A COST BENEFIT ANALYSIS FOR THE TREATMENT AND DETECTION OF MILD HYPERTENSION IN AUSTRALIA

MICHAEL JOSEPH CLAESSENS
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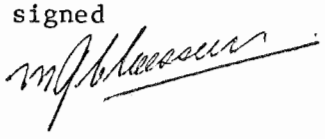
This dissertation contains my own original work containing no material which has already been published or otherwise used by me, and to the best of my knowledge no copy or paraphrase of material previously written by another person or authority, except where due acknowledgement is made.

signed



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PREFACE

Hypertension has long been recognized as a significant health problem in Australia. Since the condition results in reduced life expectancy, and employability, requiring careful monitoring and life long therapy, the choice of treatments requires special care. Mild hypertension is symptomless, and accounts for seventy percent of all cases of hypertension. Most mild hypertensives are unaware of their condition.

Chapter one of this dissertation is largely concerned with an outline of the prevalence and the principal means of detection and treatment of the condition. The cost of lifelong drug therapy, currently the primary means of treatment, is high. A comparison with the alternative non-drug treatments is therefore called for. The aims of this analysis are consistent with guidelines for hypertension control recommended by the National Heart Foundation of Australia.

The rest of chapter one, justifies the use of cost-benefit analysis in indicating the desirability or otherwise of government intervention in the market for health care. It is argued that market failure prevents individual decision makers from rationally evaluating the worth of their human capital. Market failure is evident in insurance, lifestyle and through the generation of externalities. The analysis should help to

indicate whether a control programme is economically viable, which treatments should be used and who should be treated.

Chapter two introduces the taxonomy of benefits and costs used i.e. direct and indirect, visible and invisible savings in morbidity and mortality, which are the major benefits of effective hypertension control. The human capital and willingness to pay approaches for valuation of life are examined. Both approaches can be drawn together when we view insurance and lifestyle as a reflection of individuals willingness to pay, to maintain and increase his own human capital. The permanent income hypothesis can be used to justify valueing pensioners time at the market wage. We must assume that maximising Gross National Product (G.N.P.) does not provide a basis for human capital valuation.

Choice of the real discount rate presents some difficulties. Arguments that it ought to reflect the social rate of time preference and the opportunity cost of capital are discussed. The use of the risk-free bond rate is viewed as a reliable proxy.

Chapter three examines the benefits (averted costs) of effective control of mild hypertension. A mortality model is developed upon the basis of human capital valuation, yielding the present value of losses for the condition. The stock-flow considerations, largely ignored in other studies are examined. Morbidity costs are categorized by hospitalization, future

treatment and loss in labour productivity. An understatement in estimates is likely given the difficulty in quantifying some indirect costs.

Chapter four, follows a probabilistic approach in specifying the linkages between diagnosis, treatment and outcome. The costs of treatment consist of screening, drug treatment and the 'salt-modified' diet (non-drug treatment). Sensitivity analysis is performed upon two alternative treatment mixes i.e. diuretic drugs provide the primary course of treatment (the 70% assumption) and non-drug treatment as the initial therapy (the 20% assumption).

Chapter five reviews the findings of the cost-benefit analysis. In the aggregate social costs are outweighed by social benefits. A programme based upon salt-diet modification as the primary treatment yields the highest net benefit. Benefit cost ratios suggest that, ideally, the programme should be directed at males aged 65 to 69.

Research procedures followed consisted primarily of a review of recent epidemiological studies performed in Australia, the United Kingdom and the United States. Economic analysis, in hypertension research, has been confined largely to cost-effective analyses. The increasing sophistication of cost-effective analyses and their scope for capturing the nonpecuniary value of saving life, avoiding suffering etc,

accounts for the growing usurpation of cost-benefit by cost effective analysis, in health care.

More significantly, the use of quality-adjusted life years, as a measure of health output, provides information more readily appreciated by members of the medical profession, generally lacking formal training in economics.

The Australian National Blood Pressure Study and the Risk Factor Prevalence Study (National Heart Foundation of Australia 1980) were the primary sources of data. While information on mortality rates is available on an annual basis, very little is available on the incidence of non-fatal events i.e. for stroke and myocardial infarction. Estimates of hypertension related events were inferred. Dissaggregated data on deaths from heart and blood vessel disease, provided by the N.H.F., were received too late to be adequately incorporated.

The benefits and efficacy of drug/non drug treatment of mild hypertension remains a contentious issue in epidemiological circles. The forthcoming Medical Research Council Trial (U.K.) should provide more exhaustive information regarding hypertensive related events, and age/sex related benefits of diuretic and beta-blocker therapy, than that currently available.

The analysis undertaken is exploratory in nature. The findings largely confirm those views held by the medical

profession for the need for concerted efforts at eradicating mild hypertension in Australia.

The magnitude of the net benefits are particularly sensitive to choice of adherence-to-therapy probabilities and stock-flow modelling. A more complete analysis is required which incorporates sensitivity to adherence rates, and a purpose built demographic model. A cost-benefit program examining both blood pressure and cholesterol, as the major risk factors in heart,disease would be informative.

I wish to thank Bob Rutherford, my supervisor, for assistance provided throughout the preparation of this thesis. Thanks must also go to William Magill, Dr. Trevor Beard (of The Canberra National Blood Pressure Trial) and Stan Crane (of The National Heart Foundation of Australia) for advice and suggestions, freely given; and to Lyn Kumpulainen the typist.

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CHAPTER ONE

INTRODUCTION

Hypertension (H.T.) is the sustained elevation of blood pressure in the human circulatory system. Mild hypertension (M.H.T.) falls within the range 90 to 109 mm Hg, diastolic. M.H.T., while asymptomatic, is a major correllate in the incidence of stroke, myocardial infarction (M.I.) and renal failure[1]. M.H.T. effects approximately 700,000 Australians who are currently unaware of the condition.

M.H.T. is usually detected by chance during routine superannuation, insurance or military examinations in males, or during pregnancy in females. The family general practitioner (G.P.) and mass screening, to a lesser degree, have been the principal means of detection. Of the total hypertensives in Australia only 33% of men and 61% of women are currently on medication.

The incidence of M.H.T. is particularly high in middle aged males. The relative risk of M.H.T. related events (stroke and M.I.) is not significantly different, between males and females.

Effective detection and control of mild hypertension in Australia, would produce benefits by averting costs that would otherwise be incurred. Individual's health benefits would be

realized in the form of increased life-expectancy, decreased morbidity and subsequent disability. Health resource savings would result from decreased incidence of events, with the associated utilization of medical resources.

Current means of treatment entail the widespread use of drugs in gaining satisfactory levels of bloodpressure. The economic costs of lifelong pharmacological therapy, have given rise to an increasing emphasis on prevention of M.H.T. through modification of diet and lifestyle. The use of non-drug treatments for mild hypertensives (M.H.T.`s) is gaining acceptance, as the primary means of cure. KAPLAN [39,p7] recommends the modification of dietary sodium combined with the use of Beta-Blocker hypotensive drugs, rather than the standard high dose diuretic therapies.

Two popular means of detection of M.H.T. are (i) the high risk and (ii) the mass approaches (G.P. or clinic). The high risk approach identifies those likely to be or to become M.H.T. e.g. middle aged males, with follow up care provided by family physicians. This approach remains largely developmental. The clinical approach in mass-screening for hypertension e.g. at major hospitals or shopping centres, has proved to be unsatisfactory on both cost effective and medical grounds WEINSTEIN and STASON [28,p738] conclude that intervention to improve patient adherence to therapy, should take precedence over mass screening programs.

The National Heart Foundation of Australia (N.H.F.)[43] has recently recommended a stepped care approach in controlling hypertension, for incorporation, in national public health policy. The recommendations include:-

(i) routine screening for symptomless hypertension;

(ii) pharmacalogical treatment for all persons with B.P. in excess of 95 mm Hg.;

(iii) development of effective economic procedures to reduce treatment costs;

(iv) continued research into non-drug treatment, prevention and control.

The cost-benefit analysis undertaken assumes (i) and (ii), while addressing the objectives of (iii) and (iv) above.

> "The determination of prevention priorities by disease costing may offer the best chance of obtaining the resources required for prevention [in the context of tight budgetary constraint], because it facilitates cost-benefit analysis and offers benefits that economists readily appreciate".
>
> [8.p5]

DEFINITIONS

Cost-benefit analysis applies the principles of welfare economics, in the allocation of scarce resources among competing ends, to specific interventions in the market place. The central concern is the maximization of social welfare, in that the "...activity results in a net increase in the value of goods and services produced throughout the economy" [1,p11].

The value of these goods and services is determined by the level of demand or the willingness of individuals to pay for them (W.T.P.). In the absence of market failure we assume an optimal distribution of income and that consumers are the best judges of their own welfare.

An allocation is said to be Pareto optimal, when no alternative allocation can make one individual better off without making some other worse off. The operational form of this criterion is potential Pareto optimality (Hicks-Kaldor compensation) where "...an increase in general welfare occurs if those that are made better off...could, in principle, fully compensate those that are made worse off and still achieve an inprovement in welfare" [1,p13].

WHY COST-BENEFIT ANALYSIS?

Essentially, C.B.A., as an efficiency technique, is useful for informing government policy in the appropriate form of intervention in the provision of the public good of health. Intervention is justified if the market can be said to be failing, in providing the optimal quantity of the good. Health care resources are allocated effeciently when no change in output mix, production technology or distribution increases total social welfare. The state is Pareto optimal.

A practical definition of health is the absence of disease and the adverse side effects of treatment. A non-Pareto optimal state exists with welfare lower than that obtainable, where

given an alternative allocation of health funding, M.H.T. prevalence could be reduced with no lowering of welfare elsewhere. Hicks-Kaldor hyperthetical compensation by gainers or losers, provides the minimum pre-requisite. Though a stable equilibrium might exist, prices may not reflect social opportunity costs.

The medical market is largely the result of an attempt to overcome the lack of optimality, due to the non marketability of the bearing of suitable risks and the imperfect marketability of information. Arrow [2] has reviewed the role of risk and uncertainty in the market for health care.

Due to lack of information with regard to risk factors in stroke and M.I. consumers are likely to have a distorted rate of time preference. Self interested individuals in the market dont adequately take externalities into account in the valuation of health output. No price is placed on the positive externalities generated by drug treatment e.g. increased productivity, or spillover of an individuals' health status into anothers utility function.

> "[In the insurance market] the apparent welfare loss (due to expost consumption exceeding the quantity where MB=MC), must be compared with the gain derived from the reduced risk from unexpected health expenditure"
>
> [22,p157]

A comparison of the perfectly competitive model under uncertainty with the medical care market, reveals that conceivable insurance policies do not exist. Insurance against

death, total, incomplete or delayed recovery, and loss of productive activity from M.H.T. related events may be absent.

The standard failure in life insurance is moral hazard. The event insured against is not independant of the taking of insurance. Provision for such cannot be written into the contract. The risk averse individual lives with M.H.T., with the guarantee of certain income m, in the event of death or disability. Premiums based upon predictable risks result in an underproduction of goods considered risk complementary. The risks cannot be spread as preferred.

While the pursuit of an 'unhealthy' lifestyle, is not in the realm of strict life-insurance contracts, a social cost is inflicted on society to which no price is attached. The market fails in insuring human capital. Conversely consumers are not faced with the true cost of diet and lifestyle modifications e.g. the higher incidence of M.I. among middle-aged joggers.

In the absence of externalities the risk averse consumer will insure himself against the costs of health care if offered an actuarially fair premium (price = expected value). In the real market, premiums hear little relation to actuarial risk. The price of purchasing insurance is less than the opportunity cost, resulting in over-insurance e.g. premium splitting, tax offsets and group schemes.

On the supply-side the insurance market fails to take account of psychic disutility and externality resulting from

M.H.T. related events. Under risk pooling, the insurers expected welfare loss is made infinitely small. However the pooling of unequal risks introduces failure. Certain ages and lifestyle patterns lend themselves to M.H.T. conditions.

> "Individuals...are willing to make exchanges between their own health [human capital] and other desirables...which tend to increase blood pressure"
>
> [4,p27]

Maximum possible discrimination of risks in the insurance market is required for full social benefit.

Limited entry with regard to the use of trained physicians verses imperfect substitutes e.g. para-medics, creates market failure. A physician's time may be employed in tasks utilizing only a small proportion of his human capital e.g. more efficient resource allocation might be achieved by nurses regularly taking blood-pressure.

The patient, being relatively ignorant with regard to appropriate treatment and liklihood of success, must place his trust in the medical code of ethics. Doctors may be more concerned with exploiting their monopoly power, in maximising economic rent through, say, price discrimination. Marginal variations in care are not reflected in the scheduled fee. The collective monopoly characteristic may result in the rich compensating the poor. Consumers also lack knowledge of the services available e.g. that blood pressure will be taken upon request.

Thus, although health is a marketable commodity, not only may no equilibrium or a Pareto inefficient one be achieved, but movement towards such may be slow and inconsistent. Externalities, consumer irrationality and ignorance, uncertainty and capital market imperfections (moral hazard) can largely be held responsible. Irrationality can be illustrated with particular reference to adherance-to-therapy in M.H.T. control. Once patients begin to feel better they cease medication. Failure in physcian adherance occurs since G.P.'s dont routinely take blood pressure.

Government intervention can be justified in an inefficient market where there is scope for potential Pareto improvement and the cost of intervention is less than the cost of market failure. The form of intervention must be decided upon be it tax, subsidy, price manipulation, creation of a public monopoly in insurance or specific health program. The costs of intervention are often hard to ascertain. Though C.B.A. provides a means. Non lump-sum taxes make assessment of improvement in efficiency of any market difficult. The theory of Second Best suggests that market failure may be optimal.

Public goods theory indicates that government intervention, may make the market result worse. Government decisions are generally ill-informed due to political self interest and voters rational ignorance. A line of argument developed largely by TULLOCK [25] and BUCHANNAN [7]. The C.B.A.

helps inform government decision making, as to the true welfare effects of proposals for government provision of the public good.

It has been argued that strict application of C.B.A. using the potential Pareto improvement criterion, with individuals valuations of welfare, may be too limited (see SUGDEN and WILLIAMS [23,p178]). The government should intervene in the market, since individuals are not always the best judges of their own welfare. It is held that merit good arguments have no legitimate place in C.B.A. People are often rational in accepting the risk of M.H.T. and related events, given adequate wage compensation. Alternatively they prefer the risks of M.H.T. rather than forgo utility in undertaking life-long drug therapy. C.B.A. can help provide well informed government intervention only when market failures prevent rational valuation of welfare by individuals.

Though the literature and practical analysis C.B.A., to resource allocation for disease is volumous, "...other areas seem under-represented in the literature...drugs...and the non medical means of dealing with health problems" [8,p22]. Further GRIFFITHS [14,p120] observes that "The surprising thing, given the prevalence of...mild hypertension, is that so little practical economic analysis has been done so far". This analysis, attempts to go some way towards bridging this gap, in practical application. The detection and control of mild

hypertension, through alternative treatment mixes is examined. Special emphasis is given to non-drug treatments as an alternative to life-long pharmacological courses of therapy.

While the analysis is performed in a national context, the results are applicable on a statewide basis. The C.B.A. is designed to indicate (i) whether of not detection and treatment of the M.H.T. stock and flow (those becoming M.H.T. per unit time), is economically justifiable, (ii) if so which treatment mixes produce the highest social benefits (iii) who should be treated, according to age and sex.

NOTES:

[1] Even in the absence of other risk factors e.g. high cholesterol levels, and obesity "High blood pressure [is] probably the single leading cause of strokes" [40.p5].

CHAPTER TWO

THE PRINCIPLES AND IMPLEMENTATION OF COST-BENEFIT ANALYSIS

C.B.A. helps determine whether the real resource or social opportunity costs outweigh the social benefits of some project. As argued above, the non-marketability of health means that the efficient level of output is unlikely to be achieved. In the market for healthcare, KLARMAN [17] argues that C.B.A. performs in the public sector what demand and supply fail to do in the private.

A benefit may be broadly defined as the utility, or satisfaction that some course of action brings. Since cost includes opportunity cost, costs can be viewed as benefits foregone, or negative benefits. A C.B.A. requires the identification, quantification and valuation of all costs and benefits. The further costs and benefits lie in the future, the smaller is their present value, due to the concept of time preference and the possibility of productive investment. The discount rate is chosen to make future dollars commensurate with current dollars.

The standard taxonomy divides benefits into (i) visibles, and (ii) invisibles, both direct and indirect[1]. Direct visible benefits are closely related to the aim of the project, of those persons becoming normotensive after treatment. They are visible

in being marketable. These include saved future medical expenses, the value of resources that would otherwise have been used in the rehabilitation after stroke and heart attack and absence from productive activity avoided. Indirect invisible benefits include increased life-expectancy, through decreased incidence of mortality. Indirect visible benefits accrue to those at whom the program is not directed e.g. insurance companies and other third parties for whom M.H.T. represents an externality, or savings in resources for retraining of personnel to replace the dead and disabled (human capital). Finally, indirect invisible benefits relate to pyschic benefits of people for whom utility is a function of others well being. Additionally private resources are freed, otherwise used to reduce job stress e.g. psychoanalysis, social welfare programs.

While visible costs/benefits are easily quantified "...there is no case for arbitrarily excluding intangibles however difficult they are to evaluate". [p 173].

MEASUREMENT

The valuation of social benefits implicitly uses the concept of Marshallian consumer surplus [18] the maximum sum of money a consumer would be willing to pay for a given amount of a good, less the amount he actually pays. MISHAN [19] has introduced compensating variation (C.V.) as a practical measure of the surplus. Where the individual is made better (worse) off it is the maximum (minimum) he is willing to pay (accept) to

undergo the program. The initial level of satisfaction is maintained. The program is said to yield a potential Pareto improvement where, $\sum_{i=1}^{n} CV_i > 0$, people gain more from the program than some lose.

THE VALUE OF LIFE

Savings in morbidity and mortality are the major benefits of effective control of M.H.T. Two major means of valuation have been proposed.

The gross output or human capital approach attributes health benefits to changes in economic productivity, measured as the net present value of expected future life-time earnings. Aggregate work years lost due to mortality, morbidity and disability are calculated in the absence of the program. The wage rate, which is the productivity measure, is imputed in the absence of a market e.g. housecleaner rates for housewives.

A variant on human capital is the net-output approach. It is measured as the value of the wage earner's output net of his own consumption. This expost setting leads to theoretical difficulty. The approach is unsound, since own consumption provides the wage-earner with satisfaction. As a member of society, this utility should be used in aggregating social welfare. Where we are maximising economic growth, with re-investable surplus, subsistence or essential costs of living could be deducted from gross output.

The willingness-to-pay' (W.T.P.) valuation tequnique, has been proposed by MISHAN [9]. It is based upon individuals own valuations of decreases in risks. The change in welfare is measured by the "willingness to pay" (market revealed), for the benefits of the project.

The relevant sums to subtract from benefits are those compensating people for additional risk to the whole of society (C.V's). Additional risks, voluntarily assumed, are ignored since they are already capitalized into the market. Compensating variation is used as the certainty equivalent. Universal risk aversion is assumed.

The equivalent variation (E.V.) is an alternative measure of consumer surplus. It measures that amount of money forfeited to avoid an undesirable change (the premium) or required in compensation to forego a desirable change[2]. The subsequent level of satisfaction is maintained. Where income effects are small, the choice between using EV or CV is ambiguous. Health, however, is considered to be a normal good involving a particularly strong income effect. This is illustrated by the obervation health expenditure by low income earners is small. E.V.'s, in generally exceeding C.V.'s, will represent an overstatement of willingness to pay.

As JONES-LEE [16] has argued, for a program saving n statistical lives, in period t, for each member in society the

change in safety represents the marginal change in individual risk. A health program yields small changes in life expectancy. The appropriate unit for assessing program desirability is the marginal value of an increase in life expectancy. For these purposes, with small income effects, CU's and EV's are identical measures.

W.T.P. could be determined directly by survey (questionnaire). Alternatively, through revealed preference by examination of wage differentials (premiums) in high risk occupations e.g. for North Sea oil divers. Consumption, through housing and travel choices, is indicative of the perceived risk of death or injury in a particular activity [4,p30].

Criticism has been leveled at both the human capital and 'willingness' to pay methods, as appropriate benefit valuation techniques.

MISHAN argues that human capital is based on maximising G.N.P., which is not an acceptable goal of economic policy. The approach, he asserts is not grounded in economic theory since the potential Pareto improvement criterion becomes irrelevant. The approach measures the market value of livelihood rather than the value of life. Life has value beyond that of lost productivity. The method is biased for males over females, workers over pensioners, and the high over the low income.

Mishan's criticisms appear to be overstated. Though W.T.P. may be superior theoretically,

notably

> "...there is no satisfactory means to date of generating consistent and useful numbers for [W.T.P.] valuation of life..." [26,p89].

The human capital approach does provide the only systematic means of valuation. Human capital is not directed at indicating the value of life, rather it measures the cost of the disease. Validity in the measurement of these costs, doesn't require G.N.P., maximization as a criterion. The approach is grounded in the theory of marginal productivity, with the assumptions of earnings reflecting productivity, a competitive labour market and profit maximization. Admittedly, market imperfections i.e. union activity, or lack of competition, might prevent earnings from accurately reflecting the value of output.

Risk myopia results in misinformed consumer choice, in preference revelation for W.T.P. Appropiateness of response in asking individuals to value small changes in risks is a function of questionnaire design. Neither human capital nor W.T.P. consider the elderly. Revealed preference in high risk occupations is distorted by less risk aversion among some workers than others. Social insurance, provided under the governments merit considerations, further distorts the correct revelation of preferences.

Both methods can be drawn together, despite the dichotomies. W.T.P. measures an individuals willingness to

sacrifice wealth, for future consumption to obtain improved chances of survival. It is the sum of consumer surpluses from all future consumption (life-time utility) in addition to net human capital. Thus, even with the government insurance distortion, the individual is rational in taking out extra insurance, which he bases on discounted expected future life-time earnings[3]. He insures to avoid an anticipated loss in net output, or human capital. W.T.P. is also implicit in an earnings measure for mild hypertension control. Higher wages can be viewed as compensation for increased stress and hence liklihood of developing M.H.T.[4].

Finally, an attack levelled by BROOME [5], at W.T.P. underlines the need for an ex ante benefit valuation. If identification of persons who will lose their lives if a program does (not) proceed is possible, infinitely high compensation would be demanded. This ex post result is inconsistent with health program evaluation. The marginal change in individual risk, ex ante, is the only relevant consideration.

Decision-maker's valuations of life are also informative e.g. court decisions on compensation, or implicit valuation in the political process, through examination of past government investment expenditures effecting life and limb. Project appraisal by decision-makers, does not make explicit reference to individuals valuations, therefore potential Pareto improvement

is no longer relevant. While no satisfactory Social Welfare Function is said to exist decisions made at the administrative level are still likely to approach society's 'opti optimorum'. Thus administrative valuation should provide an approximation of the value placed on life, by individuals, in the aggregate. Court awards made for injury and death, however, though a function of expected losses in productivity and emotional cost, are subject to judicial whimsy.

The life insurance approach employs examination of y/p, with y=premium and p=the additional risk, as the value placed on life. As a variant of W.T.P. it is subject to the weaknesses outlined above. Intuitively, this approach fails since life insurance is a measure of the insureree's value to others, not himself. Health status indexes are a more recent attempt at life valuation. These indexes are largely confined to cost-effective analysis, with increased years of life adjusted for quality. A common approach is to ascribe values between 0 (death) and 1 (perfect health), to different health states (outputs). Indexes suffer from problems of reliability, validity and definitional consistency.

HUMAN CAPITAL AND THE PENSIONER PROBLEM

The human capital approach to valuation of life is age dependent i.e. a life lost at an early age is worth more than one lost later. A pragmatic interpretation of human capital means that health policy should not be directed at savings in

mortality and morbidity for pensioners, the severely disabled and retarded, whose future earnings are limited. However the social value of a prevented death or existence value of these persons, is evidenced by the extent of social security provision, and individual's charitable propensities.

Transfer payments are excluded from C.B.A. They include all payments not made in return for some productive service. The transfers dont arise from the production of new goods and services, and hence do not contribute to, but distribute G.N.P. (from earners to non earners). e.g. Unemployment benefits to not enter C.B.A. as the opportunity cost of employment in some industry. Pensions present a difficult problem for valuation in this respect.

FRIEDMAN [12] has developed a life-cycle, permanent income theory of consumption. People maintain a smooth profile of income/consumption throughout their lives. Current consumption is set as some fraction of long run estimates, in wealth or permanent income terms. The estimate, made by an individual, of his permanent income uses his current income and all incomes from earlier periods. Larger weights are attached to the more recent incomes. Consumption is depressed in middle age, presumably with a view to smoothing the receipt of income into retirement.

Pensions are transfer payments, though they can be viewed as payment for productive activity earlier in life. They do not

result from the production of new goods and services. It is held that pensioners can legitimately be included in valuation of life in human capital terms. We must assume,contrary to MISHAN, that maximization of G.N.P. does not provide the basis for gross output valuation. Under optimal distribution of purchasing power, use of a permanent income model, allows explicit valuation of life for those not currently earning wages. Thus in this analysis pensions as transfers are not used in valuation. Current average weekly earnings are used on life-cycle grounds.

Valuation problems aside, the implementation of the M.H.T. program, can be viewed as a purchase of survival, decreasing the probabilities of the loss of life. The pensioner is guaranteed a fixed income stream by society. The level of payment is not adjusted for changes in survival probability. Thus the pensioner is unlikely to take account of the effect of his survival expenditure on the feasible quantities of resources used in providing the program. Over utilization of the medical services results. Pensioners are rewarded by receiving the average, rather than marginal product necessary for program efficiency. The problem is analagous to that pertaining to the open access fishery [57,p104]. For optimality pensioners would need to be charged the price that their increased expenditures cost society.

CHOICE OF THE DISCOUNT RATE IN PUBLIC PROJECT APPRAISAL

The discount rate (D.R.) provides a means of comparing dollar costs and benefits occurring through time, in a meaningful manner. Society attaches weights to this stream of benefits. A single D.R. is considered, assuming these weights decrease smoothly and exponentially. The desirability of a program, is particularly sensitive to its choice. The higher the D.R. the less favourable projects appear, whose benefits occur for off e.g. health programs for M.H.T. control, whose benefit, in reduced mortality occur for off 35 year olds, while costs of (drug) treatment are immediate.

The three main positions held with respect to D.R. choice are:-

(i) D.R. should reflect the social rate of time preference (S.R.T.P.), society's trade off between present and future benefits;

(ii) the value should reflect the opportunity cost of using resources in the public sector with the rate of return foregone in the private sector;

(iii) D.R. as a weighted average of the rates of return in the private sector in proportion to the funds drawn from each source;

The social rate of time preference is uncertain and unobservable. In perfectly competitive equilibrium all borrowing and lending occurs on the same terms. Therefore all marginal

rates of time preference are identical, yielding the market interest rate, as the appropriate D.R. Capital markets, however, are imperfect. Several market interest rates prevail, reflecting different degrees of risk and time preference. Additionally, market rates of interest would equal private preference only under the assumption of perfect information. These distortions, combined with interest rates on bonds, being a function of government policy, make market interest rates an inappropriate measure of social time preference.

The divergence between S.R.T.P. and personal time preference, is reinforced by the likelihood of a suboptimal level of savings. People fail to maximise their welfare in evaluation of present versus future consumption. PIGOU'S "defective telescopic" faculty [20,p25], accounts for this phenomenon. Individuals spending/saving decisions in the current period are based upon expected future life time earnings and a faulty conception of the economy's transformation set. Scarcity in resources is not considered. Future benefits are heavily discounted, yielding higher levels of consumption and lower levels of investment, than required for optimality. People's short-sightedness results in a D.R. likely to overstate the social rate of time preference[6]. Since people prefer health benefits sooner rather than later [13], the first drug doses taken for M.H.T. control are likely to be valued more highly,

than those taken later in life (under life long therapy). This must be considered an important element in lack of adherance to therapy.

Market interest rates, do not equate, private and social rates of time preference. People appear to have more concern for the future relative to the present however, than the market suggests. The welfare of future generations may enter the utility functions of the living, as reflected in externality effects of the savings decision. This concern for the standard of living of the unborn is not reflected in the level of interest rates. The government, at least, is "trustee" [11,p365] of future generations with regard to intertemporal resource distribution. Again we conclude that the market rate is likely to exceed the S.R.T.P. This perspective is subject to objections raised by TULLOCK [24]. Since aggregate social welfare is rising through time e.g. through technical progress in man-made capital the intensity of "inter-generational concern" is likely to be slight. Investments made in exhaustible resources, however, remain relevant.

BAUMOL [3] has suggested that the adoption of the yield on risk-free long term government bonds, would provide an upper bound on S.R.T.P. People buying bonds must prefer this investment to present consumption. If S.R.T.P. exceeded the interest rate on bonds, they wouldn't invest. The government would use its tax/transfer power to change the level of

aggregate savings, if on S.R.T.P. grounds, it believed the level of saving to be too low.

The potential Pareto improvement criterion, while also suggestive of a solution, depends upon the time period of the hyperthetical transfers, producing an ambiguous result. The D.R. for public projects is a social opportunity cost. It should represent the rate of return on society's next best use of its resources.

> "Consistency requires that projects with the same time stream of social costs and benefits should be treated in the same way, whether they are proposed in the public or private sectors"
>
> SUGDEN AND WILLIAMS [23p212]

The social D.R. it is argued, should reflect the opportunity cost of private sector capital subject to adjustment for the social cost of diseconomies e.g. pollution. Public sector for resources are obtained from the private sector mainly through taxation. The rate of return should reflect that which the private sector loses through taxation.

Examined in isolation the opportunity cost of capital depends upon whether funds raised for public investment are at the expense of private consumption or investment (or some combination of the two). Raised at the expense of private consumption alone, the D.R. should reflect the private rate of time preference. The D.R. would be lower than that used by the private sector if the opportunity cost were solely displacing private investment given partial reinvestment of returns.

Alternatively, the D.R. would lie between the rate of time preference and the private rate, given displacement of both investment and consumption. Under less than full employment[7], public expenditure is not entirely at the private sector's expense. Resource expansion, with the multiplier effect, results in an investible surplus and hence a lower D.R.

Social welfare increases when public projects are undertaken which yield higher rates of return than the private. However a social D.R. set below the private internal rate of return (IRR) results in suboptimal resource allocation. HIRSCHLEIFER [58] and MISHAN recommend that we ignore time preference and set the D.R. equal to the private IRR. Though it remains likely that the social rate of discount is lower than the private rate.

The extent of the divergence between the private and social opportunity costs is difficult to determine. Taxation on private profit is the major cause of the indeterminacy. Private projects, discounted at 4%, incurr an implicit social rate of discount of 8%, with a 50% tax on profits. Thus while pre-tax returns might approximate the social rate of discount, after tax returns will exceed social rate of discount. The incentive to save and invest is reduced. We ignore policy directed at achieving the optimal level of investment through tax/subsidy schemes.

Uncertainty remains as the major difficulty in using the opportunity cost of capital as a reflection of the D.R. In private firms shareholders view the possibility of a gain as worth less than its expected value (the certainty equivalent). Exante under risk aversion, a real cost is borne in bearing risk.

Three main views thave been expressed in coping with uncertainty:-

(i) as elucidated earlier, time and risk preference should be left to decision maker's valuations. The market is too imperfect to reveal private risk preferences;

(ii) discounting for time and risk, in private and public projects, should be on the same basis. Public projects will, thus, not displace private investment passing at higher rates of return HIRSCHLEIFER [58]; and

(iii) the approach generally adopted as put forth by BAUMOL and, ARROW and LIND [2]. Public projects can be considered 'less risky' than corresponding private projects, since the tax system may be used to pool the risk among N taxpayers. The costs of failure are small, relative to average per capita income. The government acts as an expected value decision maker. Contrary to HIRSCHLEIFER, we

effectively ignore uncertainty behaving as if we are indifferent to risk. The D.R. comes to reflect private investments made under certain returns BAUMOLS risk free bond rate, again becomes an attractive proxy.

SANDMO and DREZE [59] have suggested another alternative in social D.R. determination. This consists of a weighted average of the rates of return in the private sector, in proportion to the funds drawn from each private source. This approach is inappropriate, since it attempts to draw together two distinct concepts of S.R.T.P. and opportunity cost of private investment, into a single price.

The rate of interest on long term bonds remains the only reasonable approximation for the social rate of time preference. This rate may still lie above the true S.R.T.P., due to market `myopia". Programs involving long term benefits are favoured by a S.R.T.P., rather than the higher opportunity cost D.R.

UNEMPLOYMENT, INFLATION AND PRODUCTIVITY

In general inflation does not provide a source of technical difficulty in discounting and in choice of the D.R. All costs and benefits are expressed in constant prices and a real rate of discount is used. Changes in the relative prices introduce added complexity. The prices of the goods in question must be adjusted relative to the expected changes in their value, relative to the general level of prices. We assume that

the relative prices of medical services, labour and drugs remain constant over the life of the program.

"Full crowding out" implies that government public spending is made entirely at the expense of private investment expenditure. However, at less than full employment this is no longer a truism. The additional employment generated by a public project is a benefit. Additionally the opportunity cost of labour is relatively low, and no longer adequately reflected by the wage rate A C.B.A., by failing to take into account multiplier effects on aggregate income of additional employment, will underestimate benefits and overstate its social costs.

Costs are not corrected for projected unemployment effects, largely on the practical grounds suggested in PREST and TURVEY [21] i.e. difficulties in projecting future unemployment levels, and the dependence of employment levels upon expenditure as well as the method of project financing.

Increases in productivity, are reflected in a growth in real wages. The D.R. must be adjusted upwards for the projected rate of growth. Changes in relative productivity, between sectors, are an additional consideration.

The D.R. recommended for Commonwealth government projects is 10%. DOESSEL [10] also regards the "right" rate as being of this order. He supports his choice with reference to the very tangible loss incurred when D.R. for public projects is below the rate of return on private sector investment. From a

practical standpoint, with a fixed supply of funds, very low D.R.'s mean that more projects pass than can be funded and the ranking of these will be altered. A problem of second-best results. The 10% D.R. will ensure the undertaking of the cheapest projects first, since the order of implementation would be likely to change at lower rates i.e. highly capital intensive projects with low future running costs are favoured by a low D.R.

The risk fee bond rate, as a proxy for the social rate of time preference, is the most popular choice. Adjustment for expectations of inflation, might leave it in the order of 4-5%. The bond rate reflects the aggregate willingness of consumers to surrender their savings. Since social time preference, is likely to understate individual time preference, it favours programs with long term benefits e.g. M.H.T. control (as opposed to the higher D.R. reflected in opportunity cost).

ANDERSON and SETTLE [1] remark that the social rate of time preference, is generally believed to lie somewhere between 2.5% and 6%. As WARNER and LUCE [26,p97] suggest

> "...the best strategy seems to be to seek a reasonable number (for example, 3 percent) and then test the sensitivity of findings to both higher and lower rates."

4percent was chosen as the preferred rate of discount. This is consistent with an estimate of the real D.R. from the inflation free period of the 1950's, valued at 4-6 percent [60]. The

effect of changes in productivity can be gauged from the sensitivity performed at 2,3,6 and 10 percent.

The use of a real rate of discount as low as 4% can be justified in the special context of the health benefits accrueing in M.H.T. treatment. Assume a single person two good, two period economy. The individual is likely to discount the future too heavily due to

(i) time preference. Persons undergoing life-long drug therapy, or diet modification, while investing in their human capital through treatment, value immediate health benefits more highly than those far off. (manifested in the early dropout component of non-adherers to therapy).

or (ii) opportunity cost, the price of alterations in lifestyle especially for the young, to life long therapy are to high. Benefits in reduced morbidity and mortality occur too far off and are heavily discounted. The marginal rates of substitution between present and future consumption of benefits are too low.

EQUITY CONSIDERATIONS

C.B.A.'s in health care rarely deal with the issue of equity. The use of the age and sex-specific wage rates, in the human capital approach values mortality and morbidity savings in

working males more than females. The benefits of M.H.T. treatment accrue most heavily to the elderly.

On allocational grounds alone, a program for screening and detection of M.H.T. could be justified, even with a low rate of return, if it reached the poor and uneducated, whom the private sector might otherwise neglect (a market failure argument for government intervention). C.B.A., however, stems from the potential Pareto improvement criterion where all individuals can only conceivably be made better off by the intervention. Thus considerations of equity in C.B.A. calculation might result in a departure from the Pareto criterion and its replacement by attempts at maximization of total utility (Pareto optimality). Projects could pass even though their social cost exceeded their social benefit. Everyone could be made worse off.

NOTES

[1] The same distinctions apply to costs

[2] The same change in utility as would be achieved by the proposed change.

[3] Also the basis of compensation in court awards, with quality of life adjustment.

[4] We assume, individuals act under an "executive stress" assumption "while epidemiological studies do not support this view" [38, p 16]

[5] Mustacchi [42,AB] finds that hypertension is considered work related and therefore compensable "... judicial precedent has accepted the umproven theory that ...hypertension...[is due to] the stresses of work".

[6] The public good problem manifests itself in non excludability from a particular individuals act of saving.

[7] Though, with output as a parameter of macro-policy, 'full-crowding out', still occurs.

CHAPTER THREE

THE COSTS OF MILD HYPERTENSION (M.H.T.)

The costs of the M.H.T. condition are divided into mortality i.e. fatal events of stroke and myocardial infarction (M.I.), and morbidity or non-fatal events. Elevated blood pressure increases the probability of death and disability by increasing the incidence rate of events.

MORTALITY

The technique employed was based upon the expected future life time earnings criterion. Life tables were used in obtaining $P(D_{t+1}/t)$, the probability of dying between age t last birthday and age t+1 last birthday [54]. Effectively this may be treated as the normal life expectancy of persons who have been treated successfully for M.H.T. It should be noted that M.H.T. is epidemic in Australia. M.H.T. fatal events might then be a significant factor in the calculation of life-tables. The danger of double-counting results. This phenomenon was not considered to have significantly effected the conclusions.

A review of the relevant literature failed to yield exhaustive and compatible data indicating the increased probability of death due to M.H.T. An approximation was made given that M.H.T. accounts for almost 60% of all M.I.'s and strokes (fatal and nonfatal)[1]- see Appendix C. The resulting

conditional probabilities were extropolated using the median age, of the particular age catagories.

The target population, calculated at 662,800 was disaggregated by 5-year age groups and sex (see APPENDIX A(i)). Ages 35 through 69 were chosen, given that medical research indicates no demonstrable benefits for those falling outside this range.

Contrary to the accepted line of criticism, directed at the productivity approach to valueing life, pensioners are valued at the current market wage. This approach is supported by the permanent income hypothesis presented earlier. Since government redistributive policy is linked to current wages, use of earlier wage rates is difficult. Current average weekly earnings data 1982 [51] provide an approximation for permanent income.

Women also are valued at the current market wage. A change in the composition of the labour force, through women undertaking more responsible jobs, would be reflected in a rise in A.W.E. The premise is that more responsible jobs are more stressful. Consequent increases in the likelihood of M.I. and stroke require adequate wage compensation. Market failure may result in a distortion of market signals between wage differentals and stress however.

The opportunity cost of being a housewife is not valued at being a paid housekeeper (an equivalent risk job). Thus the

danger of double counting is introduced since housewives entering high risk jobs would lose their low risk status. Again the double counting effect can be considered negligible. It is assumed that work opportunities available generally consist of low stress occupations, as evidenced by the lower incidence of M.H.T. among women.

MORTALITY MODEL

(see table following)

N_t^*('000) : number of persons with mild hypertension (stock), at the beginning of their $t^{'th}$ year.

X : monthly earnings.

$P(D_{t+1}/t)^*$: conditional probability on $t^{'th}$ birthday of death before age t+1, given mildly hypertensive.

$A_{6\neg\frac{1}{3}}$: present value of an annuity of \$1 over 6 periods (months) at $^1/_3$% per period.

$L_t^{M,F}$: representative individual's net present value of annual expected losses, for age group t.

AGE	MONTHLY EARNINGS X		$P(D_{t+1}/t)$*		$P(D_{t+1}/t)$		N^*_t(000)		$XA_{\overline{6}|0.003}$		$t\alpha^*_M$	$t\alpha^*_F$	L^M_t $	L^F_t	PRESENT VALUE LIFE TIME LOSSES			PRESENT VALUE LIFE-TIME LOSSES OF STOCK (N^*_t)	
	M	F	M	F	M	F	M	F	M	F					$	M	F	$	M	F
35	1708	1310	.00155	.00076	.00143	.00073	12.728	2.78	10,130	7769	20	2	1.22	0.23	391.52	115.53		4,983,267	321,173
36	"	"	.00176	.00088	.00152	.00080	12.728	2.78	"	"	22	2	2.43	0.62	405.92	119.91		5,166,550	333,350
37	"	"	.00199	.00102	.00163	.00090	12.728	2.78	"	"	25	3	3.65	0.93	419.62	124.06		5,340,923	344,887
38	"	"	.00226	.00117	.00177	.00100	12.728	2.78	"	"	29	3	4.96	1.32	432.61	128.06		5,506,260	356,007
39	"	"	.00255	.00134	.00193	.00112	12.728	2.78	"	"	33	4	6.28	1.71	444.76	131.81		5,660,905	366,432
40	"	"	.00287	.00151	.00213	.00125	15.00	3.47	"	"	43	5	7.50	2.02	456.02	135.30		6,840,300	469,491
41	"	"	.00323	.00170	.00236	.00139	15.00	3.47	"	"	49	6	8.81	2.41	466.46	138.61		6,996,900	480,977
42	"	"	.00363	.00190	.00264	.00154	15.00	3.47	"	"	54	7	10.03	2.80	475.95	141.65		7,139,250	491,526
43	"	"	.00408	.00211	.00297	.00171	15.00	3.47	"	"	61	7	11.24	3.11	484.56	144.41		7,268,400	501,103
44	"	"	.00457	.00236	.00333	.00191	15.00	3.47	"	"	69	8	12.56	3.50	492.25	146.95		7,383,750	509,917
45	1646	1292	.00509	.00263	.00373	.00213	13.466	5.45	9762	7662	69	14	13.28	3.83	498.88	149.19		6,717,918	813,086
46	"	"	.00566	.00294	.00417	.00239	13.466	5.45	"	"	76	16	14.55	4.21	505.02	151.17		6,800,599	823,877
47	"	"	.00626	.00327	.00465	.00267	13.466	5.45	"	"	84	18	15.72	4.60	510.09	152.84		6,868,872	832,978
48	"	"	.00689	.00362	.00516	.00298	13.466	5.45	"	"	93	20	16.89	4.90	514.15	154.17		6,923,544	840,227
49	"	"	.00760	.00398	.00574	.00329	13.466	5.45	"	"	102	22	18.16	5.29	517.15	155.24		6,963,942	846,058
50	"	"	.00836	.00435	.00638	.00361	16.092	6.97	"	"	135	30	19.33	5.67	518.95	155.95		8,350,943	1,086,972
51	"	"	.00922	.00471	.00711	.00393	16.092	6.97	"	"	148	33	20.60	5.98	519.60	156.29		8,361,403	1,089,341
52	"	"	.01001	.00509	.00790	.00426	16.092	6.97	"	"	161	35	20.59	6.36	518.96	156.32		8,351,104	1,089,550
53	"	"	.01112	.00549	.00877	.00461	16.092	6.97	"	"	179	38	22.94	6.74	518.31	155.96		8,340,645	1,087,041
54	"	"	.01218	.00594	.00971	.00501	16.092	6.97	"	"	196	41	24.11	7.00	515.18	155.19		8,290,277	1,081,674
55	1628	1270	.01331	.00644	.01071	.00547	14.564	7.388	9655	7532	194	48	25.10	7.31	510.71	154.12		7,437,980	1,138,639
56	"	"	.01474	.00712	.01179	.00599	14.564	7.388	"	"	215	53	28.48	8.51	505.04	152.69		7,355,403	1,128,074
57	"	"	.01626	.00788	.01297	.00659	14.564	7.388	"	"	237	58	31.76	9.72	495.62	149.94		7,218,210	1,107,757
58	"	"	.01793	.00870	.01429	.00726	14.564	7.388	"	"	261	64	35.14	10.85	482.41	145.82		7,025,819	1,077,318
59	"	"	.01975	.00958	.01576	.00798	14.564	7.388	"	"	288	71	38.52	12.05	465.17	140.37		6,774,736	1,037,045
60	1525	1096	.2174	.01051	.01740	.00875	12.188	6.684	9044	6500	265	70	39.25	11.44	443.71	133.46		5,407,938	892,047
61	"	"	.02389	.01149	.01921	.00957	12,188	6.684	"	"	291	77	42.33	12.48	420.64	126.90		5,126,760	848,200
62	"	"	.02623	.01253	.02120	.01045	12.188	6.684	"	"	319	84	45.49	13.52	393.44	118.99		4,795,247	795,329
63	"	"	.02872	.01365	.02334	.01141	12.188	6.684	"	"	350	91	48.66	14.56	361.87	109.69		4,410,472	733,168
64	"	"	.03137	.01486	.02564	.01247	12.188	6.684	"	"	382	99	51.82	15.54	325.74	98.94		3,970,119	661,315
65	"	"	.03416	.01621	.02809	.01366	10.17	5.622	"	"	347	91	54.90	16.58	284.88	86.73		2,897,210	487,596
66	"	"	.03717	.01768	.03075	.01497	10.17	5.622	"	"	378	99	58.06	17,62	239.17	72.96		2,432,359	410,181
67	"	"	.04043	.01930	.03366	.01643	10.17	5.622	"	"	411	109	61.23	18.66	188.36	57.55		1,915,621	323,546
68	"	"	.04399	.02107	.03688	.01805	10.17	5.622	"	"	447	118	64.30	19.63	132.21	40.45		1,344,576	227,410
69	"	"	.04827	.02320	.04046	.01987	10.17	5.622	"	"	490	130	70.63	21.65	70.63	21.65		718,307	121,716

Extrapolation on N_t^* between years, was not feasible given the double peaked, non-linear nature, of M.H.T. prevalence data.

We assume, on average, death from M.H.T. events occurs on the 30 JUNE each year. These deaths cause losses in income for 1st July to 31st December annually. Net loss occurring without therapy was calculated using

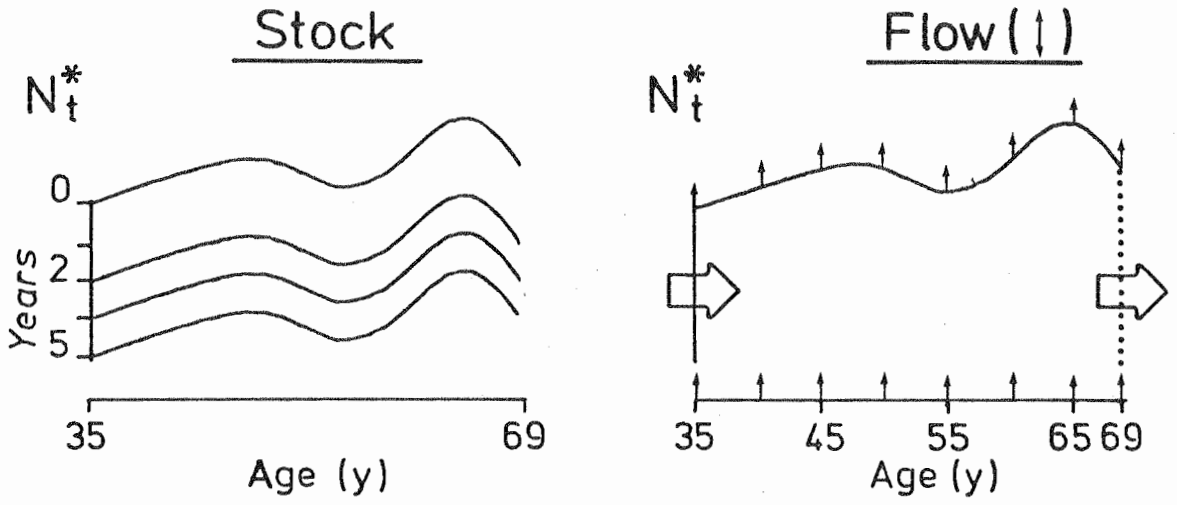
$$L_t^{M,F} = [\ P(D_{t+1}/t)^* - P(D_{t+1}/t)].X.A_{\overline{6}|0.00\overline{3}}$$

The product of N_t^* and present value of life-time losses yield the final mortality savings possible under fully effective treatment of the stock.

STOCK-FLOW CONSIDERATIONS

Other studies in hypertension control, both economic and medical, largely fail to consider the implications for costs of ongoing treatment, for those becoming hypertensive, the flow. An adequate treatment of the problem, presented by the flow, would require a purpose-built demographic model. The analysis presented, represents only a crude first approximation.

A constant stock assumption allows the flow, those becoming M.H.T. annually, to be viewed as incurring some fixed proportion of the costs and benefits of the stock, in perpetuity, (given a constant state of technology with 'tastes' in lifestyle and diet constant).



Assuming zero population growth, the outflow (↑) i.e. people dying from 'all causes' death and those turning 70 equals the inflow i.e. persons turning 35 years and people of any age acquiring, during the course of any year, a sustained elevation in blood pressure.

Using the former (outflow) as a measure of the flow, 10170 males and 5622 [52] females currently at age 69, leave the stock each year on turning 70. α_M^* and α_F^* indicate the absolute frequency of hypertensives dying annually, within age groups, where

$$\alpha_{M,F}^* = [P(D_{t+1}/t)^* - P(D_{t+1}/t)]N_t^*$$

Assuming that the number of persons entering a particular M.H.T. age group is proportional to those dying annually (in perpetuity).

$$F(LOW) = \frac{t\alpha_{M,F}^*}{\sum \alpha_{M,F}^*} \cdot N_{69}^* + {}_t\alpha_{M,F}^*$$

(see APPENDIX A (ii))

MORBIDITY

The Australian National Blood Pressure trial concludes that effective treatment of one million H.T.'s in Australia would result in 7000 fewer cardiovascular events (M.I.) and 2000 fewer strokes annually, at least [29] after a four-year period.

The costs of morbidity were divided into:

(i) hospitalization, the first year's treatment;

(ii) future treatment;

(iii)loss in labour productivity;

(i) Again events are assumed to occur 30 June each year. The direct resource cost of hospitalization was estimated using average-length of stay data [47], for stroke and M.I. in Tasmania, and cost per bed day $246.27. This figure includes salary, wages, drug and medical treatment components [56]. Adjustment for inflation to June 1984 prices was performed using C.P.I. 'all groups' index [55].

HOSPITALIZATION COSTS

UNDISCOUNTED

(JUNE 1984 $)

EVENT	STROKE		MI	
SEX	M	F	M	F
AV. LENGTH STAY(DAYS)	33	47	11	18
DIRECT COST ($)	8127	11575	2709	4433

Using data on event incidence rates for stroke and M.I.[2], according to age and sex (Appendix C), the discounted costs of hospitalization were calculated, at our preferred rate of discount 4%.

TOTAL DISCOUNTED COSTS

(STOCK) HOSPITALIZATION ($1984) D.R. 4%

AGE	M	F
35-39	1,801,847	6,660,088
40-44	23,367,605	9,231,771
45-49	47,947,554	14,244,168
50-54	155,719,963	41,006,724
55-59	173,856,274	46,770,840
60-64	86,620,748	27,558,699
65-69	24,244,406	7,751,311
	513,558,397	147,403,601
	660,961,998	

Although, non fatal events themselves decrease life expectancy, we assume expected losses in mortality have already taken this into account. Double counting is avoided.

(ii) Future treatment costs present problems in estimation. Drug treatment, in rehabilitation for stroke and M.I. varies widely in duration, intensity and type. Treatment is a function of the severity and characteristics of the event.

HARTUNIAN, SMART and THOMPSON's analysis [15] provides a proxy for estimation.

Discounting at HARTUNIAN'S preferred rate of 6% ($1975), the ratio of first year treatment to future treatment costs for both MI and stroke was found to be 2:1. The cost of treatment in the first year consisting primarily of that involved in treating the initial episode of the condition (hospitalization). While first year treatment costs would be relatively insensitive to use of different discount rates, future treatment costs might not be. Using Hartunian's average life expectancy with the events of stroke 10.5 years and MI,9 years and their U.S. figures, a sensitivity on future treatment costs was performed for D.R.'s of 2,3,4,6 and 10% (Appendix D). The 2:1 ratio remained robust.

TOTAL DISCOUNTED COSTS ($1984)

(STOCK) FUTURE TREATMENT D.R. 4%

M	F
256,779,199	73,701,800

330,480,999

(iii) 3 months absence from productive activity is assumed, per event, following Weisbrod [27]. This loss of earnings is in addition to that incurred during hospitalization [Appendix E]. Stock discounted costs are recorded below.

TOTAL DISCOUNTED COSTS ($1984)

(STOCK) LOST PRODUCTIVITY D.R. 4%

M	F
721,641,978	121,354
842,996,252	

(Appendix B (ii))

Flow morbidity costs were calculated in a similar manner. Total annual costs occurring in perpetuity in the absence of effective treatment according to:-

$$[(\frac{n_t^*}{N_t^*} .C)/r]/DR$$

n_t^* : age group annual flow

N_t^* : total H.T's by age groups.

C : annual cost in hospitalization, future treatment or lossed productivety (stock).

r : implicit, 6 months adjustment D.R. January of the year.

DR : discount rate

TOTAL (FLOW) DISCOUNTED COSTS DR 4%

HOSPITALIZATION ($1984)		LOSSED PRODUCTIVITY	
M	F	M	F
87,340,021	18,786,554	112,175,957	14,053,809
106,126,575		126,229,776	

FUTURE TREATMENT

43,670,610 9,393,277

53,063,287

(APPENDIX B (ii))

An understatement of the true costs of M.H.T. are likely. Firstly, pyschic costs deny measurement. These relate to the indirect intangible costs incurred by victims and their family and friends through pain, suffering and mental anguish. The asymptomatic nature of M.H.T. would limit this hidden cost component.

Secondly, tangible indirect costs also present difficulty in quantification. These would include cost of transport to medical facilities, ambulatory services and the use of voluntary medical labour. The additional years of life generated by effective treatment, require additional expenditure on medical care. Finally, costs could concievably include built in slack for probable inefficiencies in the programme.

NOTES

[1] Information provided by the Medical Research Council (U.K.) working party (forthcoming), should redress this problem.

[2] 6.4 Condition, Treatment in R.F.P.S. [49 p52]

CHAPTER FOUR

COSTS OF DETECTION AND TREATMENT

In costing, a probabilistic approach is followed in estimating the number of patients requiring care and specifying the linkages between diagnosis, treatment and outcome. Under assumptions of average cost, the total cost of each type of treatment are obtained. This C.B.A. improves upon previous analysis in hypertension costing, which have been based mainly in a cost effective framework (C.E.A.). While the level of benefits is not set at some pre-determined level, i.e. in say quality-adjusted life years saved, the most appropriate treatment mix is determined for achieving effective treatment.

SCREENING

Many of the C.B.A.'s performed concentrate upon the efficacy of alternative screening campaigns for disease, given that effective treatment is then obtainable. The results of this extensive literature suggest that hypertension detection and treatment clinics (mobile or otherwise) are not cost effective. Case finding through general practice has been found to be less expensive and more efficient than community based screening [33].

A screening campaign is envisaged which makes blood pressure reading mandatory on general practitioners (G.P.'s), for all patients aged 35-69. A four year program would be

implemented, over which 100% coverage of the stock is achieved[1]. Screening of the flow would be ongoing.

Three separate screening sessions per patient are assumed. This is in keeping with PETERSONS findings [36], where less than 40% initially registering high blood pressure will have it confirmed after three sets of readings.

The possible states of nature at the initial screening are NT (Normotensive) or MHT (mildly hypertensive). The initial readings can confirm these states when they exist i.e. true negative and true positive respectively, or deny these states when they actually exist i.e. false negative and false positive respectively.

The central assumptions are:-

(i) There are no false negatives and all false positives have exited to the normotensive range by the end of the third re-screening[2];

(ii) average duration of a visit is 15 minutes;

(iii) travelling and consultation times result in absence from productive activity, valued at the market wage;

TABLE S1
SCREENING (COMMENCING JUN'84)
UNDISCOUNTED MARGINAL COST

SCREEN NUMBER	COMPONENTS PATIENT	DOCTOR	COST ($) 1984 PATIENT M	$ F	DOCTOR	COMMENT
1	8 mins	8 mins	1.36	0.92	8	in addition to 15 minutes consultation
2	43 mins	13 mins	7.33	4.92	13	16.5% initially M.H.T.,prove false positive
3A	43 mins	13 mins	7.33	4.92	13	further 16.5% prove false positive
3B	15 mins	15 mins	2.56	1.72	25	Doctor costs includes $20 uric acid test.

note :-full time working hours $37\frac{1}{2}$ hrs. weekly total earnings, male 10.23/hr female 6.86/hr, scheduled fee $15 doctor consultation.

Calculations made implicitly equate LRMC with SRMC. We assume constant per-unit costs in the industry as a whole. If existing firms (surgeries) have already attained an optimal size, the increased demand resulting from rescreening (and later diagnostic sessions), will lead to an entry of new firms into the industry, with identical cost structures.

The average number of patients per G.P. in Australia was estimated at 860 [48]. Follow up screens occur at six monthly intervals, the final screen, being twelve months from the unrelated visit [34].

Thus a G.P. might expect to screen 25% of his 860 patients in each of the four years of the program. However, the

Australian Health Survey [53] suggests that over 70% of people see their G.P. within a year. Without the former assumption a two year program becomes feasible. However this might introduce over-time/penalty rate structures for the G.P.'s in the program and over utilization considerations. The average health bill for the first year would be very large. Some useful rule of thumb is required to adequately model the G.P. medical production function.

Groups considered in discounting are:-

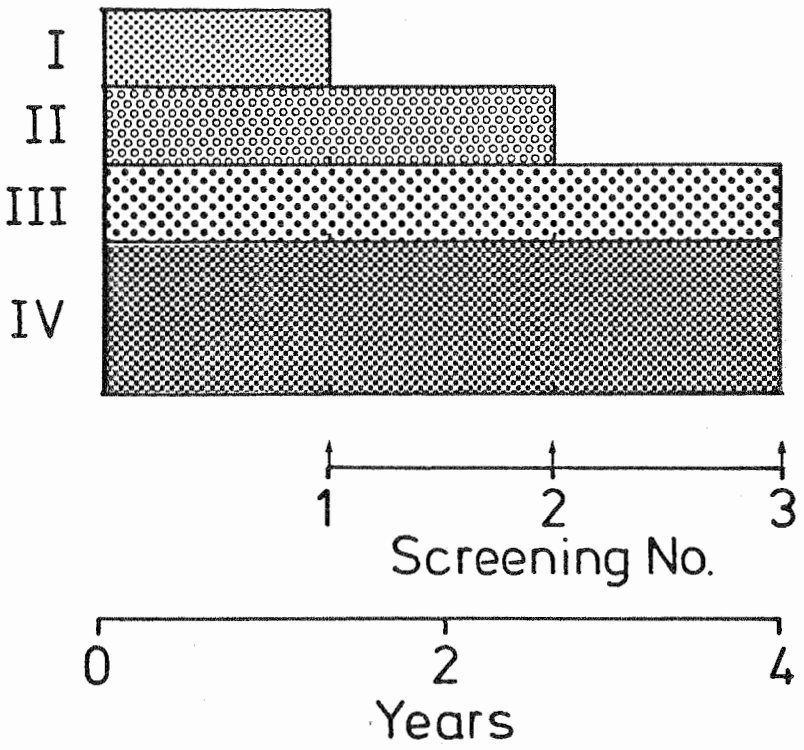
I those found to be normotensive at initial screening, or are currently on treatment (the R.F.P.S. [49,p56] indicates 33% of males and 61% of females - see Appendix A).

II those found normotensive at second screening (2)

III those found to be normotensive at screening (3)A

IV confirmed positives, the hypertensive stock in (3) B

In discounting, groups I to IV incur separate time streams of costs over the four year period. While any false positives remain in the screening program they are incurring costs. Expressed diagrammatically:-



We assume $12\frac{1}{2}\%$ coverage of the stock, semi-annually with

$A_{\overline{8}|0.02}$ incurrement of total costs.

TABLE S2

GROUP		N('000)	TOTAL DISCOUNTED COST (DK 4%, $ 1984)
I	M	1566.0	28,721,374
	F	1873.1	
II	M	116.00	4,321,836
	F	47.24	
III	M	96.86	5,909,642
	F	39.44	
IV	M	490.170	51,247,061
	F	199.603	
			$ 90,199,913

These costs exclude diagnostic tests since these are routinely performed only for the more severely H.T. The initial screen, is costed over the 8 minutes in which two sets of readings are taken as recdommended by DONNER [35]. No other time components are relevant, since blood pressure testing is not the purpose of the initial visit. Only visits in excess of the average number of consultations per episode of illness are relevant.

On-going screening costs of the M.H.T. flow, were calculated using the adjustment factor $\frac{n^*}{N_t}$, yielding total annual discounted cost of $2,718,318. Again these annual costs will occur in perpertuity, prior to effective treatment resulting in

TOTAL DISCOUNTED COST

SCREENING CAMPAIGN (FLOW)

$67,957,950

A possibility not explored is the use of nursing staff in (re)screening. Lower opportunity cost would be reflected in the saving of physcian time. An understatement of screening costs is likely with psychic costs incurred by the confirmed mild hypertensive. HAYNES [37] finds evidence for increased work absenteeism after detection and 'labelling' of hypertensives.

Effective detection of MHT introduces difficulty in accurately attributing future treatment costs to the program.

Many persons, would of become aware of their MHT by other means, incurring perhaps larger treatment costs from that point forward. The program, by accelerating the discovery of MHT, should properly, only attribute patient costs for treatment costs that would not otherwise have occurred. Total cost is biased downward[3].

COSTS OF TREATMENT

> "...unless we can better define those people with mild hypertension who will benefit most from therapy, community benefit would be bought at the expense of many previously symptom free individuals, who would experience drug side effects and expersience no benefit,"
> W.H.O. [46,p155]

Currently effective control of M.H.T. is obtained largely by pharmacological means. Diet modification, specifically the 'low sodium/high potassium diet' has gained wide-spread acceptance in potentiating the need for drug treatment[4]. The causal link between salt intake and the development of M.H.T. remains a bone of contention in the medical world. This might help explain the absence of C.B.A.'s which compare the economic performance of diet with drug treatments. This analysis attempts to bridge this gap. GRIFFITHS, while alluding to this gap, includes non drug treatment in his hyperthetical control program.

We follow the orthodox taxonomy in costs. Direct visible costs include drug costs, special dietary costs and screening.

Indirect visible costs cover follow up diagnostic care by the G.P.

DRUG TREATMENT

Calculations are performed on the basis of existing treatment priorities. Diuretics (DT1) usually provide the primary course of treatment. Beta-Blockers (DT2) are the 'second line of defence' drugs.

Two crucial assumptions are made in costing:-

(i) the 70% ASSUMPTION, which relates to the status quo in treatment i.e. that 70% of people initially undergo diuretic therapy (DT1).

(ii) the 20% ASSUMPTION, where only 20% of people initially take diuretics. NDT (salt modification) becomes the primary source of treatment.

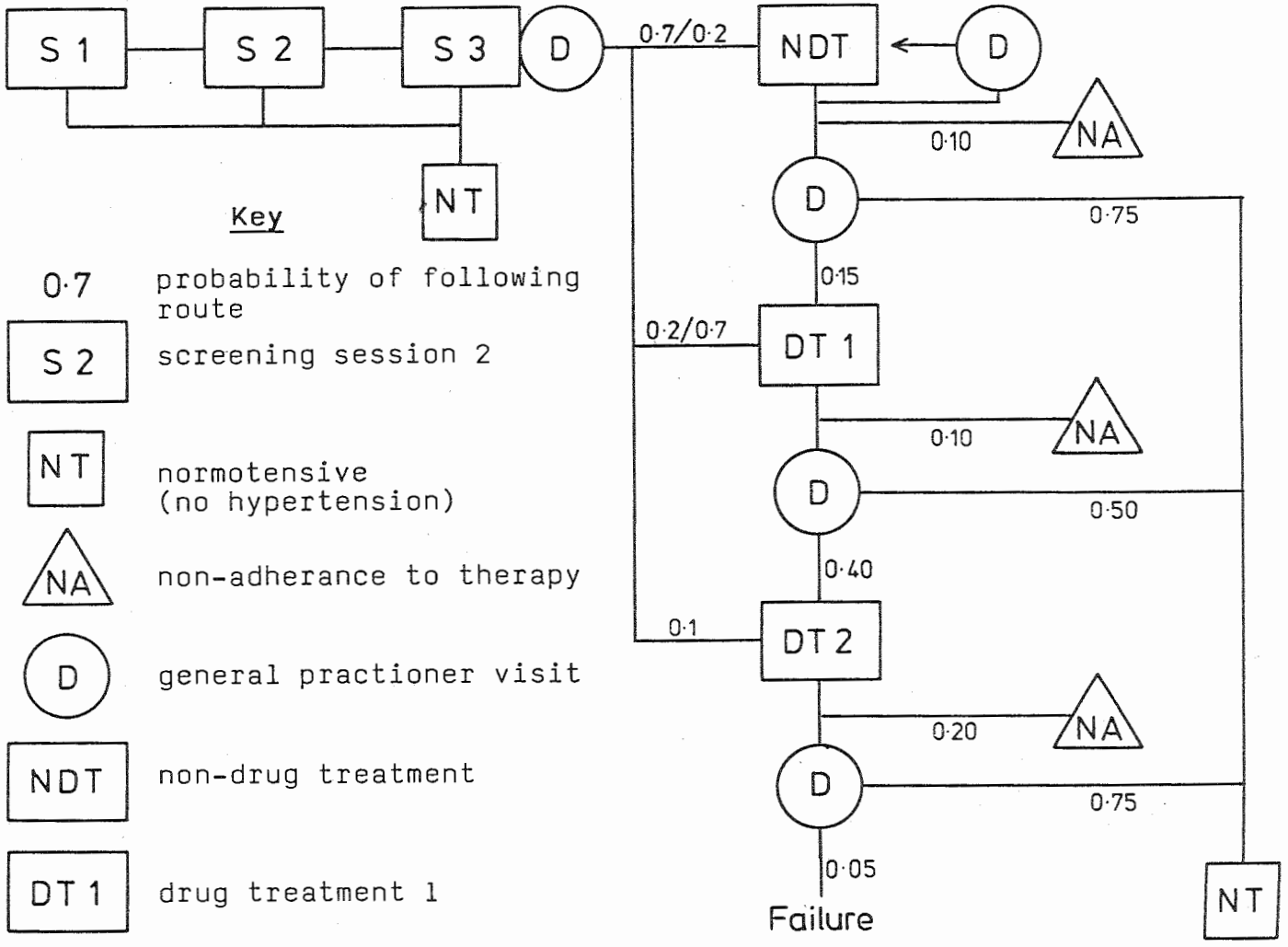
(see program flowchart following)

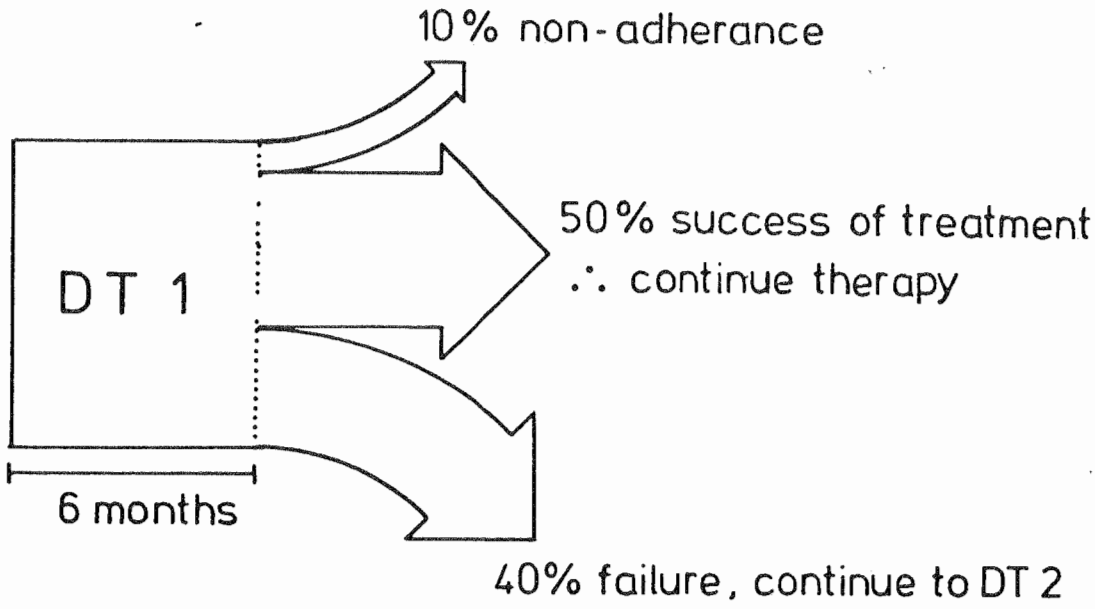
A sensitivity is performed with the alternatives. Other assumptions underlying the analysis are constant dosage[5] and non-simultaneity in treatment. As with many other aspects of a C.B.A. the latter assumption suggests further sensitivity.

DT1 DIURETICS

A selection of the most commonly prescribed Diuretics and Beta Blockers [49] yielded average cost of drug therapy per year (JUN'84) prices (Appendix F(ii)) $39.84 per patient/year DT1, $94.59 per patient/year DT2

Program treatment flowchart





Assuming $12\frac{1}{2}\%$ (of the 70%) enter DT1 each six months, commencing one year into the screening program.

A diagnostic session occurs after each initial six monthly course of treatment[6] (see flowchart). Non adherence (NA) is the most significant disguised cost. The results are particularly sensitive to the choice of this conditional probability. WEINSTEIN and STASON [28,p733] assume 33% NA for all drug treatments. However 10% was chosen following BRIERS and HAWTHORNE [6,p172] and the AUSTRALIAN NATIONAL BLOOD PRESSURE STUDY [29]. The choice of 10% appears realistic given that treatment failure (0.40, on flowchart) would include many of those who don't adhere to the drug regimen. 20% non-adherance to

therapy for Beta-Blockers (DT2) reflects the more adverse side effects of this form of treatment.

DT1 SUCCESSFULLY TREATED (NT)

The conditional probability is :-

$$P(DT1/MHT).P(S/DT1) = 0.7.0.5$$

This proportion of patients undergo lifelong therapy. We assume 25% of this group are treated each year, based one year into screening program.

TABLE D1

AGE	('000) PROPORTION 0.7.0.5.0.25		M 39.84 A_n	F 0.04	$ DISCOUNTED A_4 0.04,	DIURETIC COST
35-39	5.57	1.22	761.82	809.97	15,402,869	3,586,928
40-44	6.56	1.52	714.74	771.53	17,019,468	4,256,873
45-49	5.89	2.39	660.06	726.41	14,075,837	6,301,934
50-54	7.04	3.05	598.34	674.12	15,290,259	7.463.304
55-59	6.37	3.23	530.65	614.24	12,269,921	7,201,694
60-64	5.33	2.93	458.57	546.76	8,872,110	5,815,118
65-69	4.45	2.46	385.02	472.50	6,219,241	4,219,209
					89,149,705	38,845,060
					$127,994,765	

note :- n, is average life expectancy for age group

DT1 TREATMENT DIAGNOSIS (D)

The cost of the diagnostic session, 6 months post commencement, is 3A+3B less the uric acid test cost $20 (see Table S1) M$37.89, F$34.64. Cost is incurred by the 50% successfully treated and the 40% for whom it is discovered during diagnosis that DT1 has been a failure.

Using annuities, with 25% diagnosed each year, total discounted diagnostic costs are shown in table D2, combined with costs incurred for 6 months by treatment failures.

TABLE D2

DISCOUNTED DIAGNOSTIC TOTAL $ COSTS DR 4%		DISCOUNTED TOTAL COSTS $ PATIENT FAILURES DR 4%	
M	F	M	F
9,901,516	3,689,196	2,292,302	399,520
$ 13,696,418		$ 3,225,822	

DT1 NON-ADHERANCE (NA)

Non-adherance is most relevant to benefit calculations, in that costs incurred are the same but benefits are not recieved (or perhaps only partially)[7]. Classification was based upon PETERSON'S findings

(i) early dropouts; incurring 3 months treatment (30%)

(ii) partial compliers (missing one or more doses per month; incurring lifelong treatment costs (70%).

PETERSON's finding that partial compliers received only 45% of the benefits of treatment, suggests an overstatement of B/C ratios calculated. The conditional probabilities are :-

partial compliers

P(DT1/MHT) P(NA/DT1) P(PC/NA) = 0.7.0.10.0.7

early dropouts

P(DT1/MHT) P(NA/DT1) P(ED/NA) = 0.7.0.10.0.3

(see Appendix B(ii))

TOTAL DISCOUNTED COSTS DR 4%

EARLY DROPOUTS AND PARTIAL COMPLIERS

M	F
12,459. 078	5,418,534

$ 17,877,612

ADVERSE SIDE EFFECTS

Most side-effects of diuretic hyptotensive drugs, are mild, asymptotic and generally require no treatment. However side-effects do account for a significant component of non-adherance. Hypokalaemia in diuretic therapy is ameliorated by use of 'potassium sparing' diuretics at comparable annual cost[8].

DT2 BETA BLOCKERS

This course of treatment is costed in the same way as for DT1. Tables of discounted costs are not presented here in the interests of brevity (see Appendix G).

DT1 TOTAL DISCOUNTED COSTS OF TREATMENT ($ 1984)

75% SUCCESSFUL TREATMENT		10% FAILURES TREATMENT	
M	F	M	F
45,388,925	13,635,121	98,072	39,944
$ 58,352,796		$ 138,015	

20% NON-ADHERANCE (PARTIAL COMPLIERS & EARLY DROPOUTS)		TREATMENT DIAGNOSIS COSTS	
M	F	M	F
8,432,887	3,699,505	1,476,944	549,726
$ 12,102,392		$ 2,026,670	

Failures from DT1 are also costed through Beta-Blocker treatment allowance being made in present value calculations for time lags in effective treatment. (see Appendix H)

NON DRUG TREATMENT

The medical literature suggests that the average Australian consumes four times the daily requirement of salt, consistent with the maintainence of satisfactory blood pressure levels i.e. 1150m.g.[31,p3] daily. The addition of salt to food can be regarded as irrational, due to market failures in information. It is then a legitimate consideration in C.B.A.

Salt is viewed as a derived demand for a factor (part of the production function of diet). Demand is price inelastic since it comprises only a small proportion of the total cost of provision. People are willing to pay relatively high prices for

salt substitute products (under the orthodox assumption of constant tastes).

Costs of the NDT 'no added-salt' diet are composed of

(i)"... increased consulation and monitoring activity of such intervention" [36,p230]. Specifically diagnostic sessions at 2,3,6 and 12 months are assumed.

(ii) consumer willingness to pay for decreases in blood pressure. The assumption is of perfect information, provided by diagnostic sessions. The patient is aware of salt in all foods (processed or otherwise), and the need for reduction in salt intake to achieve normal B.P. levels.

Thus the average consumer, in reducing daily salt consumption by 4 grams daily pays:-

$$\frac{1.89}{0.25} \cdot 4 \text{ / day}^{9}$$

~3c / day

~$10.95 / year

This value would understate the true cost of a salt free diet due to:-

(iii) opportunity cost considerations with indirect tangible costs, reflected in the higher priced salt-free products, currently marketed (with small scale production).

By altering current lifestyle the patient is altering his wage earning capacity, and investing in his own human capital. However modification of behaviour paterns are also likely to include reducing obesity, cessation of smoking, low cholesterol diets etc. Thus salt diet, is one of many possible investments in health, that could be recommended in NDT [30].

75% success rate for salt diet modification is used, following MORGAN and MYERS [41] 10% non-adherance is consistent with PETERSON's [36,p3] findings in NDT compliance (see Appendix I for age sex breakdown of discounted costs under the 20% assumption).

NDT failures are costed through DT1 and DT2 (see Appendix J)

FLOW CONSIDERATIONS

As outlined previously costing of the flow, uses stock discounted cost figures. Adjustment by $\frac{n}{N_t^*}$ yielding total annual discounted costs occurring in perpetuity (Appendices, K and L).

NOTES

[1] In a 5 year program, 20% per year screened was assumed by BRYERS [6]

[2] Three screens recommended in STOKES [45]

[3] A problem explicitly recognized in MAYO CLINICAL PROC [33]

[4] By FREIS, BEARD, KAPLAN and others [32,31,39]

[5] Dosage is often increased until a satisfactory level of blood pressure is achieved.

[6] Though usually left to the G.P.'s discretion.

[7] This phenomenon was not taken into account in calculation of benefits

[8] 'MIDAMOR' AMILORIDE, treatment $34.70/year [50]

[9] representative salt-substitute product CENOVIS 'NO-SALT' $1.89/250mg

CHAPTER FIVE

PROGRAM AGGREGATE (DT1, DT2, NDT, SCREENING)

RESULTS (BENEFIT/COST)

D.R.	70% ASSUMPTION	20% ASSUMPTION
4%	2.3822	3.7692
2%	1.7214	3.3029
3%	2.1251	4.0420
6%	2.9333	5.6770
10%	3.5151	5.6510

(see APPENDIX M1)

PROGRAM BY AGE AND SEX (DT1,DT2,NDT,SCREENING)

RESULTS (BENEFIT/COST, NET BENEFIT)

	M	F	M	F
35-39	0.3696	0.4514	0.5303	0.5327
$	-62,692,073	-25,977,087	-32,557,825	-18,751,676
45-49	1.8888	0.9678	2.8865	1.3157
$	90,688,570	-1,744,436	125,952,943	12,587,776
55-59	5.1494	1.4285	7.9092	2.2053
$	516,468,112	34,031,680	559,900,340	62,005,431
65-69	1.6075	0.4733	2.4287	0.7002
$	67,115,575	-38,580,017	104,446,839	-14,841,883

REVIEW OF FINDINGS AND SENSITIVITY

The main sources of imprecision in estimates obtained relate to changes in productivity, development of new drugs, and labour fource participation rates. These sources would effect stock mortality and flow estimates particularly. Probabilities used in specifying links, between diagnosis, treatment and outcomes are at best indicative.

A sensitivity was performed to test for fragility in the choice and ranking of alternative mixes in treatment. Discount rates varying from 2 to 10 percent were used[1].

The results suggest that overall emplementation of the program, is not dependent upon the choice of assumption (70 or 20 percent) or discount rate. Ideally sensitivity would be performed on adherance rates, the major source of undertainty in treatment effectiveness.

Benefit/cost ratios are calculated under a full benefit assumption i.e. that alternative mixes of DT1, DT2 and NTD will successfully control M.H.T. in the target population. Conditional probabilities yield 2.5% and 1% failure rates under the 70 and 20 percent assumptions respectively. Thus benefit estimates are likely to be overstated. Net benefit is calculated as a means of ranking interventions by age groups.

In the aggregate social costs are outweighed by social benefits, reflected by the large ratios. A program, based on

NDT, salt-diet modification, as the primary treatment yields higher benefit (20% assumption). At the disaggregated level, no program is justified for those in the 35-39 year age group. Any treatment mix appears desirable for 45-59 year age group. Though diuretic (DT1) therapy is marginally rejected for females of 45-49, as a primary course of therapy. The program, should ideally be directed only at males in 65-69 age group, with the emphasis on N.D.T. treatment. Only a selection of age groups are calculated. However, net benefit figures indicate the program would maximize social benefit by screening and treating middle-aged males, with primary treatment in N.D.T.

The findings of this cost-benefit analysis largely confirm the trend in medical opinion, that treatment of persons with mildly elevated blood pressure is justified.

> "Applying optimal treatment to the large proportion of the population with mild hypertension could involve mass medication on a scale never before contemplated. This possibility has..encouraged efforts to evaluate non-drug treatment...[and] the most effective methods of identifying hypertensive individuals in the community."
>
> [JOHN J. McNEIL MB.B.S., MSc (EPIDEMIOC) PH.D RESEARCH FELLOW, NATIONAL HEART FOUNDATION OF AUSTRALIA MARCH 1984 IN "THE COST OF UNTREATED HYPERTENSION.]

NOTES

[1] Annual stock costs were not recaluclated with alternative D.R.'s before sensitivity on the flow.

APPENDIX A (I)

MILD HYPERTENSIVE STOCK

AGE GROUP	TOTAL POPULATION ('000)		% HYPERTENSIVE		TOTAL MILD HYPERTENSIVE		LESS CURRENTLY MEDICATED		LESS SCERENING ERROR 33%	
	M	F	M	F	M	F	M	F	M	F
35-39	503.6	486.0	28.15	10.95	141.76	53.22	94.98	20.75	63.64	13.90
40-44	427.5	406.8	39.08	16.32	167.07	66.39	111.94	25.89	75.00	17.35
45-49	377.3	357.5	39.75	29.17	149.98	104.28	100.49	40.67	67.33	27.25
50-54	394.1	397.2	45.48	35.17	179.24	133.36	120.09	52.01	80.46	34.85
55-59	369.8	370.9	43.87	38.11	162.23	141.35	108.69	55.13	72.82	36.94
60-64	292.6	321.4	46.39	39.79	135.74	127.89	90.95	49.88	60.44	33.42
65-69	250.4	285.4	45.24[a]	37.69[a]	113.28	107.57	75.90	41.95	50.85	28.11
							703.04	286.28	471.64	191.82
									662.80	

SOURCES : National Heart Foundation of Australia Risk Factor Prevalence Study No1 1980 p 26-33, Year Book Australia 1984, No 68 A.B.S. p87-116.

a complete figures not available, postulated mean age group 50-64

APPENDIX A(11)

FLOW MORTALITY LOSSES $

AGE	ANNUALLY		(FLOW.PV LIFETIME LOSSES)/D.R.	
	M	F	M	F
35	51	9	499,188	25,994
36	66	9	669,768	26,980
37	64	14	671,392	43,421
38	74	14	800,329	44,821
39	85	18	945,115	59,315
40	110	23	1,254,055	77,798
41	125	27	1,457,688	93,526
42	138	32	1,642,028	113,320
43	156	32	1,889,784	115,528
44	177	37	2,178,206	135,929
45	177	64	2,207,544	238,704
46	194	73	2,449,347	275,885
47	215	82	2,741,734	313,322
48	238	91	3,059,193	305,737
49	261	100	3,374,404	388,100
50	346	137	4,488,918	534,129
51	379	151	4,923,410	589,994
52	412	160	5,345,288	625,280
53	458	174	5,934,650	678,426
54	502	187	6,465,509	725,513
55	496	219	6,326,108	843,807
56	550	241	6,944,300	919,957
57	607	265	7,521,034	993,353
58	668	292	8,056,247	1,064,486
59	737	324	8,570,757	1,136,997
60	678	320	7,520,885	1,067,680
61	744	352	7,823,904	1.116,720
62	816	383	8,026,176	1,139,329
63	896	416	8,105,888	1,140,776
64	977	452	7,956,200	1,118,022
65	888	415	6,324,336	899,984
66	967	452	5,781,935	824,448
67	1052	498	4,953,868	716,498
68	1144	539	3,781,206	545,064
69	1254	593	2,214,251	320,961
TOTAL	16692	7195	152,904,445	19,303,840

$172,208,285

APPENDIX B(i)

ANNUAL PROBABILITY OF DEATH DUE M.H.T.

AGE GROUP		PERSONS SURVIVING 1982(i)	FREQUENCY ALL CAUSES DEATHS (ii)	HEART DISEASE /STROKE FATALITIES (iii)	$\left[\frac{(ii)}{(i)}\right].0.60$
25-44	M	2174.5	3,654	442	0.00012195
	F	2106.5	1,725	96	0.0000273
45-64	M	1433.8	15,493	6,217	0.0026016
	F	1429.0	8,153	2,317	0.0009728
65-74	M	613.5	17,869	7,983	0.0078073
	F	841.8	10,684	4,685	0.00333927

SOURCE:- DEATHS, AUSTRALIA 1982

APPENDIX B(ii)

AGE	TOTAL DISCOUNTED DIAGNOSTIC COSTS M	F	TOTAL DISCOUNTED COSTS OF PATIENT FAILURES M	F
35-39	1,337,105	268,394	309,718	67,611
40-44	1,577,303	334,274	364,988	84,468
45-49	1,414,501	524,589	327,621	132,613
50-54	1,692,066	670,986	391,581	169,633
55-59	1,531,935	710,022	354,387	179,713
60-64	1,281,058	641,705	296,510	162,680
65-69	1,067,548	539,226	247,497	136,784
	9,901,516	3,689,196	2,292,302	933,520
	13,696,418		3,225,822	

AGE	TOTAL DISCOUNTED COSTS EARLY DROPOUTS M	F	TOTAL DISCOUNTED COSTS PARTIAL COMPLIERS $ M	F
35-39	11,611	2,537	2,136,081	496,032
40-44	13,687	3,163	2,362,099	589,742
45-49	12,286	4,971	1,958,194	872,075
50-54	14,687	6,362	2,120,011	1,035,417
55-59	13,288	6,743	1,702,537	999,786
60-64	11,123	6,101	1,231,355	805,376
65-69	9,281	5,127	862,837	585,106
	85,963	35,004	12,373,115	5,383,530
			$ 17,877,621	

APPENDIX B(II)

TOTAL DISCOUNTED COSTS
(STOCK) LOST PROCUCTIVITY $ (JUN'84)

AGE	M	F
35-39	3,765,274	3,375,981
40-44	24,452,098	5,481,906
45-49	68,768,522	23,363,954
50-54	240,860,573	31,655,130
55-59	249,805,241	32,762,280
60-64	105,505,807	19,227,994
65-69	28,484,463	5,487,034
	721,641,978	121,354,278
	842,996,257	

TOTAL (FLOW) DISCOUNTED COSTS

	HOSPITALIZATION		LOSSED PRODUCTIVITY	
AGE	M	F	M	F
35-39	13,069	42,891	27,369	21,741
40-44	336,762	123,006	352,391	73,042
45-49	1,336,676	375,445	1,917,020	608,138
50-54	8,340,013	1,956,162	12,899,954	1,510,059
55-59	19,448,204	3,942,664	27,944,136	3,168,212
60-64	24,339,240	6,604,982	29,645,682	4,408,365
65-69	33,526,057	5,741,404	39,389,364	4,064,252
	87,340,021	18,786,554	112,175,957	14,053,809
	106,126,575		126,229,766	

APPENDIX C

STOCK MORBIDITY

INCIDENCE AND UNDISCOUNTED HOSPITALIZATION COSTS

AGE	%STROKE+		% M.I+		FREQUENCY STROKE		MI	
	M	F	M	F	M	F	M	F
35-39	0	0.24	0.06	0	0	33	38	0
40-44	0.12	0.24	0.36	0.12	90	42	270	21
45-49	0.3	0.48	0.46	0.72	202	131	646	196
50-54	0.78	0.42	3.66	1.14	628	146	2945	397
55-59	1.5	0.42	5.1	1.62	1092	155	3714	598
60-64	1.74	0.48	3.72	1.92	1060	160	2267	642
65-69	1.98	0.48	3.60	2.12	1007	135	1831	596

JUNE 1984 UNDISCOUNTED COSTS

	STROKE		MI	
35-39	0	380,075	102,827	0
40-44	729,000	483,731	730,618	92,916
45-50	1,636,200	150,878	1,748,072	867,220
50-54	508,680	1,681,542	7,969,150	1,756,564
55-59	8,845,200	1,785,199	10,050,095	2,645,967
60-64	8,586,000	1,842,786	6,134,486	2,840,588
65-69	8,156,700	1,554,851	4,954,674	2,637,058
	33,039,900	7,879,062	31,689,886	10,840,314

SOURCE : Risk factor prevalence study, N.H.F. NO 1 1980.

+appears to be large discrepancy between these figures (adjusted 60% MHT related) and A.N.B.P.S. estimates of incidence, possibly due to defining narrower range of Blood pressure as MHT.

APPENDIX D

MORBIDITY
SENSITIVITY, FUTURE TREATMENT COSTS/FIRST YEAR TREATMENT COSTS

HARTUNIAN DATA($M)		PRINCIPLE	PRESENT VALUE ANNUITY				
MI	974/459	67.5	551	526	502	459	389
STROKE	1526/740	97.0	911	862	819	740	613
DR	6%	6%	2%	3%	4%	6%	10%
RATIO		MI	974/551	974/526	974/502	974/459	974/389
		STROKE	1526/911	1526/862	1526/819	1526/740	1526/613
			2/1	2/1	2/1	2/1	3/1

APPENDIX E

STOCK MORBIDITY
LOSSED PRODUCTIVITY

UNDISCOUNTED COST

		M		F	
		STROKE	MI	STROKE	MI
35-39	1	0	194,712	129,690	0
	2	0	23,028	65,538	0
40-44	1	461,160	1,383,480	165,060	82,530
	2	163,620	163,620	83,412	15,981
45-49	1	997,476	3,189,948	507,756	759,696
	2	353,904	377,264	256,629	147,000
50-54	1	3,101,063	14,542,410	565,896	1,538,772
	2	1,100,256	1,219,880	286,014	297,750
55-59	1	5,333,328	8,139,176	590,550	2,278,380
	2	1,842,436	2,146,692	298,530	440,726
60-64	1	4,849,500	10,371,525	526,080	2,110,896
	2	1,721,440	1,226,447	256,920	408,312
65-69	1	4,607,025	8,376,825	443,879	1,959,648
	2	1,635,638	990,571	224,370	397,056

COST DISCOUNTED 30 JUN

	M		F	
	STROKE	MI	STROKE	MI
35-39	0	214,875	192,659	0
40-44	616,559	1,526,743	245,203	97,215
45-49	1,333,599	3,520,275	754,327	894,766
50-54	4,146,038	16,048,313	841,688	1,812,357
55-59	7,130,688	20,018,949	877,382	2,683,328
60-64	6,484,480	11,445,367	781,579	2,486,061
65-69	6,160,256	9,244,141	659,456	2,307,932

1.3 months absence from work
2. hospitalization time

APPENDIX F (i)

SCREENING DISCOUNTING

e.g. II first finding annual present values

$$M\ 9.36 + \frac{20.33}{(1.02)} = 29.29$$

$$F\ 8.92 + \frac{17.92}{(1.02)} = 26.49$$

$12\frac{1}{2}\%$ of people in this group making these 6 monthly payments over 4 years

		TOTAL COSTS
	M 14.5 ('000)	43,550
$12\frac{1}{2}$	F 5.905 ('000)	156,423
		589,973
		$589,973.A_{8\ 0.02}$
		4,321,836

APPENDIX F (ii)
HYPOTENSIVE DRUGS

DIURETICS NAME (BRAND)	COST $	BETA-BLOCKERS NAME (BRAND)	COST $
AMILORIDE (MIDAMOR)	2.89	ALPRENOLOL	5.69
CENDROFLUAZIDE (APRINOX)	2.81	ATENOLOL (TENORMIN)	9.54
CHLOROTHIAZIDE (CHLOTRIDE)	2.95	METOPROLOL	6.98
CHLOROTHACIDONE (HYGROTON)	2.57	OXYPRENOLOL	7.73
CYCLOPEWTHAZIDE (MAVIDREX)	2.81	PINDOLOL	8.53
FRUSEMIDE (LASIX)	2.77	PRUPRANOLOL	7.69
HYDROCHLOROTHAZIDE	3.41	TIMOLOL	8.53
METHYCLOTHAZIDE	2.84		
MODURETIC	3,76		
DYACIDE	4.70		
$\bar{X}$ = $3.29		$\bar{X}$ = 7.81	
$39.48 Per patient/year		$93.74 per patient/year	

source : 'PHARMACEUTICAL BENEFITS' AUGUST 1984
SCHEDULE OF PHARMACEUTICAL BENEFITS FOR APPROVED CHEMISTS : COMMONWLTH DEPT HEALTH, A.C.T.
: COST IS N.H.S. FOR 30 DAYS TREATMENT AVERAGE DOSE, APRIL '84 PRICES
: DOSES $\bar{c}$ COSTS MORE VARIABLE FOR BETA-BLOCKER

APPENDIX G
DT 2 BETA-BLOCKER
TOTAL DISCOUNTED COSTS OF TREATMENT

AGE	75% successful treatment		10% failures treatment	
35-39	7,832,686	1,821,932	13,244	2,895
40-44	8,660,712	2,340,535	15,618	3,613
45-59	7,184,649	1,978,278	14,014	5,674
50-54	7,781,410	2,190,264	16,755	7,257
55-59	6,246,687	1,810,432	15,164	7,693
60-64	4,517,190	1,347,653	12,690	6,959
65-69	3,165,595	2,146,027	10,589	5,845
	45,388,925	13,635,121	98,072	39,944
	58,352,796		138,015	

AGE	20% non-adherance (partial compliers + early dropouts)		treatment diagnosis costs	
35-39	152,536	338,155	199,634	39,768
40-44	1,607,912	401,502	235,127	49,778
45-49	1,334,213	594,471	211,100	78,080
50-54	1,455,127	705,063	252,208	99,795
55-59	1,160,799	681,033	228,457	105,895
60-64	940,797	549,222	191,089	95,893
65-69	590,296	400,057	159,329	80,517
	8,432,887	3,669,505	1,476,944	549,726
	12,102,392		2,026,670	

APPENDIX H
DT2(DT1), BETA-BLOCKER TREATMENT
OF DT1 FAILURES

TOTAL DISCOUNTED COSTS OF TREATMENT

AGE	21% successful treatment		1.4% failures treatment	
35-39	21,936,081	5,094,075	362,550	79,469
40-44	24,254,372	6,056,618	428,729	99,194
45-49	20,108,023	8,956,240	384,940	155,794
50-54	21,782,584	10,629,596	460,008	199,246
55-59	17,482,734	10,266,251	416,318	211,194
60-64	12,643,981	8,267,591	348,408	191,070
65-69	8,858,462	6,009,611	290,720	160,712
	127,067,237	55,279,982	2,691,746	1,096,679
	182,347,219		3,788,425	

AGE	5.6% non-adherance		treatment diagnosis costs	
35-39	4,178,746	952,731	516,537	109,783
40-44	4,626,687	1,209,811	608,742	137,032
45-49	3,842,378	1,707,804	546,488	215,244
50-54	1,149,426	2,030,197	653,058	275,249
55-59	925,528	1,965,131	591,047	291,756
60-64	2,440,654	1,587,400	494,623	263,955
65-69	1,720,705	1,158,902	412,727	222,016
	18,883,924	10,611,976	3,823,222	1,515,015
	34,952,809		5,338,237	

APPENDIX I

NDT, NON DRUG TREATMENT

TOTAL DISCOUNTED COSTS (20% ASSUMPTION)

AGE	75% successful treatment		15% failures treatment	
35-39	6,348,454	1,474,260	66,399	14,503
40-44	7,019,383	1,752,804	78,253	18,102
45-49	5,819,401	2,591,999	70,250	28,432
50-54	6,304,032	3,076,278	83,949	36,361
55-59	5,059,624	2,971,124	75,978	38,542
60-64	3,659,253	2,392,700	63,583	34,869
65-69	2,563,701	1,739,224	53,055	29,329
	36,773,848	15,998,389	491,467	200,138
	52,772,237		691,605	

AGE	10% non-adherance		treatment	diagnosis costs
35-39	1,083,765	241,004	5,368,502	1,111,830
40-44	1,229,716	289,294	6,327,307	1,355,101
45-49	1,054,391	437,840	5,680,515	2,128,737
50-54	1,193,109	535,424	6,787,961	2,722,601
55-59	1,013,431	537,691	6,143,848	2,885,194
60-64	788,914	456,045	5,140,853	2,609,779
65-69	667,994	357,603	4,290,517	2,222,472
	6,971,320	2,854,901	39,739,503	1,035,704
	9,826,221		54,775,217	

APPENDIX J

I DT1 (NDT) DIURETIC TREATMENT NDT FAILURES

II DT2 (NDT) BETA-BLOCKER TREATMENT NDT FAILURES FROM DT1
20% ASSUMPTION
TOTAL DISCOUNTED COSTS (REPRESENTATIVE AGES ONLY)

I	successful treatment		treatment failure		nonadherance		treatment	diagnosis
35-39	2,310,430	538,039	168,636	36,813	326,987	75,841	728,033	146,136
45-49	2,111,376	945,290	178,384	72,205	300,687	133,626	770,174	285,630
55-59	1,840,488	1,080,254	192,958	97,856	262,904	153,786	834,114	386,596
65-69	932,886	632,881	134,758	74,476	134,681	90,669	581,263	293,600
	18,460,784		465,263		2,549,333		1,975,445	
II								
35-39	328,973	76,521	13,244	2,895	6,407	14,203	8,385	1,670
45-49	301,755	83,088	14,014	5,674	56,037	24,968	8,866	3,279
55-59	262,361	76,038	15,164	7,693	48,753	28,603	9,595	4,448
65-69	132,955	90,133	10,589	5,854	24,791	16,802	6,692	3,382
	2,251,403		53,593		4,669,539		781,962	

APPENDIX K

FLOW DRUG TREATMENT COSTS (N^*)

ANNUAL COSTS, DISCOUNTED M, F

AGE	DT1 successful		DT1 diagnosis		DT1 failures	
35-39	79,883	16,498	6,933	1,236	1,606	311
40-44	160,209	37,064	14,848	2,909	3,436	735
45-49	252,194	94,795	22,794	7,893	5,280	1,995
50-54	298,519	173,215	44,100	15,576	10,206	3,938
55-59	515,202	261,418	64,332	25,775	14,882	6,524
60-64	598,483	334,571	86,420	36,917	20,002	9,359
65-69	648,742	374,732	111,373	47,899	25,821	12,150
	2,653,232	1,292,239	350,800	138,205	81,233	35,012
	3,945,471		489,005		116,245	

AGE	DT1 nonadherance		DT2 successful		DT2 diagnosis	
35-59	11,136	2,296	40,616	8,389	1,635	183
40-44	22,364	5,161	81,526	20,370	2,213	433
45-49	31,754	13,196	115,778	29,765	3,402	1,175
50-54	55,636	24,184	202,840	50,844	6,573	2,317
55-59	72,054	36,539	262,323	65,723	9,594	3,844
60-64	83,817	46,693	364,728	77,530	12,890	5,517
65-69	90,985	52,430	33,255	190,630	16,622	7,152
	367,746	180,499	1,388,030	443,251	53,329	20,621
	548,250		1,781,281		72,950	

AGE	DT2 nonadherance		DT2 failures		DT2(DT1) successful	
35-39	790	1,557	68	13	111,517	22,995
40-44	15,136	3,494	147	31	223,838	51,678
45-49	21,501	8,944	226	85	317,380	132,112
50-54	37,664	16,367	437	168	556,580	241,915
55-59	48,746	24,721	637	279	719,774	365,379
60-64	56,720	31,596	856	400	836,236	466,309
65-69	61,581	35,536	1,104	520	906,051	523,364
	242,138	122,215	3,476	1,498	3,671,676	1,803,752
	36,267		4,974		5,475,428	

AGE	DT2(DT1) non adherance		DT2(DT1)diagnosis		DT2 (DT1) failures	
35-39	21,669	4,386	2,678	565	1,879	365
40-44	43,551	10,529	5,730	1,193	4,636	863
45-49	61,918	25,695	8,806	3,238	6,203	2,344
50-54	108,835	26,222	17,020	6,390	11,989	4,625
55-59	141,082	71,338	24,820	10,591	17,483	7,667
60-64	164,646	91,323	31,311	15,185	23,504	10,992
65-69	179,515	102,944	43,058	19,722	30,330	14,276
	721,216	353,344	133,423	56,824	95,429	41,132
	1,075,560		190,247		136,536	

APPENDIX L

FLOW NON DRUG TREATMENT COSTS

ANNUAL, DISCOUNTED

AGE	NDT DIAGNOSTIC		NDT SUCCESSFUL		NDT FAILURES	
35-39	27,838	5,119	32,919	6,788	344	67
40-44	59,561	11,794	66,076	15,255	737	158
45-49	91,540	32,029	93,778	38,999	1,132	428
50-54	176,912	63,202	164,300	71,412	2,188	844
55-59	258,004	164,739	212,474	107,858	3,192	1,399
60-64	346,801	150,141	246,853	137,652	4,289	2,006
65-69	447,614	197,421	267,411	154,495	1,535	2,605
	1,408,270	564,455	1,083,811	532,459	17,416	7,507
	1,972,715		1,616,270		24,923	

AGE	NDT NON ADHERANCE		DT1(NDT) SUCCESS		DT1(NDT)DIAGNOSIS	
35-39	5,620	1,097	11,522	2,379	1,040	185
40-44	11,575	2,517	23,107	5,346	2,227	436
45-49	16,991	6,588	36,374	13,672	3,419	1,184
50-54	31,096	12,429	57,479	24,983	6,615	2,336
55-59	42,558	19,520	74,308	37,704	9,650	3,866
60-64	53,220	26,263	86,320	48,248	12,963	5,538
65-69	36,430	31,766	93,569	54,048	16,706	7,185
	224,491	100,153	382,679	186,380	52,620	20,730
	324,644		569,059		73,350	

AGE	DT1(NDT)FAILURE		DT1(DNT)NON ADHERANCE		DT2(NDT)SUCCESS	
35-39	231	45	1,607	331	2,239	462
40-44	496	106	3,226	744	4,494	1,123
45-49	761	288	4,580	1,903	6,382	1,641
50-54	1,472	568	8,024	3,488	11,178	2,802
55-59	2,146	941	10,392	5,270	14,459	3,623
60-64	2,885	1,350	12,089	6,735	16,796	4,273
65-69	3,724	1,752	3,123	7,562	18,203	16,507
	11,715	5,050	53,041	26,043	76,051	24,431
	16,765		79,074		98,182	

AGE	DT2(NDT)FAILURE		DT2(NDT)NON ADHERANCE		DT2(NDT)DIAGNOSIS	
35-39	26	5	305	1,557	399	71
40-44	57	12	584	1,348	854	167
45-49	87	33	8,296	8,944	1,313	453
50-54	169	65	14,534	6,315	2,536	894
55-59	246	108	18,808	9,538	3,726	1,483
60-64	330	154	21,885	12,190	4,973	2,129
65-69	426	200	23,760	13,711	6,413	2,759
	1,341	577	88,172	53,603	20,190	7,956
	1,918		141,775		28,146	

APPENDIX M1

BENEFITS (TOTAL)

Under full benefit assumption, discount rate 4%

Mortality(S)		205,183,621
Morbidity(S)	hospitalization	660,961,998
	future treatment	330,480,999
	productivity	842,996,257
Mortality(F)		172,208,285
Morbidity(F)	hospitalization	106,126,575
	future treatment	53,063,288
	productivity	126,229,766
	TOTAL	2,497,250,789

COSTS (TOTAL)

(S)TOCK:-			
screening(S)		90,199,913	90,199,913
DT1(S)	success	127,994,764	36,569,931
	failure	3,225,822	921,663
	non-adherance	17,877,612	5,050,106
	diagnosis	13,696,418	3,913,262
DT2(S)	success	58,351,796	16,671,942
	failure	138,015	39,433
	non-adherance	12,102,392	3,457,826
	diagnosis	2,026,670	579,049
DT2(DT1)[a]	success	275,892,934	50,255,124
	failure	3,788,425	1,082,407
	non-adherance	34,952,809	9,986,517
	diagnosis	5,338,237	1,525,210
NDT(S)	success	14,906,055	52,171,192
	failure	197,601	691,605
	non-adherance	2,807,492	9,826,221
	diagnosis	15,650,062	54,775,217
DT1(NDT)	success	5,274,510	18,460,784
	failure	132,932	465,263
	non-adherance	728,381	2,549,333
	diagnosis	564,313	1,975,445
DT2(NDT)	success	643,258	2,251,403
	failure	15,312	53,593
	non-adherance	1,334,154	4,669,539
	diagnosis	223,418	781,962
	SUB-TOTALS	588,063,395	368,923,940

(F)LOW

screening(F)		67,957,950	67,957,950
DT1(F)	success	98,636,777	28,181,936
	failure	2,906,125	830,321
	non-adherance	13,706,125	3,916,036
	diagnosis	12,225,125	3,492,893
DT2(F)	success	44,532,025	12,723,436
	failure	124,350	35,529
	non-adherance	9,056,675	2,587,621
	diagnosis	1,823,750	521,071
DT2(DT1)	success	136,885,700	39,110,199
	failure	3,413,900	975,400
	non-adherance	28,864,000	8,246,857
	diagnosis	4,756,175	1,358,907
NDT(F)	success	11,544,786	40,406,750
	failure	178,021	623,075
	non-adherance	2,318,886	8,816,100
	diagnosis	14,090,821	49,317,875
DT1(NDT)	success	4,064,707	14,226,475
	failure	119,750	419,125
	non-adherance	564,814	1,976,850
	diagnosis	523,928	1,833,750
DT2(NDT	success	701,300	2,454,550
	failure	13,700	47,950
	non-adherance	1,012,670	3,544,375
	diagnosis	201,043	703,650
	SUB-TOTALS	460,223,112	293,608,681
	TOTAL	1,048,286,507	662,532,621
BENEFIT / COST		2.3822	3.7692
SENSITIVITY	D.R.		
	2%	1.7214	3.3029
	3%	2.1251	4.0420
	6%	2.9333	5.6770
	10%	3.5151	5,6510

[a]read as 'failures from DT1 entering DT2'

APPENDIX M2
AGE GROUP 35-39

BENEFITS :-

		M	F
mortality(S)		26,657,905	1,721,849
morbidity(S)	hospitalization	1,801,847	6,660,088
	future treatment	900,924	3,330,044
	productivity	3,765,274	3,375,981
mortality(F)		3,585,792	200,531
morbidity(F)	hospitalization	13,069	42,891
	future treatment	6,534	21,446
	productivity	27,309	21,741
	TOTALS	36,758,654	21,374,571

COSTS :-

	70% ASSUMPTION		20% ASSUMPTION	
STOCK	M	F	M	F
screening(S)	18,822,304	18,190,097	18,822,304	18,190,097
DT1(S)	19,197,384	4,421,502	5,484,966	1,263,286
DT2(S)	8,190,145	2,201,020	2,340,041	628,863
DT2(DT1)	26,741,145	8,379,448	7,640,328	1,735,265
NDT(S)	3,610,519	803,340	12,853,841	1,838,696
DT1(NDT)	1,009,739	227,665	3,863,059	796,829
DT2(NDT)	102,003	27,225	357,009	892,118
SUB-TOTAL	77,673,239	32,049,277	51,032,578	25,548,324
FLOW				
screening(F)	14,181,002	13,704,688	14,181,002	13,704,688
DTT1(F)	2,488953	508,522	711,129	146,348
DT2(F)	1,062,742	253,558	303,641	71,814
DT2(DT1)	3,443,575	706,275	983,879	201,793
NDT(F)	477,150	93,365	1,670,025	326,775
DT1(NDT)	102,858	20,999	360,000	73,500
DT2(NDT)	21,208	14,964	74,225	52,365
SUB-TOTAL	21,777,488	15,302,381	18,283,901	14,577,923
TOTAL	99,450,727	47,351,658	69,316,479	40,126,247
NET BENEFIT	-62,692,073	-25,977,087	-32,557,825	-18,751,676
BENEFIT/COST	0.3696	0.4514	0.5303	0.5327

NOTE: Costs presented are the aggregate of success, failure, non -adherance and diagnosis. DT1(S) refers duiretic treatment of stock (F) for flow.

AGE GROUP 45-49

BENEFITS :-

		M	F
mortality(S)		34,274,875	4,156,226
morbidity(S)	hospitalization	47,947,554	14,424,168
	future treatment	23,973,777	7,212,084
	productivity	68,768,522	23,363,954
mortality(F)		13,832,222	1,566,748
morbidity(F)	hospitalization	1,336,676	375,445
	future treatment	668,338	750,890
	productivity	1,917,120	608,138
	TOTALS	192,719,084	54,457,653

COSTS :-

	70% ASSUMPTION		20% ASSUMPTION	
STOCK	M	F	M	F
screening(S)	13,178,334	12,583,324	13,178,334	12,583,324
DT1(S)	17,788,439	7,836,182	5,082,410	2,238,909
DT2(S)	8,743,871	2,656,503	2,498,277	850,000
DT2(DT1)	24,649,407	9,931,758	7,042,686	3,123,361
NDT(S)	3,607,016	1,482,001	12,624,557	5,187,008
DT1(NDT)	960,178	410,501	3,360,621	1,436,751
DT2(NDT)	108,764	33,431	380,672	117,009
SUB-TOTAL	69,024,109	35,033,700	44,167,557	25,445,362
FLOW				
screening(F)	9,928,752	9,480,462	9,928,752	9,480,462
DTT1(F)	7,799,431	2,946,968	2,228,408	841,991
DT2(F)	3,522,671	999,234	1,006,478	285,495
DT2(DT1)	9,865,175	4,084,725	2,818,621	1,167,065
NDT(F)	1,453,149	557,457	5,086,025	1,951,100
DT1(NDT)	322,385	120,464	1,128,350	421,625
DT2(NDT)	114,842	79,079	401,950	276,775
SUB-TOTAL	33,006,405	18,268,389	22,598,584	14,424,515
TOTAL	102,030,514	54,202,089	66,766,141	39,869,877
NET BENEFIT	90,688,570	-1,744,436	125,952,943	12,587,776
BENEFIT/COST	1.8888	0.9678	2.8865	1.3157

AGE GROUP 55-59

BENEFITS :-

		M	F
mortality(S)		35,812,148	5,488,842
morbidity(S)	hospitalization	173,856,274	40,770,840
	future treatment	86,928,137	20,385,420
	productivity	249,805,241	32,762,280
mortality(F)		37,418,446	4,958,600
morbidity(F)	hospitalization	19,448,204	3,942,664
	future treatment	9,724,102	1,971,332
	productivity	27,944,136	3,168,212
	TOTALS	640,936,688	113,448,190

COSTS :-

	70% ASSUMPTION		20% ASSUMPTION	
STOCK	M	F	M	F
screening(S)	12,867,896	12,836,293	12,867,896	12,836,293
DT1(S)	3,614,416	9,097,959	4,534,877	2,599,415
DT2(S)	7,651,106	2,605,053	2,186,030	744,301
DT2(DT1)	21,958,575	12,734,332	6,233,879	3,638,381
NDT(S)	3,512,252	1,837,872	12,292,881	6,432,551
DT1(NDT)	894,417	490,996	3,130,464	1,718,486
DT2(NDT)	95,963	33,366	355,873	116,782
SUB-TOTAL	62,8522,309	39,635,870	41,581,900	28,086,209
FLOW				
screening(F)	9,694,863	9,671,053	9,694,863	9,671,053
DTT1(F)	16,661,748	8,256,395	4,760,499	2,358,970
DT2(F)	8,032,494	2,364,181	2,294,999	675,481
DT2(DT1)	22,578,975	11,374,375	6,454,137	3,249,821
NDT(F)	3,687,336	1,667,972	12,905,675	5,837,900
DT1(NDT)	694,601	341,292	2,412,400	1,194,525
DT2(NDT)	266,250	105,372	931,875	368,800
SUB-TOTAL	61,616,267	39,780,640	39,454,448	23,356,550
TOTAL	124,468,576	79,416,510	81,036,348	51,442,759
NET BENEFIT	516,468,576	34,031,680	559,900,340	62,005,431
BENEFIT/COST	5.1494	1.4285	7.9092	2.2053

AGE GROUP 65-69

BENEFITS :-

		M	F
mortality(S)		9,308,073	1,570,446
morbidity(S)	hospitalization	24,244,406	7,751,311
	future treatment	12,122,203	3,875,656
	productivity	28,484,463	5,487,034
mortality(F)		23,055,596	3,306,955
morbidity(F)	hospitalization	33,526,057	5,741,404
	future treatment	16,763,029	2,870,702
	productivity	39,389,364	4,064,252
	TOTALS	177,585,118	34,667,760

COSTS :-

	70% ASSUMPTION		20% ASSUMPTION	
STOCK	M	F	M	F
screening(S)	8,636,125	9,873,832	8,636,125	9,873,832
DT1(S)	8,406,404	5,485,452	2,472,543	1,567,272
DT2(S)	3,925,782	2,632456	3,754,108	752,130
DT2(DT1)	12,295,370	8,238,298	3,512,963	2,353,800
NDT(S)	2,147,220	2,242,465	7,515,267	4,398,628
DT1(NDT)	509,596	311,893	1,783,599	1,091,626
DT2(NDT)	50,007	33,192	175,027	116,176
SUB-TOTAL	35,970,504	27,817,591	25,146,452	20,103,460
FLOW				
screening(F)	6,506,565	7,439,085	6,506,565	7,439,085
DTT1(F)	21,923,028	12,180,281	6,263,722	3,480,081
DT2(F)	10,239,067	5,845,949	2,925,447	1,670,272
DT2(DT1)	28,973,850	16,507,650	8,278,245	4,716,470
NDT(F)	5,599,929	2,759,193	19,599,750	9,657,178
DT1(NDT)	908,015	503,906	3,178,050	1,763,675
DT2(NDT)	348,505	194,122	1,220,050	679,425
SUB-TOTAL	74,499,039	45,430,186	47,971,827	29,406,183
TOTAL	110,469,543	73,247,777	73,118,279	49,509,643
NET BENEFIT	67,115,575	-38,580,017	104,466,839	-14,841,883
BENEFIT/COST	1.6075	0.4733	2.4287	0.7002

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