATIENT AND TOTAL COSTS IN 1997 US\$ (PERCENTAGE OF TOTAL) FOR CURING ONE PATIENT WITH TUBERCULOSIS ACCORDING TO MANAGEMENT.	40
TABLE 4: AVERAGE HEALTH SYSTEM COSTS IN 1997 US\$	41
TABLE 5: AVERAGE PATIENT COSTS IN 1997 US\$	43
TABLE 6: COST-EFFECTIVENESS OF DIFFERENT CASE MANAGEMENT STRATEGIES.....	46
TABLE 7: NUMBERS OF BEDS AVAILABLE AND REQUIRED TO MANAGE PATIENTS WITH TUBERCULOSIS.....	46

LIST OF ABBREVIATIONS

AIDS	Acquired immune deficiency syndrome
CBA	Cost-benefit analysis
CEA	Cost-effectiveness analysis
CHW	Community health worker
CMA	Cost-minimisation analysis
CUA	Cost-utility analysis
DOT	Directly observed treatment
E	Ethambutol
GDP	Gross domestic product
H	Isoniazid
HIV	Human immunodeficiency virus
PHC	Primary health care
R	Rifampicin
S	Streptomycin
SCC	Short course chemotherapy
T	Thiacetazone
OMA	Output maximisation analysis
QALYs	Quality adjusted life years
WHO	World Health Organisation
Z	Pyrazinamide
ZMoH	Zambia Ministry of Health
ZNTP	Zambia National Tuberculosis Program

Introduction

Tuberculosis and Acquired immune deficiency syndrome (AIDS) are probably the most baffling but important communicable diseases of this century because of the biology of tuberculosis and AIDS, their global impact, diverse modes of transmission, invariable fatality and the challenges posed to scientific research and researchers (Saunderson, 1995). Although both have been widely discussed by the Western media in recent decades, for a number of reasons, it is the combination of these two diseases in an ever increasing number that is of concern to health planners. While AIDS is untreatable and prevention of further infection largely depends on changes in sexual behaviour, tuberculosis remains eminently treatable depending on the control strategy of active cases and on the drugs used (Saunderson, 1995).

In recent decades, Zambia has been experiencing an increase in the number of tuberculosis cases. While technical advances employed in developed countries have the potential to reduce the number of tuberculosis cases reported in Zambia each year, a constrained budget prohibits the government from importing such technology. Thus, there is need to put to the best use any resources available in the country for what may appear to be trivial changes, but which could lead to significant gains in both compliance and the cure rates in the management of tuberculosis. This can only be done by using the most optimal program design for the control and management of tuberculosis.

The present study reports on the cost-effectiveness of community-based DOT in a low income country. Community based-DOT is compared with conventional care and cost data are collected for both the patient and the health system. The cure rate is used as the measure of effectiveness and cost-effectiveness is determined by the cost per case cured.

Chapter One

Background Information

1.1 Country setting

Zambia is in central-southern Africa covering an area of 752,610 square kilometres. It is a landlocked country and shares common borders with the Democratic Republic of Congo, Tanzania, Malawi, Mozambique, Zimbabwe, Namibia and Angola.

The total population in 1991 was approximately 8 million people of which 55% is found in urban areas. The country's growth rate is 3,2 % and the population density is 12 persons per square kilometre. A total of 48% of the population is under the age of 15 years. The birth rate in the country is 39,4 births per 1,000 persons; the death rate is 11,4 deaths per 1,000 persons; and the life expectancy is 59,4 years for males and 65,9 years for females. The infant mortality rate is estimated at 100 deaths per 1,000 persons. An estimated 65% of the population live within 15 kilometres of a health facility while 73% are within 8 kilometres (Central Statistics Office, 1996).

Health care in Zambia is provided by government institutions, religious missions, a number of parastatal companies, private practitioners, traditional healers and the armed services. Of these, the government has been the principal provider of care through a wide net work of health centres and hospitals followed by religious missions which provide approximately 30% of total hospital beds, mainly in district and general hospitals.

The Zambian economy has historically been based on the mining and export of copper. Between 1964 and 1975, copper mining and exportation accounted for approximately 95% of total export earnings. During this period the country's gross domestic product (GDP) growth rate was at its prime 8%. However, with the sudden drop in world copper prices in 1975, coupled with the early 1980s world recession, the Zambian economy has suffered one of the world's steepest and most sudden downturns (World Bank, 1993). Thus, in 1990 Zambia dropped from the middle-income category to that of low income. The GDP growth rate is currently at -4,5% (Central Statistics Office, 1996).

1.2 Statement of the problem

Like other sub-Saharan African countries, Zambia is faced with an increase in the number tuberculosis cases spurred on by the HIV/AIDS epidemic. In less than a decade, the reported number of cases has risen from 484 in 1989 to well over 1,000 cases per 100,000 of the population in 1995 (Central Statistics Office, 1996). This sharp increase in the number of cases reported has exerted pressure on the existing health system. Occupancy rates in most medical wards have exceeded 100% capacity. In 1994 alone, tuberculosis was responsible for more than 30% of all hospital admissions and 20% of all adult deaths (Central Statistics Office, 1996).

Prior to 1990, the Zambian government spent more than 20% of its budget on the treatment of tuberculosis alone (World Bank, 1993). Given that constrained resources preclude the construction of new wards or hiring of additional staff, coping with the increase in the case load is proving to be difficult. Health institutions have thus, been compelled to limit the number of times that a patient can be admitted or discharged patients before they are fully ambulant. The consequent results have been an increase in the number of tuberculosis cases, the development of multi-drug resistant and chronic tuberculosis (Zambia Ministry of Health, 1997).

Community-based DOT is the standard approach to care in the United States and some middle income countries (Floyd et.al, 1997). Though expensive, studies have shown that it is less costly than admissions and high cure rates have been achieved (Frieden et.al, 1995). For instance, Wilkinson and colleagues (1997), observed that the cost of managing a patient to treatment completion using community-based DOT in South Africa was only R3,156. This compared with an estimated cost of R8,978 for an approach which hospitalises patients for two months at the beginning of treatment. In addition, they also observed that the DOT approach is effective: 85% of patients complete treatment.

In March 1997, Chikankata mission hospital located in a rural setting in Zambia adopted such a program after the observation that (Siankanga, 1990):

- a) in rural Zambia the family is the most effective means of supporting the sick and of assisting the hospital in providing them with health care and psychological support;
- b) as the incidence of HIV/AIDS continues to grow rapidly, the decentralisation of health care is seen to be the only key to providing HIV-infected people with medical, nursing, spiritual, social and psychological support;
- c) taking care into the community would in itself have an educational effect on members of the family and the wider community. Thus, this would contribute to behaviour change and subsequently lead to a reduction in the levels of HIV infection in the long-run and;
- d) people with incurable illnesses prefer to die at home (Attawell, 1994).

Studies on the cost-effectiveness of community-based DOT treatment have been conducted in middle income countries in the past (see Barnum, 1986; Murray et.al, 1991 and Wilkinson et.al, 1997). The purpose of this study is to evaluate whether community-based DOT is an attractive economic option in a low income country such as Zambia.

The study compares costs to both the patient and the health system under two different program designs-community-based DOT and conventional care.

1.3 Objectives of the study

The specific objectives of this study are:

- a) to assess whether community-based DOT reduces the cost incurred by the health system;
- b) to determine whether community-based DOT reduces the cost incurred by the patient and;
- c) to determine the most cost-effective strategy in the management of tuberculosis to both the patient and the health system.

1.4 Justification and significance of the study

Given the prevailing economic situation of the 1990's, the Zambian government is no longer able to support any additional pressure exerted on its health system. More seriously, the current practice of many health institutions faced with limited budgets is feared to further lead to an increase in the number of tuberculosis cases. Limiting the number of times a patient can be admitted or discharging patients who are not fully ambulant so as to visit their nearest health clinic for their DOT may result in the further transmission of tuberculosis in the community, the development of multi-drug resistant tuberculosis and also the development of chronic tuberculosis.

Studies done in both South Africa and Botswana, (two middle income countries) have shown that community-based DOT is an economically viable option in a resource constrained setting (Floyd, 1997; Murray et.al, 1991). Further, these studies have also revealed that community-based DOT can reduce the number of tuberculosis cases and

cure over 85% of cases (Wilkinson et.al, 1997). Whether this option is also economically viable and effective in a low income country, faced with limited resources and an increase in the number of tuberculosis cases, is to be seen. The study attempts to answer the question whether the integration of DOT into the community is the most cost-effective health intervention available in Zambia.

The findings of the study may be fed into the policy development plans of the Ministry of Health, non-government organisations and other private health sectors in the country in their attempt to reduce the number of tuberculosis cases.

1.5 Organisation of the study

The remaining chapters of the study are organised as follows:

Chapter two begins by presenting basic characteristics of tuberculosis. Thereafter, an epidemiology of the tuberculosis situation in the country is highlighted. Issues such as tuberculosis cases and case rates, age and sex distribution of smear positive tuberculosis, hospital morbidity costs, inpatient mortality, types of tuberculosis and measurements of its control are presented.

Chapter three presents a conceptual framework for a cost-effectiveness analysis. A summary of the various tools used in economic evaluation with emphasis on cost-effectiveness analysis is given. The various costs and measures of effectiveness included in a cost-effectiveness are also presented. A summary of the methodological issues surrounding an economic evaluation are highlighted and finally a critical appraisal of studies conducted in South Africa, Botswana and Uganda on the cost-effectiveness of alternative tuberculosis management strategies is given.

Chapter four presents the methodology used in the study. A description of the setting and population sample is presented. The type of cost data collected and measure of effectiveness used is outlined. Finally, an outline of the proposed cost and cost-effectiveness analysis is presented.

The results in terms of the average health system cost, average patient cost and total costs are presented in chapter five. Results of cost-effectiveness and resource use are also given.

Chapter six is a discussion of the results in terms of health system costs, patient costs, cost-effectiveness and resource use. The likely policy implications of the findings are given. Limitations of the study and conclusions are also explored.

Chapter Two

Characteristics and Epidemiology of Tuberculosis and Measures of its Control

The aim of the chapter is to present the basic characteristics of tuberculosis, its epidemiology and measures of its control as applied in Zambia.

2.1 Basic characteristics of tuberculosis

The present study defines tuberculosis in agreement with previous studies (e.g. Glatthaar, 1982; McIntyre, 1987) as:

“...a chronic infectious disease which is caused by specific mycobacterium and is characterised by the formation of lesions in any tissue or organ of the body, but mainly in the lungs.”

Using the framework of the above definition, and in line with McIntyre, (1987):

- a) the tubercle bacilli (M Tuberculosis) is transmitted through inhalation and ingestion. When a person with infectious tuberculosis coughs or spits, another person who inhales the droplets which contains the bacilli is likely to contract the disease.
- b) the tubercle, once transmitted to an uninfected person, causes a ‘primary infection’ in the mid-lung region, and later a ‘secondary focus of infection’ develops in one of a number of possible tissues and organs. In most cases, this occurs in the apices of the lungs and hence, called pulmonary tuberculosis.

c) most people are able to combat the infection with their cellular defence mechanisms and develop a natural resistance to further infection. However, in cases where this process is not completed, living bacilli may remain in the lesion which can be reactivated at a later stage under certain predisposing conditions (McIntyre, 1987, pp. 20-22).

2.2 Epidemiology of tuberculosis in Zambia

This section presents the epidemiology of tuberculosis in Zambia. Definitions of common terms used to describe tuberculosis are given. Most of the data presented in this section is derived from the Central Statistics Yearly Bulletin, 1996.

2.2.1 HIV seroprevalence and tuberculosis

The HIV situation in Zambia has had a major impact on the number of tuberculosis cases currently being experienced. HIV seroprevalence in the country is among the highest reported in the sub-Saharan region. Serosurvey results among pregnant women in three sites in 1992 showed 38% were HIV positive. A repeat survey in 1993 in seven sites showed rates of seropositivity of 42,5%.

Limited data are available on HIV seroprevalence among tuberculosis patients. However, data from an HIV Sentinel Surveillance conducted in 1996, reported that 64% of all reported tuberculosis cases were also infected with HIV/AIDS.

2.2.2 Tuberculosis cases and case rates

A case of tuberculosis refers to a patient whose disease has been bacteriologically confirmed (Central Statistics Office, 1996). In 1992, 4,179 cases of tuberculosis were

reported in Zambia. Available rates reveal that case rates declined continually until 1990, when they began to rise. The rate increased from 202/100,000 in 1990 to 326/100,000 in 1993 which is a 6,1% increase. Tuberculosis case rates in Zambia are reported to be amongst the highest in sub-Saharan Africa (Central Statistics Office, 1996).

2.2.3 Smear-positive tuberculosis case rates

Smear-positive refers to tuberculosis cases that are infectious. The more strongly positive, the more infectious the patient is said to be. The rate of smear-positive disease in 1993 was 611/100,000. There has been considerable variation in the rates of smear-positive by province in the country, ranging from a low rate of 116/100,000 to a high of 982/100,000 during the same year. These differences are due to both local differences in disease rates as well as differences in the practice of sputum smears. Smear-positive tuberculosis rates in Zambia are also amongst the highest in sub-Saharan Africa (Central Statistics Office, 1996).

2.2.4 Age and sex distribution of smear-positive cases

The male to female sex ratio for the period 1987-92 was reported as 1,9:1. The distribution of smear-positive cases tends to increase with age with the greatest increase in cases experienced between the age group 20-29 years. This age and sex distribution of smear-positive cases in Zambia is similar to that experienced in Botswana (Zambia Ministry of Health, 1997).

2.2.5 Hospital morbidity and mortality

In 1986, tuberculosis was the sixth leading cause of inpatient morbidity accounting for 4,7% of all hospital admissions. In 1991, it was the fifth leading cause accounting for 4,3% of admissions. During this period, nearly 3 out of 4 patients were hospitalised for at least part of the treatment.

In both 1986 and 1991, tuberculosis was also the leading cause of inpatient mortality, accounting for 11,7% and 9,1% of reported inpatient deaths respectively.

2.2.6 Types of tuberculosis

The vast majority of tuberculosis cases treated by the Zambia National Tuberculosis Program (ZNTP) are pulmonary in nature. In 1992, extra-pulmonary cases accounted for 10,8% of the total cases. Most of the cases reported are new rather than relapse cases. In 1994, relapses accounted for only 3,7% of all pulmonary cases.

2.2.7 Sputum analysis among pulmonary cases

Sputum analysis is a bacteriological investigation used to detect persons infected with tuberculosis. The percentage of persons with pulmonary tuberculosis who have had sputum examination has increased over the years. In 1996 the percentage of new pulmonary tuberculosis patients who had an initial smear investigation was 60% compared to only 40% in 1992.

2.2.8 Outcome of treatment

The outcome of tuberculosis treatment is determined by both the compliance and cure rates. The compliance rate is defined as the total number of days attended divided by the total number of days that a patient should have attended (Central Statistics Office, 1996).

Similarly, the cure rate is defined as the total number of cases cured divided by the total number of tuberculosis cases (Central Statistics Office, 1996).

The overall compliance and cure rates for smear-positive new cases have improved markedly over the years. This is largely due to the change in treatment regimens from long to short drug regimens. In 1997, compliance rates had increased from 55% in 1989 to 85%. Likewise, cure rates had improved from 45% to 68% during the same time period for the entire country.

2.3 Measures of tuberculosis control in Zambia

This section presents the various tuberculosis control strategies used in Zambia.

2.3.1 Conventional care

Prior to 1990, treatment of tuberculosis in Zambia was widely based on 2 months of inpatient care. This lengthy hospital admission was to ensure patient compliance during the most intensive phase when the patient was most infectious. During this period, streptomycin was an integral part of the treatment regimen.

At the time of discharge, the patient was given a one month supply of drugs and instructed to subsequently collect drugs once a month from the nearest health clinic for the remaining treatment period. The patient was also instructed to collect sputum examinations every two months of treatment (2, 4 and 6 months).

Drug regimens under this approach to care have varied throughout the country. However, it is assumed that a six month course was used as recommended by the World Health Organisation (WHO). This consists of two months of isoniazid (H), ethambutol (E), pyrazinamide (Z) and rifampicin (R), followed by four months of R and H.

2.3.2 Directly observed treatment (DOT)

With the increase in the number of tuberculosis cases reported a revised treatment program based on shorter drug regimens and reduced hospital stay was introduced in 1991 (commonly referred to as short course chemotherapy (SCC)). The revised treatment program involves 2 months of isoniazid (H), rifampicin (R), pyrazinamide (Z) and streptomycin (S) followed by 4 months of RH.

The program was directed towards enhancing outpatient care as opposed to inpatient care. Thus, it placed emphasis on: immunisation with BCG, case finding and contact tracing, case holding and supervision of treatment, health education and community mobilisation, and staff training. Some of these components are discussed below.

2.3.2.1 *Immunisation with BCG*

Immunisation with BCG is an integral part of tuberculosis control in Zambia. Children are vaccinated at birth, at the age of three months if no scar is visible and when they enter school.

2.3.2.2 *Case finding and contact tracing*

Identifying persons infected with tuberculosis is done using various techniques. In Zambia, three techniques are commonly used. These are:

- a) chest X-rays - radiological investigation is used extensively as a means of case finding or contact tracing. Chest X-ray investigations are performed on every adult suspected to have tuberculosis. On average a patient may have 4 to 5 X-rays performed.
- b) bacteriological investigation - adult patients and suspects are asked to produce a sputum specimen for laboratory investigations. The sputum undergoes two examinations to establish whether tubercle bacilli are present. In the first test - direct microscopy - a slide of a smear of the sputum is prepared and microscopically examined soon after the specimen is obtained. In the second test - sputum culture - a culture of the sputum is derived before examination (McIntyre, 1987; p.43).
- c) tuberculin testing - in the screening and diagnosis of tuberculosis in children, the Heaf tuberculin test. This is done by injecting an active ingredient referred to as Tuberculin PPD into the epidermis by means of a spring-loaded 'gun'. According to the size of the induration, a grading system is used to classify the result (McIntyre, 1987; pp.43-4).

2.3.2.3 *Case holding and supervision of treatment*

The program aims at increasing both the compliance and cure rates. Thus, emphasis is placed on direct supervision of at least 6 of the 7 weekly doses. Supervision of treatment can be undertaken by a nurse or clinician based in a hospital or health clinic, or by a community health worker (CHW) based in the community.

Patients suspected to have tuberculosis have their diagnosis confirmed by investigating 2 to 3 sputum samples. Once a case has been confirmed, depending on their clinical conditions, patients are asked to remain in hospital for at least 3 three weeks. The average length of stay in hospital in 1997 was 17,5 days.

While in hospital patients are helped to choose a supervisor who can continue to administer treatment after discharge. Emphasis is placed on choosing a supervisor who makes accessing of treatment convenient for the patient.

After discharge, patients are required to take their drugs on an intermittent basis. Thus, a patient visits his supervisor twice in a week and 48 times during the entire treatment period.

Supervisors are supervised by a senior doctor and the tuberculosis co-ordinator. Each month they make a visit to the patients' supervisor to check on compliance and collect outcome data.

The effectiveness of supervised treatment has been established in previous studies. According to Murray et.al (1991), a fully supervised short course treatment achieves better results in terms of cure rates and relapse rates than the conventional approach of long inpatient stay and long drug regimens.

2.3.2.4 *Health education*

Health education is aimed at creating greater awareness of the symptoms of tuberculosis within the community so as to encourage infected persons to present themselves at a clinic for investigation (McIntyre,1987). Health education is directed towards both supervisors and tuberculosis patients.

2.4 Summary

In this chapter tuberculosis was defined as a chronic infectious disease caused by a specific mycobacterium. The number of tuberculosis cases reported in the country have been increasing over the years spurred on by the AIDS/HIV epidemic. Tuberculosis was reported as one of the leading causes of inpatient morbidity and mortality. The age group severely infected is between 20-29.

Prior to 1990, the control and treatment of tuberculosis was largely based on lengthy hospital admissions and long drug regimens. With the increase in case loads and low patient compliance coupled with low cure rates, a revised treatment regimen based on SCC was introduced in 1991. The success of this program is based on full supervision of at least 6 of the 7 weekly doses. Supervision of treatment is undertaken by nurses or clinicians based in hospitals or health clinics or by CHWs based in the community.

Chapter Three

Conceptual Framework for Cost-Effectiveness Analysis

Introduction

Many times decisions have to be made on how best to use scarce resources within the health sector. Health economists use various tools of economic analysis to aid them make such decisions. The aim of this chapter is to provide a conceptual framework for the evaluation of a health care program.

3.1 Premise of economic evaluations

Health economists realise that health producing resources are scarce. Thus, other than making decisions based on 'educated guesses', 'gut feelings', and 'what we did last time', health economists prefer an organised and systematic consideration of the factors involved in a decision to commit resources to one use. One of such consideration is conducting an economic evaluation.

An economic evaluation addresses questions of allocative and technical efficiency. Thus, it concerns itself with issues such as whether or not to allocate resource to a given program or whether or not to allocate more or less of the available resources.

There are basically five tools of economic evaluation - namely cost-minimisation analysis (CMA), output maximisation analysis (OMA), cost-effectiveness analysis (CEA), cost-utility analysis (CUA) and cost-benefit analysis (CBA). A description follows.

3.2 Forms of economic evaluation

The various tools used in an economic evaluation are presented below.

3.2.1 Cost and cost-minimisation analysis (CMA)

A CMA is used when the case for an intervention has been established and the programs or procedures under consideration are expected to have the same, or similar, outcomes. Given these circumstances, attention is focused on the cost side of the equation to identify the least costly option.

3.2.2 Cost-benefit analysis (CBA)

A CBA is the most comprehensive method of economic evaluation which places monetary values on both costs and consequences of health care. It is used in cases where both costs and consequences of programs or procedures vary, but are expected to have the same or similar outcomes.

CBA can be applied in two ways. The human capital approach means that the value of people's contributions is linked to what they are paid. The approach based on individual's observed or stated preference means that their personal valuations are placed on an activity by assessing how much money they are prepared to accept for an increased risk or to pay for a particular service. Each method has its disadvantages, but the most successful has been observed to be the 'willingness to pay' approach (Robinson, 1993).

3.2.3 Cost-utility analysis (CUA)

This approach is also used when costs and consequences of alternatives differ even when interventions have the same or similar outcomes. It measures costs in monetary terms and consequences in terms of quality adjusted life years (QALYs). CUA allows the impact of interventions on both mortality and morbidity to be assessed at the same time.

3.2.4 Output-maximisation analysis (OMA)

OMA involves identifying the health care option with the highest amount of expected output under a given level of resource endowment. Thus, the problem facing a decision maker opting to use this tool is: 'Given that the options under evaluation have equal cost, which option promises the highest level of output?'

3.2.5 Cost-effectiveness analysis (CEA)

CEA involves comparing two or more alternative programs or procedures. Costs are measured in monetary terms, while consequences are measured in their natural units. This tool of analysis is further discussed below.

3.3 Cost-effectiveness analysis (CEA)

The term cost-effectiveness analysis refers to evaluations that measure outcomes of alternative programs in natural units. When different health care interventions do not produce the same outcomes, the costs and consequences of the options are assessed under a cost-effectiveness analysis (Robinson, 1993). This means that the costs will be

compared with outcomes which are measured in their natural units, such as, per life saved, per life year gained, per pain or symptom free day or per case cured.

In order to conduct a cost-effectiveness analysis appropriate measures of costs and effectiveness are needed. These will depend on the objectives of the particular interventions under review. In most cost-effectiveness analysis, measures of effectiveness are defined in appropriate natural units and expressed in a single dimension while the costs included are defined by the perspective of the evaluation - such as the societal, institutional (health system) and or parental (community) point of view (Drummond and Stoddart, 1985). Costs and measures of effectiveness included in a cost-effectiveness analysis are discussed below.

3.3.1 Types of costs

A cost is defined as any loss of utility or welfare resulting from the project (see McIntyre, 1987). The choice of cost items included in a cost-effectiveness analysis depends on the perspective from which the evaluation is being conducted. If the evaluation is being made from the widest perspective viz., the view point of society, then three main categories of costs are considered. These are:

- a) *Organising and operating costs within the health sector:* These include clinicians, nurses, ancillary staff and support staff time; administrative time; materials and supplies; drugs; maintenance of equipment, vehicles and buildings; transport and travel; utilities-telephone, postage, water, power; capital costs-plant and equipment, vehicles and buildings.
- b) *Costs borne by the patients and their families:* These include - (i) out of pocket expenses e.g. consultation fees, laboratory test fees, x-ray fees, drug fees, other user fees, hospitalisation fees, registration fees, transport expenses; (ii) patient

and family inputs into treatment, e.g. special diet expenses, drugs, needles, syringes and materials; (iii) time lost from work e.g. production losses, travel time, waiting time, consultation time, hospitalisation time and; (iv) intangible costs or psychic costs, e.g. pain, anxiety and stress. Costs described in (i) and (ii) are direct costs, while those in (iii) and (iv) are indirect costs.

- c) *External costs*: These are costs borne externally to the health sector, patients and their families as well as other stake-holders e.g. employers, other ministries and other people in the neighbourhood whose welfare is affected adversely by the presence of the health care intervention.

3.3.2 Measurement of costs

Once the range of costs has been identified individual items need to be measured and valued. Most direct cost items are valued using market prices based on the notion that, where markets are operating perfectly, prices reflect the opportunity cost of the given resource (Drummond and Stoddart, 1985). For example, staff time can be valued at the appropriate hourly rate and medical supplies can be valued at the prices charged by suppliers.

Capital costs are valued differently since they represent investments at a single point in time, often at the beginning of the intervention rather than annual sums. Thus, capital costs have two cost components (Drummond and Stoddart, 1985):

- (a) opportunity cost of funds tied up in the capital asset - which can be valued by applying an interest rate and;

- (b) depreciation costs - which can be measured and valued by annuitizing initial capital outlay over the useful life of the assets, i.e., calculating the equivalent annual capital cost.

However, where market rates such as rentals of buildings or lease of equipment exist, they may be used to cost capital.

Indirect costs, on the other hand, for which there are no market prices, are valued using 'shadow prices'. For example, the time a patient spends in hospital thus, displacing work time can be valued using the relevant wage to value lost time.

3.3.3 Allocation of shared costs

Shared costs refer to those resources that serve many different programs. These include administration and medical record costs. When obtaining cost data for a cost-effectiveness analysis, such costs need to be allocated appropriately. There are various approaches that can be used to do this. However, this study uses the direct allocation approach which entails that each overhead cost is allocated directly to final cost centres. For example, a programs' allocated share of central administration can be said to be equal to central administration cost times that programs proportion of the allocation basis which could be paid hours (see Drummond and Stoddart, 1985). The disadvantage of allocating costs using this method is that it may lead to an underestimation of costs in all final cost centres.

3.3.5 Measures of effectiveness

Common measures used in several studies have been 'lives saved' and 'life years gained' (Robinson, 1993). Murray et.al (1991) in their study of the cost-effectiveness of SCC for

tuberculosis treatment in Botswana measured effectiveness in terms of deaths averted and years of life saved.

On the other hand, Floyd et.al (1997) and Saunderson (1995) used the bacteriological cure rate as their measure of effectiveness in their studies of the costs and cost-effectiveness of alternative tuberculosis management strategies in South Africa and Uganda respectively.

Other measures of effectiveness include the compliance and default rates resulting from alternative drug regimens in the treatment of tuberculosis (Kumaresan and Maganu, 1992) and the number of cases successfully treated for tuberculosis after the use of alternative drug regimens (Barnum, 1986).

3.3.6 Obtaining effectiveness data

Effectiveness data can be obtained in a number of ways. However, the most ideal is to integrate clinical trials into the evaluation in order to collect relevant data on costs and effectiveness at the same time (Drummond and Stoddart, 1985). The only problem is that setting up and conducting appropriate trials may be time consuming and expensive. As a result, many cost-effectiveness analysis rely on the existing medical literature for their data. However, if neither specifically designed clinical trials nor the existing work provide the necessary data in full, an evaluation may make assumptions about clinical evidence (Drummond and Stoddart, 1985). This however, may require that the results be subjected to a range of different assumptions about effectiveness through sensitivity analysis discussed in detail below.

Barnum (1986), obtained his effectiveness data by building a clinical trial into his cost-effectiveness analysis of tuberculosis management in Botswana. Likewise Floyd and colleagues (1997), collected effectiveness data by integrating clinical trials into their

study. However, Murray et.al (1991), collected similar effectiveness data from previous studies conducted in Malawi, Mozambique and Tanzania.

3.3.7 Uncertainty and sensitivity analysis

Sensitivity analysis is a reworking of the analysis using different assumptions on the values to be assigned to variables about which there is uncertainty or methodological controversy (Drummond and Stoddart, 1985). The objective is to ascertain whether the different assumptions have any impact on study results. If the results are sensitive to the estimates assumed, further work may be justified to improve the accuracy of estimates. This section describes the various sensitivity analysis that can be undertaken.

3.3.7.1 *Risk averse strategy*

The risk averse strategy is used when comparing a new technology with an established one. It entails loading the assumptions against the new technology whenever uncertainty arises (Warner and Luce, 1982). Given that the new technology emerges as the preferred option, even after the assumptions have been staged against it, some confidence can be placed in the results (Robinson, 1993). Such an approach was used by Culyer and Maynard in their study of the relative cost-effectiveness of surgery versus the then new option of cimetidine in the treatment of duodenal ulcers (Culyer and Maynard, 1981). Despite the system loading of assumptions in favour of surgery, they concluded that it was more cost-effective when the choice was clinically acceptable.

3.3.7.2 *Sensitivity Analysis*

Another approach to uncertainty about the costs effectiveness of different procedures is to use sensitivity analysis. This permits the robustness of the results to be tested in light

of the variation in the values of key variables. There are different forms of sensitivity analysis (i.e. Briggs et.al, 1993):

- a) *Simple sensitivity analysis* entails varying one or more of the components of an evaluation to see how it affects the results. For example, Sculpher and colleagues varied both the lengths of inpatient stay and the hospital costs per inpatient day in their study of alternative treatments of menorrhagia (Sculpher et.al, 1993).
- b) *Extreme scenario* is another form of sensitivity analysis. Thus, if two treatments are being compared this approach would seek to identify extreme estimates of cost and effectiveness so that the two options can be compared under pessimistic (high cost and low effectiveness) and optimistic (low cost and high effectiveness) assumptions.
- c) *Probabilistic sensitivity analysis* assigns ranges of distributions to variables, and computer programs are used to select values, at random, from each range, and to record the results. The advantage of this approach is that it can simultaneously deal with a large number of variables and indicate the degree of confidence that can be attached to any option.

By using these different methods of sensitivity analysis it is possible to show whether the results of a particular study are accurate over a range of assumptions (Warner and Luce, 1982). However, many studies do not include sensitivity analysis. According to Robinson (1993), an audit conducted by Udvarhelyi et.al (1992), of 77 articles appearing in American general medical, general surgical, and medical subspecialty journals over two periods 1978-80 and 1985-87 found that, despite the frequent citation of limitations underlying assumptions, sensitivity analysis was applied in only 30 per cent of the studies reviewed.

3.4 Limitations of cost-effectiveness analysis

Cost-effectiveness analysis as a tool of an economic evaluation has limitations. Some of these limitations as reported by Drummond and Stoddart (1985) follow:

- a) it cannot resolve the problem of option selection each time different options yield more than one kind of beneficial effect with the mix of benefits differing between options;
- b) it gives no guide as to whether interventions should be implemented at all even though it is possible to rank order options to meet a specific objective and;
- c) it cannot be used to compare the benefits of an option with its opportunity cost.

3.5 Methodological issues in economic evaluations especially CEA

Consistent with the present framework, 10 methodological issues of Drummond and Stoddart model can be drawn. These are presented in the table below.

TABLE 1: METHODOLOGICAL ISSUES IN ECONOMIC EVALUATIONS

<p>1. Was a well-defined question posed in answerable form?</p> <p>a) Did the study examine both costs and effects of the program(s)?</p> <p>b) Did the study involve a comparison of alternatives?</p> <p>c) Was a viewpoint for the analysis stated?</p>	<p>6. Were costs and consequences valued credibly?</p>
<p>2. Was a comprehensive description of the competing alternatives given?</p>	<p>7. Were costs and consequences adjusted for differential timing?</p>
<p>3. Was there evidence that the programs' effectiveness has been established?</p>	<p>8. Was an incremental analysis of costs and consequences of alternative performed?</p>
<p>4. Were all relevant costs and consequences included?</p>	<p>9. Was a sensitivity analysis performed?</p>
<p>5. Were costs and consequences measured accurately using in appropriate physical units?</p>	<p>10. Did the presentation and discussion of the results of the study include all issues of concern to users?</p>

Adapted from Drummond & Stoddart (1985)

3.5.1 Appraisal of published cost-effectiveness articles

This section aims at using the Drummond and Stoddart's 10 points criteria to review some studies on cost-effectiveness. Articles reviewed were selected because of their relevance to the current study, measured in terms of the type of health care interventions compared in the studies, the perspectives adopted and similarity in economic backgrounds. The articles reviewed are:

- (a) Wilkinson et.al (1997), a study conducted in Hlabisa South Africa a middle income country;
- (b) Saunderson (1995), conducted in Uganda a low income country and;
- (c) Barnum (1986), conducted in Botswana another middle income country.

A summarised review of the three studies is presented in Table 2 below. From the table, it appears all the three studies have met most of the 10 criteria originally suggested by Drummond and Stoddart (1985). The results in each study indicate that the most cost-effective strategy is that which emphasises outpatient care. It is also clear from the conclusions in each study that outpatient care improves both compliance and cure rates. From Table 2 below and information on the economic background of each country sampled in the studies reviewed, it is revealed that no study has yet been conducted to determine the cost-effectiveness of alternative tuberculosis control programs in a low income developing country utilising both the health system and patient view points. The present study is the first to comprehensively test the validity of the cost-effectiveness of alternative tuberculosis management programs in Sub-Saharan Africa as theoretically defined by Drummond and Stoddart model.

TABLE 2: A REVIEW OF PREVIOUS COST-EFFECTIVENESS STUDIES

	Wilkinson et.al, (1997)	Saunderson, (1995)	Barnum, (1986)
Objective(s)	(a) Cost-effectiveness analysis of DOT strategy and; (b) project costs of alternative strategies.	(a) Evaluate effectiveness of alternative strategies in tuberculosis management	(a) Cost-effectiveness analysis of alternative tuberculosis drug regimens
Perspective(s)	(a) Health system (b) Patient	Patient view point	Health system
Options	(a) DOT (b) National strategy (c) Sanatorium care	(a) Inpatient care (b) Outpatient care	(a) Long treatment drug regimen (TH); (b) Short treatment drug regimen (R or E)
Cost-effectiveness measurement	Cost per case cured	Cost per case cured	Cost per case cured
Cost measurement	(a) Direct health system and patient costs (b) Indirect patient costs - time lost from work	(a) Direct costs - travel costs (b) Indirect costs - time lost from work	Direct costs incurred by the health care system
Results	DOT is the most cost-effective strategy	Outpatient care is the most cost-effective	Short term drug regimen is most cost-effective
Conclusion(s)	(a) DOT reduces patient and health system costs and; (b) improves compliance and cure rates.	(a) Outpatient care reduces cost to patients and; (b) improves compliance and cure rates	(a) Short term drug regimens reduce health system costs and; (b) improve compliance and cure rates

3.6 Summary

The chapter provided a conceptual framework for a cost-effectiveness analysis. Cost-effectiveness analysis has been described as a form of economic evaluation in which the costs of alternative procedures or programs are compared with outcomes measured in natural units.

Cost data included in a cost-effectiveness analysis depends on the perspective adopted by the study. The widest perspective is the societal view point. Cost items need to be valued and measured in their appropriate units. Direct costs are valued using market prices, while indirect costs are valued using shadow prices. Capital costs are valued using interest or discount rates.

Effectiveness data are collected from economic evaluations built in alongside clinical trials. In the absence of clinical trials, effectiveness data can be obtained from existing published work.

Sensitivity analysis is applied when there is uncertainty about the costs and effectiveness of different programs. This analysis investigates the extent to which results are sensitive to alternative assumptions about key variables.

The articles reviewed met most of the methodological issues as defined by Drummond and Stoddart (1985). The review of previous cost-effectiveness studies reveals that no study has yet been conducted to determine the cost-effectiveness of alternative tuberculosis control programs in a low income country especially in Africa, based on both patient and health system perspectives.

Chapter Four

Methodology

Introduction

This chapter presents the methodology used in this study. These include a description of the setting for the study, the type of data sets utilised in the study and their source. The size and the criteria of selecting the sample population is also highlighted.

4.1 Setting

The study was based at a rural mission hospital run by the Salvation Army of Zambia in Chikankata - Mazabuka district. This hospital is situated 130 kilometres south of Lusaka. It has a bed capacity of 240 beds and renders services in leprosy, tuberculosis, ophthalmology, primary health care (PHC), nutrition and AIDS. It also runs three rural health clinics within its catchment area. The hospital serves a population of approximately 100,000 which lives within an 80 kilometre radius. The main source of income for the people living within the catchment area is peasant farming, teaching in surrounding government schools and working as farm labourers.

The total number of tuberculosis cases reported in the site of study in 1991 was 549, representing one of the highest rates in the country. Thirty-five percent of these cases were reported between the age group 0-14. The hospital has a tuberculosis co-ordinator who is responsible for surveillance of tuberculosis in the area and maintains the tuberculosis register.

The mission hospital was selected as a site of study for the following reasons:

- a) the hospital has the oldest and most successful home-based care programs in the country;
- b) the hospital is the only health institution in the country that has in place community-based DOT and;
- c) the hospital has a reliable data base.

4.2 Perspective of the study

The study adopted a societal viewpoint. Cost data were collected for both the health system and the patient. The alternatives reviewed were community-based DOT and conventional care. The cost data, effective data, source of data and selection of the sample population included in each of the alternatives reviewed are presented below.

4.3 DOT data collection

This sub-section gives an overview of the type of data, source of data and the criteria utilised in the selection of the study sample.

4.3.1 Population sample

A random sample of 50 patients (representing 9,12% of the total number of tuberculosis cases reported) was selected from the 1997 tuberculosis register. Age range was 13 through 76 years. All participants were ethnically Zambians and were randomly matched within sex and age constraints from largest existing tuberculosis data sets in the hospital.

The participants were not having difficulties with English as a second language. The criteria used included:

- a) patients managed on the adult wards (i.e. over 13 years of age), since it is on these wards that the problem of bed capacity exists;
- b) new adult patients diagnosed with all forms of tuberculosis and;
- c) patients who received their DOT within the hospitals' catchment area.

The locally validated questionnaire used for the study was administered to the participants at home in English. The research project had previously been explained to the participants. Completion of the self-report instrument was preceded by a thorough explanation of the response format, accompanied by a demonstration of several relevant examples.

Hospital records relating to this sample group were reviewed and the following information was gathered (McIntyre, 1987):

- a) personal details;
- b) process by which tuberculosis was discovered;
- c) results of diagnostic tests;
- d) length of stay in hospital;
- e) treatment regimen;
- f) number of investigations;
- g) compliance to treatment and;
- h) cure rates.

4.3.2 Data collection for costing

Cost data were collected for both the hospital and the patient. The data included:

a) *Health system costs:* Cost data were collected for the entire treatment period. The data included - the cost of a day in hospital, a hospital or health clinic visit, sputum smear examinations, drugs, administration and, organisation and supervision of supervisors. Most of the data were obtained from hospital expenditure records, hospital planning and financing units, vehicle logbooks, hospital staff list, hospital payroll print-outs, central medical stores and private sector laboratory charges.

Capital cost data were also obtained by quoting 1997 purchase prices. The expected useful life for a vehicle, equipment and buildings were also taken into account and the discount rate recorded.

b) *Patient costs:* Patient costs in terms of travel and time costs were recorded from questionnaires administered to a sample of 50 respondents. Time costs were translated into monetary costs using monthly incomes reported in the questionnaire.

4.4 Conventional approach data collection

For comparison, hospital cost data were obtained for the year 1989 before the introduction of DOT. The type of data, source of data and the criteria used in the selection of the population sampled are outlined below.

4.4.1 Population sample

A population sample of 50 patients or participants (representing 15% of the total number of tuberculosis cases reported) was selected from the 1989 tuberculosis register. The criteria applied in the selection of subjects is similar to that outlined in sub-section 4.3.1. Patient folders were searched and information collected were similar to those presented in sub-section 4.3.1.

4.4.2 Data collection for costing

Cost data were collected only for the health system, which were similar to that presented in the sub-section 4.3.2. The sources were used as indicated in the same sub-section.

4.5 Effectiveness measure

Since the WHO measure of success is the cure rate, it was used in this study as the measure of effectiveness. The cure rates used under conventional care and DOT were 65% and 85% respectively. Sources of this data included the patients' folder and the tuberculosis registers.

4.6 Cost analysis

Costs associated with managing tuberculosis patients in each strategy were collected for the entire tuberculosis treatment period. The actual components of each strategy were similar - hospital stay, sputum examination, outpatient or supervisor visits, supervision of supervisors, drugs and, program management. The only variations that existed were

whether each component was included in the strategy, the detail of each component (e.g. type of drug regimen) and its relative importance (e.g. length of hospital stay).

The analysis focused on average costs alone, thereby excluding to calculate any marginal costs. According to Wilkinson et.al (1997) average costs give a better indication of the overall cost of a program which allows for a more rigorous comparison than marginal costs.

The average cost of a day in hospital, a hospital visit, a health clinic visit, a visit to the CHW, sputum smear, drugs, arrangements for supervision and supervision of supervisors and, administration were calculated. Average costs for recurrent items such as x-rays, drugs and, sputum tests were calculated using cost data obtained from Central Medical Stores.

Annual capital costs were calculated using quoted 1997 prices. The expected useful life years for vehicles, equipment and buildings were assumed to be 5, 10 and 25 years respectively. A discount rate of 8% used by the Ministry of Finance for project appraisals was used for annualization of capital costs.

Shared costs were allocated using the direct allocation approach. Thus:

- a) 95% of the costs of administrative and support staff and of capital costs were allocated to inpatient care and;
- b) 5% to outpatient care since staff involved in direct outpatient accounted for 5%.
- c) 5% was allocated to laboratory costs since 5% of the total number of laboratory tests done in 1997 were tuberculosis investigations.

In order to calculate the average cost incurred by the patient in terms of travel and time costs, questionnaires administered to 50 respondents were examined. Time costs were

translated into monetary costs using monthly incomes reported in the questionnaire. The average monthly income reported was US\$113,21. All calculations assumed that patients worked 25 days a month and 8 hours a day. Average costs associated with visits to hospital and health clinics and for DOT by specific type of supervisory site were calculated.

4.7 Cost-effectiveness analysis

The cost data was analysed in combination with outcome data to calculate the cost-effectiveness indicator in terms of the cost per case treated. This was calculated for both the alternatives using the formula below (ZMoH, 1997):

$$(\text{Average cost per patient} \times 100) \div \text{Cure rate}$$

A sensitivity analysis was undertaken for those costs about which there was some uncertainty regarding their accuracy.

4.8 Summary

In order to carry out an economic analysis of the most cost-effective strategy used in the control and management of tuberculosis, DOT was compared with conventional care using patient and health system cost data. This meant that hospital cost data were collected for two different time periods, i.e.:

- (a) for the period 1989 just before the introduction of DOT and;
- (b) for the period 1997 after the introduction of DOT.

Hospital cost data collected included drug costs, administration costs, laboratory test costs, supervision costs, staff costs and capital costs. This was facilitated by reviewing a

number of documents such as patient folders, payroll printouts, vehicle logbooks, and other hospital records. Patient cost data collected included time and travel costs. These were obtained by analysing questionnaires completed by a population sample of 50 respondents.

Cost data under each strategy were manipulated to calculate average costs for the health system and patient. In order to determine the most cost-effective strategy, cost data were later analysed in combination with cure rates which were obtained from hospital records.

University of Cape Town

Chapter Five

Results

Introduction

This chapter presents the results. All cost data presented are converted to US\$ (dollar) using the conversion rate US\$1 = 1,325 Zambian Kwacha (ZK).

5.1 Average health system, patient and total costs

Calculations of the average health system costs, patient costs and total costs, showed that DOT is considerably cheaper than the conventional strategy. From Table 3 below, it is 2,6 times cheaper for the health system, 2,5 times cheaper for the patient and 2,6 times cheaper overall. In both cases, health system costs accounted for 92% of total costs.

It is also clear that admission to hospital is the most costly item. For DOT, it accounted for 72,6% of health system costs, 67% of patient costs and 73% of costs overall; for the conventional approach, it accounted for 92,2% of health system costs, 93,2% of patient costs and 92,2% of costs overall. The other important cost items were visits for DOT (13,2% of the total cost of the DOT strategy) and drugs (7,3% of the total cost of the directly observed treatment strategy). Arrangements for supervision and supervision of supervisors seemed to be relatively inexpensive, accounting for only 4,6% of the total cost of the DOT strategy.

TABLE 3: AVERAGE HEALTH SYSTEM, PATIENT AND TOTAL COSTS IN 1997 US\$ (PERCENTAGE OF TOTAL) FOR CURING ONE PATIENT WITH TUBERCULOSIS ACCORDING TO MANAGEMENT.

Cost Item	Health system costs		Patient costs		Total costs	
	DOT	Conventionally delivered treatment	DOT	Conventionally delivered treatment	DOT	Conventionally delivered treatment
Hospital stay	439,59 (73%)	1479,74(92,2%)	37,98(67%)	130,2(93,2%)	477,57(72,6%)	1609,94(92,2%)
Visits for DOT	79,2(13,2%)	N/A	18,72(33%)	N/A	97,2(14,8%)	N/A
Outpatient visits for sputum collection	N/A	31,38(2%)	N/A	5,4(4%)	N/A	36,78(2,1%)
Health clinic visits for collection of pills	N/A	27,83(1,7%)	N/A	4,05(2,8%)	N/A	31,88(1,8%)
Arrangements for supervision and supervision of supervisors	30,13(5%)	N/A	N/A	N/A	30,13(4,6%)	N/A
Drugs	48(8%)	54(3,31%)	N/A	N/A	48(7,3%)	54(3,1%)
Sputum examinations	N/A	7,5(0,47%)	N/A	N/A	N/A	7,5(0,4%)
Management and audit	5,14(0,8%)	5,14(0,32%)	N/A	N/A	5,14(0,7%)	5,14(0,3%)
Total	602,06	1605,59	56,7	139,65	658,04	1745,24

5.2 Average health system costs

The average health system costs are presented in Table 4 below.

TABLE 4: AVERAGE HEALTH SYSTEM COSTS IN 1997 US\$

Cost Item	Average Cost
Day in hospital (excluding drugs and laboratory tests)	24,66
Outpatient visits (excluding drugs and laboratory tests)	13,96
Health clinic visits (excluding drugs and laboratory tests)	5,23
Visit to CHW	0
Visit for DOT	1,65
Course of drug treatment:	
• DOT	48
• Conventionally delivered treatment	54
Arrangements for supervision and supervision of supervisors	30,13
Management and audit	5,14
Sputum smear testing	1,25

The most expensive item for the health system is drugs. However, differences in the cost of the drug regimens used were not large (between US\$48 for the DOT regimen and US\$54 for conventionally delivered treatment). The likely explanation for the high drug cost is the use of streptomycin in the treatment of tuberculosis in its early stages.

A sensitivity analysis performed on the cost of the different drug regimens showed no significant difference to that reported in the table above.

Supervision plays a pivotal role in tuberculosis management under community-based DOT. According to Table 4, the organisation of supervision and the supervision of supervisors were less than expected at US\$30,14 per patient. The average cost of a day in hospital is US\$24,66. Given that inpatient care at the mission hospital is very basic with food being provided by relatives of the patient, the cost reported is high. Also, the figure represents a minimal level of nursing supervision since much of the basic nursing care is done by relatives of the patient. Thus, if food was to be provided and the costs of full nursing supervision taken into account, this item of cost would be much higher.

Although the cost of drugs and laboratory investigations were omitted, average costs incurred by the health system in terms of outpatient visits for collection of sputum and monthly collection of pills are costly at US\$13,96. On the other hand, the average cost of health clinic visits for the monthly collection of pills is US\$5,23.

Each visit for DOT cost the health system an average sum of US\$1,55. In calculating this cost, it was assumed that 46% of the patients were supervised by staff in health clinics, 27% by CHWs and, another 27% by staff in the tuberculosis ward. This is according to 1997 data. The average cost of management and audit was US\$5,14. The least average cost estimated was US\$1,65 for sputum smear testing. Visits to CHW by patients cost the health system US\$0,00 because CHWs supervise treatment on a voluntary basis.

5.3 Average patient costs

The data for average patient costs calculated in terms of time and travel costs are presented in Table 5 below. Diagnosis and treatment of tuberculosis is free to the patient. However, most patients incur personal costs for transport and from lost income.

TABLE 5: AVERAGE PATIENT COSTS IN 1997 US\$

Cost Item	Travel Cost	Time Cost (equivalent in minutes)	Total Cost
Day in hospital	0	3,79(480) [†]	3,79
Hospital visit	0,82	5,13(540)	5,95
Health clinic visit	0,126	1,22(129)	1,35
Visit for directly observed treatment:			
• when TB ward chosen:	0,35	0,70(122)	1,05
• when health clinic chosen:	0	0,45(78)	0,45
• when community health worker chosen	0	0,14(15)	0,14
Average [‡]	0,2	0,2(20)	0,39

[†] It was assumed that 25 out of 30 days were worked. Thus, a day in hospital is equivalent to 8 working hours or, 480 minutes. The average income per month of 50 inpatients with tuberculosis was estimated at US\$ 113,21.

[‡] In calculating this cost, it was assumed that 46% of the patients were supervised by staff in health clinics, 27% by community health workers and, another 27% by staff in the tuberculosis ward as in 1997.

A short questionnaire designed to identify the patients costs was completed for 50 tuberculosis patients who were found to be smear positive. The respondents comprised of 20 males and 30 females. The questionnaire was used to establish the time and travel costs associated with visits to the hospital, health clinics and CHWs. Patients were asked about the time it takes to access care and the travel costs involved.

Their median age was 35 years (range was 15 to 76). The average number of dependants was 6. Analysis of the questionnaire showed that 35% of the patients were subsistence farmers, 16% were farm labourers, 13% were teachers and other professions, 13% were self-employed, 9% were in school and, 27% were either unemployed or housewives.

From Table 5, it is apparent that the total average patient cost for a hospital visit is the most significant at US\$5,95. On the other hand, a visit to the a CHW did not require any travel expenditures; the small loss to the patient is a reflection of the time lost from income generating activity. Visits to clinics and particularly hospital are more expensive because travel costs rise as time lost from work increases.

A day in hospital cost the patient US\$3,79. In calculating this cost, it was assumed that 25 out of 30 days were worked. Thus, an average day in hospital is equivalent to 8 working hours or, 480 minutes. The average monthly income reported by the respondents was US\$113, 21.

Visits for DOT to the tuberculosis ward, health clinic and CHWs cost a total of US\$1,05, US\$0,45 and US\$0,14 respectively. The least costly visit was to the CHWs. It was also the only cost below the given average cost of US\$0,39. In terms of time, a hospital visit cost a patient 2 hours, a health clinic visit 1,3 hours and a visit to CHWs 15 minutes. Once again, it is clear that a visit to a CHW in terms of time cost the patient less. This was below the calculated average time of 20 minutes.

5.4 Cost-effectiveness data

Table 6 below, gives details of how DOT utilises resources. It is apparent from the table that DOT is the most efficient. At US\$863,79 per patient cured, it is 4 times more cost-effective than the conventional approach.

5.5 Resource use data

Table 7 shows that DOT is also feasible within existing resource constraints. The reduced length of stay under community-based DOT means that it can be implemented without displacing patients from other wards, reducing the quality of care provided, and needing extra investment in both infrastructure and staff.

5.6 Summary

The study results show that community-based DOT is far much more cost-effective than the conventional approach. In combination, arrangements for supervision, supervision of supervisors, and 48 visits cost the health system US\$109,33 per patient which is equivalent to 4,4 days spent in hospital receiving treatment for tuberculosis. It cost the patient US\$18,7 which is equivalent to 5 days in hospital. Further, the total cost of supervising a patient under community-based care is less than expected. Although there were small variations in cost items under each strategy, these were outweighed by the agreement that DOT is most cost-effective.

The results also show that community-based DOT reduces the amount of pressure exerted on the existing bed capacity. Therefore, it is a viable and feasible option that can be implemented using existing resources.

TABLE 6: COST-EFFECTIVENESS OF DIFFERENT CASE MANAGEMENT STRATEGIES

Management strategy	Cost for a cured patient (\$)(% of patients)	Cost for a patient who completes treatment but for whom cure is not confirmed (\$)(% of patients)	Cost for a patient who does not complete treatment (\$)(% of patients)	Cure Rate (%)	Cost per patient cured
DOT	820,60(85)	820,60(5)	542,60(10)	85	965,40
Conventionally delivered treatment	2555,70(65)	2555,70(0)	1806,47(35)	65	3931,85

TABLE 7: NUMBERS OF BEDS AVAILABLE AND REQUIRED TO MANAGE PATIENTS WITH TUBERCULOSIS

Management strategy	Number of beds required given:				
	Number of beds available	1995 case load	1996 case load	1997 case load	1998 case load*
DOT (average length of stay 17,5 days)	40	19,44	30,67	28	20
Conventionally delivered treatment (av. length of stay 60 days)	40	66,66	105,16	98	69

* Includes 1st quarter only

Chapter Six

Discussion and Conclusion

Introduction

The aim of this chapter is to present a discussion of the findings in the study. An attempt is made to make comparisons with results of previous cost-effectiveness studies conducted in Africa. Limitations of the study are also outlined in this chapter and conclusions given.

6.1 Discussion

A discussion of the study results is presented below.

6.1.1 Average health system costs

The overall results of this study indicate that average costs incurred by the health system under the community-based DOT strategy are less than those reported under the conventional approach to care. The main reason for this low cost is the short period of hospitalisation. Treatment under community-based DOT is based in the community and supervised by community health workers who work on a voluntary basis. This makes it cheaper than lengthy hospital supervision and care. All other components of the cost of tuberculosis management under community-based DOT are relatively small when compared with the cost of hospital care.

The study also found that the average cost incurred by the health system in the supervision of community-based DOT is not significantly high. This is an important finding because supervision plays a pivotal role in determining the success of community-based DOT. Instead, on the contrary, the results seem to indicate that shifting the emphasis of care from the hospital to the community significantly reduces health system average costs. For example, the cost of arrangements for supervision and supervision of supervisors (US\$30,13) in combination with 48 visits by the patient (US\$79,20) is US\$109,33. This is equivalent to only 4,4 days in hospital.

As Wilkinson et.al (1997) noted, the cost of hospital care is unlikely to fall enough to make DOT comparatively expensive even in a very poor setting. In support of their argument, they cite an example of Malawi where the cost of a day in hospital was US\$2,09 in 1995. Thus, 60 days in hospital cost the health system US\$125,40, while community-based DOT - 48 visits for DOT and CHW supervision - cost only US\$64,30. This calculation assumed that health clinic and CHW visits and driver costs were 13,3 times less than those reported in Hlabisa - the site of study.

6.1.2 Average patient costs

The results also indicate that community-based DOT reduces the amount of travel and time costs incurred by patients by allowing an easy access to care for the patient and by reducing the length of stay in hospital by a patient. In this study, it was calculated that the reduced length of stay in hospital saves the patient as much as US\$161, 08, assuming that a day in hospital costs the patient US\$3,79.

Further, additional savings are achieved by the patient when a CHW is visited for DOT as opposed to a clinic or hospital visit. It was found that a visit to a CHW did not result in any travel cost due to the close proximity of the CHW. Whatever cost is indicated (US\$0,14) is a reflection of the time lost from an income generating activity. Visits to

clinics (US\$0,45) and the hospital (US\$1,05) cost more because of the rise in travel costs and an increase in the time lost from work.

6.1.3 Cost-effectiveness analysis

The cost-effectiveness findings of this study are similar to findings in other studies conducted in the same area. The results show that community-based DOT is three times far much more cost-effective than conventional care. According to available statistics, cure rates have reportedly increased from 65% in 1989 to 85% in 1997. Similarly, the cost of treating a patient for the entire treatment period is US\$820,60 as opposed to US\$2,555.70 under conventional care. The improved effectiveness and reduced costs are indicators of the positive achievements that have been brought about by the adoption of community-based DOT

These findings are in line with Floyd et.al (1997), who carried out a study on the cost-effectiveness of alternative tuberculosis management strategies in Hlabisa, South Africa and observed that community-based DOT was 28 times more cost-effective than conventional care. In addition, they observed that after DOT was introduced cure rates increased from a 17% in 1990 to 81% between 1991 and 1994 and the cost of curing a patient had fallen from R88,307 to R3,799.

A study by Saunderson (1995) also revealed that community-based DOT was far much more efficient than conventional care in Uganda. Not only had the introduction of community-based DOT reduced the costs incurred by the health system and the patient in the region under study, but also higher compliance and cure rates were reported.

6.1.4 Resource use analysis

The findings also show that community-based DOT utilises resources more efficiently. Compared to the conventional approach, shorter hospitalisation of patients means that patients are not displaced from other wards, quality of care is not compromised with, and extra investment in both infrastructure and staff is not needed. Thus, implementing community-based DOT in Zambia should significantly help to decongest hospitals, thereby improving the hospitals' capacity to cope with the growing tuberculosis case load. The findings of the present study lend credence to the fact that more resources should be directed towards Primary Health Care (PHC) and outpatient Care.

6.1.5 Application of study results to other districts in Zambia

Similar findings can be expected in other districts in Zambia, provided that the cost of major inputs such as staff, vehicles and fuel and population densities do not vary much from those included in this study. As with all scientific endeavour, replication of several study of this nature in Africa is needed to confirm or disconfirm these findings.

6.1.6 Policy implications

From the study it is clear that a simplified approach to tuberculosis management based on short hospital stay and a strong community program is most cost-effective. Thus, health care resources should be directed towards PHC programs and outpatient care. Further, resources need to be directed towards the training of CHWs who play a critical role in the control and management of tuberculosis.

6.2 Limitations of study and directions for future research

The limitations of the study were:

- a) the costs of the patients were based on a small sample without a control group. Therefore, further studies are needed to confirm these tentative findings;
- b) the study focused solely on new tuberculosis cases, thus, omitting important information that might have been found in re-treatment cases and;
- c) the sample group included in the study was adult tuberculosis patients only.

In terms of the survey's utility, the results of the present study may serve several purposes. First, this information can serve as an important springboard for the successful integration of proven PHC with community-based DOT in sub-Saharan Africa. Second, this data can also play an instrumental role in assessing the feasibility of implementing community-based DOT interventions. In this regard, the degree of similarity between these results obtained here and those reported for previous studies reviewed was encouraging. Finally, research of this type may yield useful data that could serve as a guide to future research. Future research could also investigate whether the frequency of community-based DOT practices is reflective of available resources and the socio-economic status in the target country. The results obtained here tentatively suggest it might.

6.3 Conclusion

In sum, the present findings provided tentative support for community-based DOT and PHC as well as for the validity of Drummond and Stoddart's 10-points. Clearly, the model requires suitable adoption and further development. To a greater extent, community-based DOT in the present study has shown to significantly reduce costs to

both the health system and patient. The study has also shown that community-based DOT is implementable within the existing infrastructure. This makes community-based DOT an attractive and viable economic option that should be implemented in a country faced with constrained resources and a limited budget. Continued implementation of community-based DOT in other parts of Zambia is a likely solution to coping with the increased tuberculosis case load. Taken together, community-based DOT in developed and developing countries (especially low-income countries) should have considerable potential for new insights in both research and applied contexts.

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