

Preventable Chronic Diseases Strategy

- the Evidence Base

Best buys and key result areas in chronic disease control

August 1999
Territory Health Services



TERRITORY HEALTH SERVICES
Northern Territory Government

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Example One

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Introductory notes

This document focuses on the evidence base behind the NT Preventable Chronic Diseases Strategy. It should be read in conjunction with the Ministerial Statement delivered by Hon. Stephen Dunham MLA, Minister for Health, Family and Children's Services, in the August 1999 sitting of the NT Legislative Assembly.

The evidence is drawn from a collective review of the national and international literature over a three year period. The literature was collected specifically for the purpose of informing strategy development, and during the course of a series of projects and ongoing activities relating to chronic disease in the NT.

Because of the wide range of subject areas covered, the emphasis in reading the literature was on finding authoritative systematic reviews, meta-analyses, expert reviews and consensus statements.

Where available, this document focuses on the 'interventional' literature, rather than literature that mainly describes the nature or size of a problem. Where there is striking evidence to support intervention, but as yet insufficient evidence to define the precise intervention, this constitutes a 'key result area' or a component of one. If a particular program with a discrete set of activities can be identified and purchased, this constitutes a 'best buy'. At times, the distinction may be blurred (see following summary of key result areas). The level of specification of the intervention also determines whether it is described as a key result area or a best buy.

There are 6 key result areas in this document; the first four for prevention, then one for early detection and one for best practice management. The balance of these key result areas shows the emphasis on prevention in the Preventable Chronic Diseases Strategy.

The document also contains reference where possible to the cost-effectiveness literature (see supplementary note), since THS is committed to developing a mix of services that are both an efficient use of resources and deliver better health outcomes.

It should be noted that for some of the best buys and key result areas, the strength of the historical evidence is such that randomised controlled trials of interventions have never been undertaken, and indeed would be unethical. This is often the case with well established public health interventions. We have not therefore graded the level of evidence according to the criteria accepted by NHMRC (1998) since these criteria attach no formal value to expert opinion or the findings of experts or consensus working groups. In the NT context, a disregard of expert opinion would be inappropriate, given the lack of formal evidence in many crucial areas and critical population groups (such as the indigenous population). We were also not in a position to assess the quality of each study individually - instead we have relied on the assessments of expert reviewers and review groups. Public health policy always results from a consideration not only of evidence but also of values and resources (Muir Gray, 1997) and this document demonstrates a strong marrying of evidence and local consensus.

This document will be useful in defining a progressive implementation agenda for the PCDS, and framing implementation plans, but does not itself constitute an implementation plan. Operational areas within THS have been asked to incorporate elements of the PCDS within their business plans. Prioritisation of the agenda will be determined by what operational areas are currently doing and the marginal costs and benefits of shifting resources. A Monitoring and Evaluation Group will monitor the overall progress of the the PCDS across the key result areas and report to an Advisory Committee that will be responsible for changing the direction of implementation as indicated.

We have attempted at all times to consider the relevance of the evidence base to the situation in the NT. A series of drafts of this document have been circulated widely for comment, and those comments incorporated as appropriate. We welcome further comments on the evidence base itself and our interpretation of its applicability. Any comments should be sent to the Community Physician, Centre for Disease Control, Territory Health Services, Block 4, Royal Darwin Hospital Campus, Tiwi NT 0810. This document will be revised in six months time.

A summary of the six key result areas (KRA) and their components, and the best buys (BB)

A key result area is one for which there is strong evidence to support intervention, but as yet insufficient evidence to define all the precise interventions that constitute a complete program leading to health gain. Local experience leads us to believe that the key result areas are of particular relevance to the NT population. Within a key result area, there may be a number of ‘best buys’. We will continue to develop innovative evaluated programs in the key result areas, and undertake research to answer key questions.

A best buy is a discrete program or set of interventions that can be identified and purchased, which evidence suggests will lead to health gain in a defined population, and is of proven cost-effectiveness. Local experience leads us to believe that the program can be generalised to at least some segments of the NT population. The fact that a program is labelled a best buy does not imply that is more important than a key result area, or even that we have evidence on how it can be implemented in all population groups.

At times, the distinction between a best buy and key result area may be blurred. For example, the level of specification of the intervention partly determines whether it is described as a key result area or a best buy. Many specific interventions that could be accurately called ‘best buys’ are included in the evidence base that follows but are not included in this summary list which is intended to give a broad overview of the main key result areas, and their major components. It should also be noted that medical interventions in the curative arena that are straightforward and well evaluated lend themselves more easily to the label ‘best buy’ than do complex multifaceted interventions in the preventive arena that have to take into account socio-cultural factors.

Key result area 1 - Maternal health

Improving infant birthweight (KRA)

Key result area 2 - Promotion of child growth

Breastfeeding (BB)

Preventing childhood malnutrition (KRA)

Decreasing childhood infections through better environmental health conditions (KRA)

Childhood immunization (BB)

Key result area 3 - Underlying determinants of health

Maternal and childhood education (KRA)

Alleviate poverty (KRA)

Promote 'sense of control' and mental well-being (KRA)

Key result area 4 - Lifestyle modification

Smoking cessation and prevention programs (BB)

Brief intervention for hazardous alcohol use (BB)

Nutrition, weight loss and physical activity programs in high risk populations (BB/KRA)

Key result area 5 - Early detection and early treatment

Screening (BB/KRA)

Adult immunisation (BB)

Aggressive blood pressure lowering to prevent progression of renal disease (BB)

Key result area 6 - Best practice management

Prevention of complications of diabetes (BB/KRA)

Aggressive management of heart attacks and known cardiovascular disease (BB)

Rehabilitation and outreach programs (cardiac, respiratory, renal) (BB)

Supplementary note on cost-effectiveness literature

Cost effectiveness analysis is a method for comparing the long-term costs and benefits of medical interventions. It refers to the incremental cost of an intervention (compared with the current treatment) divided by the incremental benefit, often expressed as cost per life year gained.

Cost utility analysis weights the benefit by the recipient's quality of life and is usually expressed as cost per quality-adjusted life years (QALY).

Ades *et al.* (1997) describe a cost effectiveness value of \$20,000 or less as highly cost effective, a value of \$20,000 to \$40,000 indicates consistency with currently funded interventions and a value greater than \$40,000 indicates marginal or poor cost-effectiveness.

In terms of published cost-effectiveness analyses, diabetes is the most studied of the chronic diseases.

But it should be noted that accurate cost-effectiveness data is often not available for many routine clinical interventions, and for public health interventions, it is even more difficult to estimate costs and benefits.

Guidelines have been published to help judge the quality of economic evaluations (e.g. Sackett *et al.*, 1991), but time constraints precluded our assessing the studies individually.

All dollar figures in this document are in US dollars unless otherwise stated, since the majority of the cost-effectiveness literature comes from the US.

Key result area 1 - Improving maternal health

Improving infant birthweight

- The nutritional status of the mother, in particular height, weight before pregnancy and weight gain during pregnancy all influence the growth of the baby before birth, and its subsequent birthweight (Godfrey *et al.*, 1996).
- There is now strong evidence that undernutrition and poor fetal growth as measured by a low birth weight predicts the development in adulthood of hypertension, diabetes, hyperlipidemia, ‘syndrome X’ and mortality from cardiovascular disease and chronic lung disease. This is known as the ‘Barker Hypothesis’; namely that environmental factors ‘programme’ particular body systems during critical periods of growth, in utero and infancy, with long term direct consequences for adult chronic disease (Barker, 1993; Barker, 1997; Scrimshaw, 1997).
- Local work from the NT also links low birthweight to the development of renal disease in adulthood (Hoy *et al.*, 1998).
- Helping pregnant women to quit smoking is also of proven value in improving birthweights (see section on ‘smoking cessation and prevention’).
- The NT Strong Women, Strong Babies, Strong Culture Program (SWSBSC) has had a measurable positive impact on birthweight. Low birth weight declined by 19.8% to 11.3% in the SWSBSC communities compared to a 17.4% to 15.9 % decline in comparison communities. In addition, the mean birth weight increased by 79 grams more in the SWSBSC communities compared to the control communities. (Mackerras, 1998). It complements routine antenatal care available through community health centres, general practices and hospital outpatients.

Key result area 2 - Promotion of child growth

Breastfeeding

- Breastfeeding protects against infectious diseases and childhood malnutrition (Cunningham *et al.*, 1991).
- Lower rates of type 2 diabetes have also been associated with exclusive breastfeeding practices in a longitudinal study of Pima Indians (Pettitt *et al.*, 1997).

Preventing childhood malnutrition

- Childhood malnutrition is most strongly linked with the underlying determinants of health (see key result area 3).
- The 'Barker hypothesis' also positively correlates infant growth at one year to adult chronic disease outcomes, particularly cardiovascular disease and hypertension (Barker & Osmond, 1986a; Law *et al.*, 1993; Fall *et al.*, 1995).
- Poor growth in childhood can lead to permanent stunting, which is an independent risk factor for chronic obstructive airways disease (Barker *et al.*, 1989).
- Malnutrition, apart from being a major cause of childhood mortality (Murray & Lopez, 1997) also predisposes a child to chronic and recurrent infectious diseases (see following section).
- Growth monitoring and promotion programs have been shown to be effective in decreasing malnutrition and improving longitudinal growth (Cervinkas *et al.*, 1993; Karlberg *et al.*, 1994).

Decreasing childhood infections through better environmental health conditions

- Poor environmental health conditions contribute directly to diarrhoeal diseases and a variety of other infectious diseases including respiratory infections, ear infections and skin infections. These infections can trigger childhood malnutrition (Black, 1991). There is a cycle of disadvantage whereby malnutrition predisposes a child to infectious diseases which can in turn worsen nutritional status, and so on (Gracey, 1991).
- Chronic and recurrent childhood infectious disease can lead to chronic adult respiratory disease (Barker & Osmond, 1986b; Shaheen *et al.*, 1994) and some forms of kidney disease (Dillon *et al.*, 1998).
- Poor environmental health conditions can also trigger post-streptococcal glomerulonephritis (PSGN). People with a history of PSGN have higher levels of proteinuria subsequently (Buzio, 1994) and in the NT context, repeated episodes of PSGN in childhood may predispose a person to developing renal disease in adulthood (Wendy Hoy, personal communication). Even in the absence of recognised glomerulonephritis, systemic infection can lead to changes in the filtering mechanisms in the kidney (Thomas, 1998).
- The strength of the historical evidence that improved environmental health conditions has led in all societies to dramatic reductions in infectious diseases is overwhelming (Werner and Sanders, 1997). The provision of clean water supplies and sanitation has improved population health (Cvjetanovic, 1986; van Poppel & van der Heijden, 1997). Less overcrowding and improvements in personal hygiene (Feachem, 1984) are also important. Indeed these basic environmental health standards are so critical that they could be viewed as *preconditions* to health. This is one area where there is no need for ‘controlled clinical trials’.
- The poor and continuing state of environmental health ‘hardware’ in indigenous communities has been widely acknowledged but rarely formally documented (Gracey *et al.*, 1997). There is a direct link between these conditions and admissions to hospital in children (Muñoz *et al.*, 1992).
- There are also excellent local examples of best practice in environmental health interventions : Uwankara Palyanku Kanyintjaku (UPK) Report , Pipalyatjara - Housing for Health (Pholeros *et al.*, 1993), Ramingining Manymak Wanga Project and Numbulwar housing repairs program (Bill Hardy, personal communication), and the Environmental Health Standards Project.

Childhood immunization

- Childhood immunization is probably more cost-effective than any other public health intervention (World Bank, 1993). It complements but does not substitute for improvements in environmental health conditions. Childhood immunisation helps to mitigate the adverse effects of malnutrition, and break the malnutrition-infection cycle. It therefore promotes healthy childhood growth, which is protective against the development of adult chronic disease.

Key result area 3 - Underlying determinants of health

Maternal and childhood education

- Maternal education is the strongest predictor of childhood mortality in the developing world (Hobcraft, 1993).
- There is as close a correlation between child survival and general levels of education in a community, as there is between child survival and maternal education (Caldwell, 1989).
- The World Development Report (World Bank, 1993) suggested that a 10% increase in literacy rates could lead to a 10% decrease in child mortality.
- Lack of post secondary schooling has also been associated with an increased risk of hypertension, obesity, smoking, excessive alcohol intake and lack of exercise (World Bank, 1996).

Alleviate poverty

- There is an overwhelming body of data that shows the relationship between income, social class, social inequality and adverse health outcomes in adulthood, including coronary heart disease (National Health Strategy, 1992; Dixon, 1999).
- Cardiovascular disease, mental illness, type 2 diabetes and some forms of cancer are all more common in adults who have been socio-economically disadvantaged in childhood (Smith *et al.*, 1998).
- Welfare and employment policies are critical, as are taxation policies to reduce the income differentials within society (Wilkinson & Marmot, 1998).

Promote 'sense of control' and mental well-being

- Not only is one's *absolute* level of income important, but so is one's *relative* position in society and the degree to which one has control over one's life and work situation and an ability to influence events that impinge on one's life (Petersen & Stunkard, 1989; Marmot, Ryff *et al.*, 1997; Marmot, Bosma *et al.*, 1997).
- Low socioeconomic status is also associated with stressful life circumstances, lack of social support networks and poor mental health (Dixon, 1999). Such factors are potentially crucial both in the genesis of chronic diseases (since there is evidence linking the pathophysiology of the stress response to the development of the 'metabolic syndrome'), and in the ability of people with chronic disease to take a degree of control over their illnesses and make appropriate behavioural changes.
- Apart from the well documented links with substance abuse, there is also a strong possibility that the effects of stress and poor mental health can be trans-generational. These are crucial issues in the context of Aboriginal health and history in Australia. Consistent with the National Aboriginal Health Strategy (1989), the 1996 THS Aboriginal health policy provides a model of Aboriginal health that shows the links between ill-health (including specifically chronic diseases), direct causative factors (including nutrition, substance abuse, high levels of mental stress and environmental conditions) and underlying determinants, including the history of European/Aboriginal contact, the loss of lands and culture, and the lack of meaningful activities and employment.
- The evidence on 'control' and determinants also supports the relevance of health promotion which is the process of enabling individuals and communities to increase control over the determinants of health and thereby improve their health (Territory Health Services, 1998).
- The evidence on control also offers a sound rationale for the development of models of indigenous control of health services. Both the 1996 THS Aboriginal health policy and the 1997 Aboriginal Public Health Strategy support the principle of community control and responsibility for the provision of community health services. And THS is committed to working in partnership with the Aboriginal community controlled health sector, as well as with regional health boards and other models of service delivery.
- Interventions in the early childhood years may produce long lasting benefits. A 15 year follow up of a randomised trial of the effectiveness of home visitation services led to a substantial decrease in the subsequent incidence of child abuse (Olds *et al.*, 1997) . A history of child abuse is itself linked to the development of chronic disease in adulthood (Felitti *et al.*, 1998). There are a range of positive parenting programs and home visiting programs in Australia, some of which have been evaluated (Department of Health and Aged Care, 1998).
- Evaluation has identified a return of at least \$7 on every dollar spent on good quality early child care and education programs, based on reduced subsequent costs

in special education, welfare, prisons and crime (Barnett *et al.*, 1987; Schweinhart *et al.*, 1993).

- Interventions in adulthood need to address job security, work conditions, social isolation, and treatable mental illnesses such as depression (Wilkinson & Marmot, 1998).
- The Chronic Illnesses Self Management Course developed at Stanford University has been extensively evaluated (Lorig *et al.*, 1999). 952 subjects over the age of 40 were randomised in the US to either attend or not attend the course. At 6 months follow-up, people who attended the course had increased their exercise, communicated better with physicians, had better self-reported health and less limitations to their social roles and activities. They had also had significantly fewer hospitalisations and days in hospital. Overall, the course helped to improve health status and decrease health care costs. Savings on health care exceeded the cost of the course by a factor of 10. The course was first run in Australia in 1994 and is currently being delivered in 6 states. A preliminary evaluation of the course has been performed in Victoria and the findings are consistent with the much larger US evaluation (Burrows & Brown, unpublished).

Key result area 4 - Lifestyle modification

Smoking cessation and prevention programmes

- NHMRC (1997a) recommends that all patients should be asked if they smoke, and those that do should be asked if they have considered quitting. A randomised controlled trial of anti-smoking advice found that smoking cessation by middle-aged men reduced overall mortality by 7 per cent, reduced coronary heart disease by 13 per cent and reduced the incidence of lung cancer by 11 per cent (Rose & Colwell, 1992).
- In a meta-analysis of 39 controlled trials of smoking cessation strategies, interventions based on face-to-face counselling had the best results (Kottke *et al.*, 1988).
- There is strong evidence for the effectiveness of GP advice (Russell *et al.*, 1979), and in the GP setting, quit rates will improve with the use of nicotine replacement therapy, behavioural tips and follow-up (Ashenden *et al.*, 1997).
- Helping pregnant women quit smoking during pregnancy is a proven intervention for reducing the risk of low birth weight, preterm labour, spontaneous abortion and perinatal death (Lowe & Wakefield, 1998). A meta-analysis of 16 studies showed that brief advice to quit smoking and provision of quit materials will increase the likelihood of maternal cessation during pregnancy (Mullen *et al.*, 1994). This finding was supported in a recent Cochrane review (Lumley *et al.*, 1998). There are programs running elsewhere in Australia that have proven their effectiveness (Lowe *et al.*, 1998).
- Smoking cessation is one of the few proven interventions that lead to improvements in survival in people with chronic airways disease (Anthonisen *et al.*, 1994; NHMRC 1997a).
- The evidence is less strong to support smoking prevention programs. Nevertheless, the initiation of tobacco use mostly occurs before the age of 18 years. In the NT, in some predominantly non-Aboriginal teenage groups, the prevalence has been rising. Indeed in 17 year old boys, it rose from 30% in 1984 to 45% in 1993 (Johnston *et al.*, 1998). There is limited information on Aboriginal teenagers. There are many examples of school-based smoking education programs and their evaluation in the international literature, of mixed epidemiological quality (Nutbeam *et al.*, 1993; Arkin *et al.*, 1981; Aaro *et al.*, 1982). A recent community-based intervention in a remote NT Aboriginal community (Johnston *et al.*, 1998) demonstrated the need to develop innovative interventions that are not solely school-based. Smoking prevention programs in adolescence need to be run as part of broad community-wide programs dealing, for example, with access issues and including smoking cessation programs for adults.

Brief intervention for hazardous alcohol use

- NHMRC (1997a) recommends that screening for alcohol consumption should be applied to all adolescents and adults over the age of 12 years. Most patients expect their doctor to inquire about this area of their health and would try to change their drinking habits if advised to do so.
- A World Health Organisation randomised clinical trial in 10 countries showed that among men, an intervention of 5 minutes of simple advice, delivered to heavy drinkers in a primary health care setting, was more effective in leading to reduced consumption than a 20 minute health interview alone (Babor & Grant, 1992). Without a brief intervention, and after nine months of follow-up, 42% of men reduced their drinking by one standard drink or more, 25% increased their drinking and 33% did not change. With intervention, 63% reduced their drinking, 14% drank more and 23% remained the same. The effectiveness of brief intervention was less evident in females, as both the control and intervention groups reduced their intake over time.
- A meta-analysis of 12 randomised trials showed that brief advice from a primary care practitioner improved drinking habits in heavy drinkers of alcohol (Wilk *et al.*, 1997).

Nutrition, weight loss and physical activity programs in high risk populations

- Food shortage can lead to malnutrition and excess intake contributes directly to obesity, cardiovascular disease and diabetes. There is a socioeconomic gradient in the source of nutrients. The poor substitute cheaper processed foods for fresh foods (Wilkinson & Marmot, 1998).
- The three main areas of influence on an individual's weight are biological, environmental and behavioural (Egger & Swinburn, 1997). Biologic and inherited influences are important and largely unmodifiable. It is highly likely that the main factors in the increase in overweight and obesity in Australia over the past few decades have been changes to the macro-environment of food supply and to a decline in physical activity levels (NHMRC, 1997b). The public health implication is that we need to address the environments in which people live (and eat and take activity), rather than treat obesity solely as a problem of individual physiology. The National Framework for Chronic Disease Prevention will link Australia's initiatives in nutrition and physical activity (Colin Sindall, personal communication).
- Segal *et al.* (1996) have analysed the cost-effectiveness of intervention strategies that aim at reducing weight and improving physical fitness. They estimate the cost of primary prevention programs for NIDDM at <\$3,000/life year saved. 'Second generation' prevention programs such as the Nova Scotia Heart Health Program incorporate elements of community participation and community development (Gyarfas, 1992; MacLean, 1994). A systematic review has demonstrated that community involvement in the development and implementation of such programs in indigenous communities is vital to their success (Couzos *et al.*, 1998).

- Recent reports strongly emphasise the preventive health benefits gained by the accumulation of 30 minutes of moderate-intensity physical activity on most or all days of the week (US Surgeon General's Report, 1996; Commonwealth Department of Health and Family Services, 1998). The best evidence for the health benefits of physical activity is in the prevention of coronary heart disease (CHD). The maximum CHD benefit is associated with moving from sedentary or low fitness levels to moderate activity or moderate fitness levels i.e. the amount of physical activity which is needed to have a significant preventive benefit for CHD is now thought to be quite modest. Physical activity also reduces the risk of developing hypertension and diabetes (US Surgeon General's Report, 1996).
- Individuals who exercise regularly have a lower rate of progression to diabetes even when risk is adjusted for obesity, hypertension and family history of diabetes (Helmrich *et al.*, 1991). The benefit is directly proportional to the extent of physical activity.
- Intervening to increase physical activity is, however, not straightforward. Policy makers have a key role in changing the physical and social environment to make it more conducive to physical activity (Sallis *et al.*, 1998). More research is needed on the feasibility, efficacy and efficiency of all lifestyle interventions in a general practice setting (Little and Margetts, 1996; Ashenden *et al.*, 1997). Educational and environmental interventions should be seen as complementary (Sallis *et al.*, 1998).
- There have been a number of studies of combined diet, exercise and weight loss interventions in groups at high risk of diabetes: the Swedish Malmo study (Eriksson & Lindgarde, 1991), the Chinese Da Qing Study (Pan *et al.*, 1997), the Oslo Study (Andersson *et al.*, 1996) and a study in Tanzania (Ramaiya *et al.*, 1992). All drew similar conclusions. In the largest study, the Da Qing study, the prevalence of diabetes in a high risk control group after 6 years of follow up was 67%; in the intervention groups, it was 44% (diet alone), 41% (exercise alone) and 46% (diet and exercise). The study also provided evidence that relatively modest levels of activity, rather than intense exercise, were of substantial benefit.
- There have been no published trials, in any population, of the efficacy of community-wide interventions in reducing the incidence of diabetes (de Courten *et al.*, 1998).
- However, there are many examples of community wide health promotion interventions targeting Aboriginal people in Australia. The most notable and studied example in the nutrition area comes from the Northern Territory - the Minjilang Nutrition Program (Lee *et al.*, 1994a). After 12 months of the intervention, the diet of community members had improved as had their metabolic, anthropometric and haematologic parameters.
- Key components of a food and nutrition policy relevant to the NT setting include store food programs (Lee *et al.*, 1994a), legislation and regulation, education, and involvement of indigenous nutrition workers (Office for Aboriginal and Torres Strait Islander Health Services, 1997).

- A meta-analysis of randomized controlled trials conducted in 1997 concluded that individual dietary interventions in primary prevention can achieve modest improvements in diet and cardiovascular risk factors that are maintained for 9-18 months (Brunner *et al.*, 1997). So programs aimed at the whole community (such as store food programs) should be run in conjunction with individual dietary counselling as appropriate.
- There is evidence that a vegetarian diet can significantly reduce the progression of proteinuria in diabetic and non-diabetic renal disease (Segasothy & Bennett, 1997).
- There is also evidence that a so-called 'Mediterranean diet' leads to significant reductions in cardiac events following heart attacks (see section on cardiac rehabilitation - Lyon Diet Heart Study).
- Lee *et al.* (1994b) demonstrated an inadequate dietary folate intake in the Minjilang population, using the store turnover method. This may be important since there is a growing body of evidence linking a low folate intake with a subsequent rise in plasma homocysteine levels and an increased risk of cardiovascular disease (Stein & McBride, 1998). However, it should be noted that no published studies have yet proven that nutritional intervention with folate supplementation will lower the risk of cardiovascular disease.
- Similarly, although there is also a strong literature linking a high intake of antioxidants, found mainly in fruit and vegetables, with lower rates of heart disease (American Heart Association Science Advisory and Coordinating Committee, 1999), the evidence from randomised trials of anti-oxidant vitamin supplements is not yet consistent enough to fully assess the risk-to-benefit ratios for supplements (Gaziano, 1996).
- It is reassuring that the literature on vegetarian diet, Mediterranean diet, folate/homocysteine and antioxidants supports the continued emphasis on making fresh fruit and vegetables widely available, and on advising people to cut down on excessive meat intake and increase their intake of fruits and vegetables to prevent lifestyle associated diseases.

Key result area 5 - Early detection and early treatment

Screening

- Where there are interventions that are known to delay the onset and reduce the incidence of complications (see next section), early detection is highly likely to be cost-effective.
- There is good evidence for screening all adults for the following common chronic diseases: hypertension, obesity, smoking and alcohol use (RACGP, 1996).
- Early detection of hypertension has been recommended by the NHMRC, since treatment has the capacity to significantly decrease morbidity and mortality associated with cardiovascular disease (NHMRC, 1997). The choice of first-line drug therapy is still controversial and debated (Joint National Committee on Detection, Evaluation and Treatment of High Blood Pressure, 1997), but this should not obscure the fact that there are now a wide variety of effective agents. Generally, there has been a trend to lower blood pressure targets. The Hypertension Optimal Treatment (HOT) study found that the maximum protective effect is achieved at about 140/85 mm Hg (Hansson *et al.*, 1998), but lower targets may be appropriate in particular groups e.g. those with diabetes and/or renal disease (Jennings *et al.*, 1999).
- The decision as to when to screen for hypercholesterolemia is complex and influenced by the efficacy of dietary interventions and cholesterol-lowering drugs for primary prevention (ie before cardiovascular disease becomes symptomatic). Data from the West of Scotland Coronary Prevention Study (Shepherd *et al.*, 1995) formed the basis of a cost-effectiveness study; drug treatment cost 20, 375 UK pounds per life-year gained overall, falling to 13, 995 UK pounds per life year gained in the 40% at highest risk (Caro *et al.*, 1997). Certainly, the higher the number of risk factors for cardio-vascular disease, the more cost-effective screening and treatment for hypercholesterolemia becomes.
- Screening for diabetes, hyperlipidemia and renal disease is indicated in at-risk indigenous adults (Couzos *et al.*, 1998).
- A recent NSW study utilising a decision analysis approach concluded that screening for type 2 diabetes was most likely to be effective if it led to initiation of treatment of other cardiovascular risk factors (Goyder & Irwig, 1998). An integrated approach to screening and management, as is embodied in the GSAT protocols, is therefore needed.
- Easton and Segal (1998) have developed an economic model to determine the cost per case of type 2 diabetes detected through screening. They showed that the cost per case is lower when screening is targeted at high risk groups. The cost of mass screening of high-risk populations for diabetes is approximately \$A 1895/case detected, but if screening is then performed opportunistically, the cost falls to \$A 111/case detected.

- NT data collected by Rowena Ivers (1998) shows that opportunistic screening is feasible in rural and remote Aboriginal communities, since the majority of community members attend the clinic at least once in a 2 year period, though targeted mass screening may be needed for groups such as young men, who present less frequently.
- A recent meta-analysis has demonstrated that patient education and counselling are effective for increasing preventive behaviours in healthy people (Mullen *et al.*, 1997). This is important if risk behaviours are detected at screening.
- The National Institutes of Health in the USA is conducting a Diabetes Prevention Program (DPP) in 25 centres over a 6 year period, aiming to prevent or delay the onset of type 2 diabetes in persons with IGT. Subjects will be randomised to either an intensive lifestyle intervention group or a pharmacological treatment group (Mudaliar SR & Henry RR, 1997). The results of this trial will contribute further to the evidence base for early interventions.

Adult immunisation

- The number of adult deaths from vaccine-preventable illnesses in the developed world far exceeds the number of deaths from illnesses targeted by childhood immunisation (Gardner & Schaffner, 1993). Adult immunisation with pneumococcal and influenza vaccines is particularly recommended for the elderly and people with chronic diseases.
- Influenza vaccine (estimated from uncontrolled trials) is 70% effective in preventing clinical illness (American College of Physicians Task Force on Adult Immunization, and Infectious Diseases Society of America, 1994). It is particularly effective in the elderly (Gross *et al.*, 1995) and costs per hospital stay are also less in vaccinated patients (Nichol *et al.*, 1994).
- Pneumococcal vaccine has been shown to be very protective against pneumococcal pneumonia and bacteremia in healthy young adults in high risk settings, and case control studies in elderly patients show an efficacy of 56-70%, though this may be less in the immunocompromised (American College of Physicians Task Force on Adult Immunization, and Infectious Diseases Society of America, 1994).
- NHMRC (1997c) recommends annual influenza and pneumococcal vaccination to all individuals over the age of 65 years and Aboriginal and Torres Strait Islanders over the age of 50 years. It also recommends immunization of those with chronic diseases including diabetes and cardiac, pulmonary and renal disorders.
- A National Influenza Vaccine Program has been established to provide annual influenza vaccination free of charge to all Australians 65 years of age and over from 1999.
- A National Indigenous Pneumococcal and Influenza Immunization Program has been recently established which aims to reduce the high rates of acute respiratory

illness and death specifically in the indigenous population. Five yearly pneumococcal and yearly influenza vaccine will be available free of charge for all indigenous people over 50 years and those in the 15-49 year old age group who are at high risk (including those with chronic diseases). THS has been promoting increased uptake of both vaccines as part of the annual NT Adult Immunisation Campaign run by the Centre for Disease Control since 1995.

- A health promotion program utilising a variety of strategies led to improved uptake of adult immunizations in indigenous adults in Queensland (Young, 1998).

Aggressive blood pressure lowering to prevent progression of renal disease

- Aggressive lowering of blood pressure can slow the rate of progression of renal disease by up to 50% (Zuchelli *et al.*, 1992). Angiotensin converting enzyme inhibitors are one of a number of groups of blood pressure lowering agents.
- They may also have an additional effect, beyond that expected from their blood pressure lowering effect, in proteinuric renal disease, with or without diabetes (Giatras *et al.*, 1997; GISEN, 1997). Their usage to prevent diabetic renal disease and delay the onset of renal failure has been subject to cost-effectiveness analyses. Rodby *et al.* (1996). estimated that the use of ACE-inhibitors for proteinuria to prevent end-stage renal disease would save \$55,000 over a lifetime per person treated; Siegel *et al.* (1992) estimated the savings at \$12,100 per year of life saved.
- Dr. Hoy's team has also produced some early evidence of the efficacy of ACE-inhibitor treatment in reducing the rate of progression of renal disease in the NT. This data is provisional and lacks a strict control group, but the results are consistent with the international literature. The group treated included people with hypertension, diabetics with any abnormal degree of albuminuria and those with progressive albuminuria. Since 1995, 220 people have been enrolled, with significant falls in blood pressure and stabilisation of levels of albuminuria (compared to an estimated annual 15% increase without treatment). The number of Tiwi progressing to ESRF has slowed from 10 in 1994-1995 to an estimated 2 in 1998-1999 and the estimated savings in ESRF costs for the Tiwi alone is 3.4 million dollars from 1996-1999. Current program costs are small in comparison and have been estimated at \$1000 per person per annum. The question is not whether such an intervention program should be introduced across the NT, but how it can be integrated into the routine primary health care system and how compliance can be optimised in a non-research setting so that the effectiveness of the program is maximised.
- Her team has also shown that no-one develops renal failure without first developing albuminuria. This has enormous implications for early detection protocols, which can confidently focus on detecting albuminuria and for early intervention protocols which can aim to prevent worsening albuminuria.

- It should be noted that multifactorial intervention, targeted at a range of risk factors, rather than proteinuria alone, is likely to produce even greater benefits (Gaede, 1998).

Key result area 6 - Best Practice Management

Prevention of complications of diabetes

- The Diabetes Control and Complications Trial (The DCCT Research Group, 1993) was a landmark study that demonstrated that good glucose control in type 1 diabetes dramatically reduced the incidence of microvascular complications. Similar data has now been published for type 2 diabetes (UKPDS, 1998a). It is known that the cost of health care rises as the degree of sugar control worsens (Gilmer *et al.*, 1997). Data from the DCCT estimated that the incremental cost of intensive treatment aimed at lowering sugar levels is \$28,661 per year of life gained (The DCCT Research Group, 1996).
- The DCCT model has also been applied to type 2 diabetes (Eastman, 1997; Eastman *et al.*, 1997), the more common form in the NT, with intensive treatment estimated to cost \$16,002/QALY gained, a comparable figure to type 1 diabetes. Regardless of the precise dollar figure, the model predicted that treatment would be more cost-effective in populations with early age of onset of diabetes, and higher rates of complications (both factors that apply to the NT Aboriginal population). Treatment is also more cost effective in those whose sugar control is worse to begin with (O'Connor *et al.*, 1998). Local data indicates that a substantial proportion of Aboriginal people with diabetes have poor control of their sugars and would benefit correspondingly from tighter control (Markey *et al.*, 1996). The implication is that early detection and best practice management leading to improved sugar control will both be cost effective.
- The UKPDS (1998b) also showed that tight blood pressure control reduced diabetes-related deaths and complications, without altering all-cause mortality. Cost effectiveness analysis of instituting tight blood pressure control resulted in a highly favourable incremental cost estimate of 1049 UK pounds per extra year free from diabetes-related end points (UKPDS, 1998c).
- There are a number of other specific cost-saving interventions: annual screening for retinopathy with follow-up laser photocoagulation to prevent blindness has been shown to be feasible (Backlund *et al.*, 1997) and cost effective at \$3190/QALY saved (Javitt & Aiello, 1996); use of ACE-inhibitors for proteinuria to prevent end-stage renal disease (see previous section); preliminary evidence that use of ACE-inhibitors may prevent retinopathy (see Chaturvedi *et al.*, 1998); treatment of high blood pressure in those with diabetes to prevent end-stage renal disease (see previous section); and preventive foot care (patient education and health staff surveillance) leading to earlier detection of diabetic neuropathy and fewer foot ulcers and amputations (Vijan *et al.*, 1997). Such foot care programs are generally effective and low cost (Mayfield *et al.*, 1998). It should be noted that 1.9% of diabetic admissions to NT hospitals between 1993-1996 were associated with amputation and that the number of diabetic hospital separations in Central Australia has increased by 128% from 1992-1998, with 9-13% of separations being related to lower limb complications (Dan Ewald, personal communication).

- Controlling diabetes may also lead to a decline in the impact and costs of cardiovascular disease, which accounts for 47% of the direct and indirect costs of diabetes (Huse *et al.*, 1989). A precise estimate is difficult because of the other inter-related factors.
- Screening for gestational diabetes mellitus has also been estimated to be cost-effective (Gregory *et al.*, 1993).
- Intensive diabetes management preconception and early in pregnancy (e.g. California Diabetes and Pregnancy Program) results in savings of \$5 for every dollar spent on the program (Scheffler RM *et al.*, 1992).
- A comprehensive review of the literature (Vijan *et al.*, 1997), with a focus on randomised trials, has demonstrated the potential of reducing the complications of diabetes via self management education, prophylactic aspirin, aggressive antihypertensive therapy and improved glycaemic control.
- A meta-analysis of randomised trials (Griffin, 1998), and a parallel Cochrane review (Griffin & Kinmonth, 1998) comparing general practice and shared care with follow-up in a hospital outpatient clinic demonstrated that structured care (whether general practice-based or hospital-based) led to better outcomes. Recall and reminder systems, with prompts for patients and doctors, were important components of structured care. Another systematic review of diabetes shared care also concluded that it is the existence of some kind of structure, rather than any particular structure of care, that resulted in improved outcomes (Greenhalgh, 1994). These systematic reviews support the direction THS is taking with the Coordinated Care Trials, the Total Recall System and the development of a Community Health Information System.
- For a more comprehensive review of the literature on service redesign for diabetes, see the 1999 National Report to Health Ministers on Diabetes (in press). For a more comprehensive review of the literature on the primary care management of diabetes in indigenous populations, see Couzos *et al.* (1997). For a more comprehensive review of the cost-effectiveness literature on diabetes, see Colagiuri *et al.* (1998).

Aggressive management of heart attacks and known cardiovascular disease

- An overview of 133 trials of antiplatelet therapy concluded that aspirin reduced the risk of cardiovascular events by about 25% in high risk groups (Antiplatelet Trialists' Collaboration, 1994).
- In the acute phase of evolving myocardial infarction, aspirin has the best benefit-to-risk ratio of any proven therapy (Hennekens *et al.*, 1997). The use of thrombolytic agents is also highly effective (FTT, 1994) as is the control of blood glucose at the time of infarct (Malmberg *et al.*, 1995).
- Lowering cholesterol with statin drugs in those who have had a major coronary event is highly effective (Scandinavian Simvastatin Survival Group, 1994; Sacks *et al.*, 1996; MacMahon *et al.*, 1998). Investigators from the Scandinavian Simvastatin Survival Group (Jonsson *et al.*, 1996) estimated the cost to be 5502 UK pounds per discounted life-year saved; depending on coronary risk profiles, the estimated cost per life-year saved with pravastatin varies from \$7124 to 12665 (Ashraf *et al.*, 1996).
- What is less well appreciated is the role of dietary factors other than cholesterol - particularly certain types of fatty acids found in high concentrations in the 'Mediterranean diet' (Leaf, 1999). The Lyon Diet Heart Study (de Lorgeril *et al.*, 1999) followed 605 patients after their first heart attack and randomised them to a Mediterranean-type diet or a healthy control diet. All cause mortality in the Mediterranean diet group was 56% lower than in the control group after 4 years, and the number of cardiac deaths and non-fatal heart attacks was 72% lower. This study demonstrates that inexpensive dietary changes can play a major role in preventing the recurrence of heart disease.

Rehabilitation and outreach programs (cardiac, respiratory, renal)

- Cardiac rehabilitation programs have been well evaluated and proven to be effective (Pell, 1997). They are associated with improved risk factor profiles, better psychosocial and marital adjustments, continuation in work, and significant delay in death from cardiovascular disease, as compared with usual medical care alone (Hedback & Perk, 1987). They are also as cost-effective as thrombolytic therapy and cholesterol-lowering therapy, with an estimated cost of \$4,950 per year of life saved (Ades *et al.*, 1997).
- Both the Heart Foundation (1998) and the World Health Organisation (1993) recommend that cardiac rehabilitation programs should be available, and routinely offered, to all people with cardiovascular disease.
- Home oxygen therapy is of proven survival benefit in patients with chronic airways disease (Nocturnal Oxygen Therapy Trial Group, 1980).

- A meta-analysis demonstrated that respiratory rehabilitation that includes at least 4 weeks of exercise training relieves shortness of breath and improves symptom control (Lacasse *et al.*, 1996).
- Flinders Medical Centre Study (1998) found that pulmonary rehabilitation with fortnightly follow-up costs approximately \$1200/patient/year. The mean cost/day of inpatient admission for COPD is \$340. For a rehabilitation program to be cost effective, an average reduction in length of stay of 4 days/patient/year would be required. Cost/QALY in US dollars is \$23,000.
- A post-acute Respiratory Outreach Service Program in Sydney halved readmission rates and reduced the length of stay of inpatients (Brown & Caplan, 1997).
- End stage renal failure support programs for those on dialysis cost an average of \$56,000 Australian dollars per patient per year in the NT (Management Reporting Unit, THS, 1999). A study by Devitt & McMasters (1998) in Central Australia highlighted the high social costs of coming to terms with living on 'the machine'.
- Data on the effectiveness of dedicated hospital stroke units and stroke rehabilitation services are not presented here, as stroke is not one of the five chronic diseases included in the NT Preventable Chronic Diseases Strategy.

References

- Aaro LE, Bruland E, Lochsen PM. Smoking among Norwegian school children 1975-1980: the effect of antismoking campaigns. *Scandinavian Journal of Psychology* 1982; 24: 277-283.
- Ades PA, Pashkow FJ, Nestor JR. Cost-effectiveness of cardiac rehabilitation after myocardial infarction. *J Cardiopulmonary Rehabil* 1997; 17: 222-231.
- American College of Physicians Task Force on Adult Immunization, and Infectious Diseases Society of America. *Guide for Adult Immunization*. 3rd edition. Pennsylvania: American College of Physicians, 1994.
- American Heart Association Science Advisory and Coordinating Committee. Antioxidant consumption and risk of coronary heart disease: emphasis on vitamin C, vitamin E and beta-carotene. *Circulation* 1999; 99: 591-595.
- Andersson S, Hjermann I, Urdal P, Torjesen P, Holme I. Improved carbohydrate metabolism after physical training and dietary intervention in individuals with the 'atherothrombogenic syndrome'. Oslo Diet and Exercise Study (ODES). A randomised trial. *Journal of Internal Medicine* 1996; 240: 203-209.
- Anthonisen NR, Connett JE, Kiley JP *et al*. The Lung Health study: effects of smoking intervention and the use of an inhaled anticholinergic bronchodilator on the rate of decline of FEV₁. *JAMA* 1994; 272: 1497-1505.
- Antiplatelet Trialists' Collaboration. Collaborative overview of randomised trials of antiplatelet therapy - I. Prevention of death, myocardial infarction, and stroke by prolonged antiplatelet therapy in various categories of patients. *BMJ* 1994; 308: 81-106.
- Arkin RM, Roemhild HF, Johnson CA *et al*. Minnesota Smoking Prevention Program. *Journal of School Health* 1981; 11: 611-616.
- Ashenden R, Silagy C, Weller D. A systematic review of the effectiveness of promoting lifestyle change in general practice. *Fam Pract* 1997; 14: 160-176.
- Ashraf T, Hay JW, Pitt B *et al*. Cost-effectiveness of pravastatin in secondary prevention of coronary artery disease. *Am J Cardiol* 1996; 78: 409-414.
- Babor TF, Grant M (eds.). *Project on identification and management of alcohol-related problems. Report on Phase II: a randomised clinical trial of brief interventions in primary health care*. Geneva: World Health Organisation, 1992.
- Backlund LB, Algvere PV, Rosenqvist U. New blindness in diabetes reduced by more than one-third in Stockholm County. *Diabet Med* 1997; 14: 732-740.
- Barker DJ, ed. *Fetal and infant origins of adult disease*. London: BMJ Publishing Group, 1993.
- Barker DJ. Maternal nutrition, fetal nutrition, and disease in later life. *Nutrition* 1997; 13:807-813.
- Barker DJ, Osmond C, Law CM. The intrauterine and early postnatal origins of cardiovascular disease and chronic bronchitis. *J Epidemiol Community Health* 1989; 43: 237-240.
- Barker DJ, Osmond C. Infant mortality, childhood nutrition, and ischaemic heart disease in England and Wales. *Lancet* 1986*a*; 1: 1077-1081.
- Barker DJ, Osmond C. Childhood respiratory infection and adult chronic bronchitis in England and Wales. *BMJ (Clin Res Ed)* 1986*b*; 293: 1271-1275.
- Barnett WS, Frede EC, Mobasher H, Mohr P. The efficacy of public preschool programs and the relationship of program quality to efficacy. *Educational Evaluation and Policy Analysis* 1987; 10: 37-49.
- Black RE. Would control of childhood infectious diseases reduce malnutrition? *Acta Paediatr Scand (Supp)* 1991; 374: S133-S140.

- Brown A, Caplan G. A post-acute respiratory outreach service. *Aust J Nurs* 1997; 14: 5-11.
- Brunner E, White I, Thorogood M, Bristow A, Curle D, Marmot M. Can dietary interventions change diet and cardiovascular risk factors? A meta-analysis of randomized controlled trials. *Am J Public Health* 1997; 87: 1415-1422.
- Burrows C, Brown K. Evaluation of a self-management course for people with chronic illness, conducted by the Arthritis Foundation of Victoria. August 1996 (unpublished, in the possession of the Arthritis Foundation NT).
- Buzio C, Allegri L, Mutti A et al. Significance of microalbuminuria on the follow up of acute poststreptococcal glomerulonephritis. *Clin Nephrol* 1994; 41: 259-264.
- Caldwell JC. Mass education as a determinant of mortality decline. In: *Selected Readings in the Cultural, Social and Behavioural Determinants of Health*, Caldwell JC and Santow G (eds.). Canberra: Health Transition Centre, ANU, 1989, pages 101-111.
- Caro J, Klittich W, McGuire A et al. The West of Scotland coronary prevention study: economic benefit analysis of primary prevention with pravastatin. *BMJ* 1997; 315: 1577-1582 (abstracted in *ACP Journal Club* May/June 1998: 80).
- Cervinkas J, Gerein NM, George S (eds.). *Proceedings of the Nyeri colloquium on growth promotion for child development*. Ottawa: International Development Research Centre, 1993.
- Chaturvedi N, Sjolie AK, Stephenson JM *et al*. Effect of lisinopril on progression of retinopathy in normotensive people with type 1 diabetes. *Lancet* 1998; 351:28-31.
- Colagiuri S, Colagiuri R, Ward J. *National Diabetes Strategy and Implementation Plan*. Canberra: Diabetes Australia, 1998.
- Commonwealth Department of Health and Family Services. *Developing an Active Australia: a framework for action for physical activity and health*. Canberra: DHFS, 1998.
- Couzos S, Metcalf S, Murray R, O'Rourke S. *Systematic review of existing evidence and primary care guidelines on the management of non-insulin-dependent diabetes*. Canberra: OATSIHS, 1998.
- Cunningham AS, Jelliffe DB, Jelliffe EF. Breast-feeding and health in the 1980s: a global epidemiologic review. *J Pediatr* 1991; 118: 659-666.
- Cvjetanovic B. Health Effects and impact of water supply and sanitation. *World Health Statistics Quarterly* 1986; 39: 105-117.
- De Courten M, Hodge A, Dowse G, King I, Vickery J, Zimmet P. *Review of the epidemiology, aetiology, pathogenesis and preventability of diabetes in Aboriginal and Torres Strait Islander populations*. Canberra: OATSIHS, 1998.
- De Lorgeril M, Salen P, Martin J-L, Monjaud I, Delaye J, Mamelle N. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. *Circulation* 1999; 99: 779-785.
- Department of Health and Aged Care. *A healthy start for 0-5 year olds*. Canberra: Commonwealth of Australia, 1998 (Department of Health and Aged Care Occasional Papers Series No 3.)
- Devitt J, McMasters A. *Living on Medicine: a cultural study of end-stage renal disease among Aboriginal people*. Alice Springs: IAD Press, 1998.
- Dillon MJ, Goonasekera CD. Reflux nephropathy. *J Am Soc Nephrol*. 1998 Dec;9(12):2377-83.
- Dixon J. *A National Research and Development Collaboration on Health and Socioeconomic Status for Australia: first discussion paper*. Canberra: National Centre for Epidemiology and Population Health, 1999.

- Eastman RC, Javitt JC, Herman WH *et al.* Model of complications of NIDDM. II. Analysis of the health benefits and cost-effectiveness of treating NIDDM with the goal of normoglycemia. *Diabetes Care* 1997; 20: 685-686.
- Eastman RC. Aspects of the health economics of diabetes intervention. *International Diabetes Monitor* 1997; 9: 1-5.
- Easton JL, Segal L. Opportunistic screening for diabetes. *Med J Aust* 1998; 168: 45.
- Egger G, Swinburn B. An “ecological” approach to the obesity pandemic. *BMJ* 1997; 315: 477-80.
- Eriksson K-F, Lindgarde F. Prevention of type 2 (non-insulin-dependent) diabetes mellitus by diet and physical activity. *Diabetologia* 1991; 34: 891-898.
- Fall CH, Vijayakumar M, Barker DJ, Osmond C, Duggleby S. Weight in infancy and prevalence of coronary heart disease in adult life. *BMJ* 1995; 310: 17-19.
- Feachem R. (1984) “Interventions for the control of diarrhoeal diseases among young children: promotion of personal and domestic hygiene”. *Bull Wld Hlth Org* 1984;62:467-476.
- Felitti VJ, Anda RF, Nordenberg D *et al.* Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: the Adverse Childhood Experience (ACE) study. *American Journal of Preventive Medicine* 1998; 14: 245-258.
- Flinders Medical Centre Respiratory Unit. Prevention and Care of Chronic Airflow Limitation - a program budgeting and marginal analysis. Adelaide: Flinders Medical Centre, 1998.
- FTT (Fibrinolytic Therapy Trialists’ Collaborative Group). Indications for fibrinolytic therapy in suspected acute myocardial infarction: collaborative overview of early mortality and major morbidity results from all randomised trials of more than 1000 patients. *Lancet* 1994; 343: 311-322.
- Gaede P, Vedel P, Parving HH, Pedersen O. Multifactorial intervention delays the progression of long-term complications in patients with type 2 diabetes. *J Am Soc Nephrol* 1998; 9: 115A.
- Gardner P, Schaffer W. Immunization of adults. *NEJM* 1993; 328: 1252-1258.
- Gaziano JM. Antioxidants in cardiovascular disease: randomized trials. *Nutrition* 1996; 12: 583-588.
- Giatras I, Lau J, Levey AS. Effect of angiotensin-converting enzyme inhibitors on the progression of non-diabetic renal disease: a meta-analysis of randomised trials. *Ann Intern Med* 1997; 127: 337-345.
- Gilmer TP, O’Connor PJ, Manning WG, Rush WA. The cost to health plans of poor glycemic control. *Diabetes Care* 1997; 20: 1847-53.
- GISEN Group. Randomised placebo-controlled trial of effect of ramipril on decline in glomerular filtration rate and risk of terminal renal failure in proteinuric, non-diabetic nephropathy. *Lancet* 1997; 349: 1857-1863.
- Godfrey K, Robinson S, Barker DJ, Osmond C, Cox V. Maternal nutrition in early and late pregnancy in relation to placental and fetal growth. *BMJ* 1996; 312: 410-414.
- Goyder E, Irwig L. Screening for Type 2 diabetes: a decision analysis approach. NSW Health Department, October 1998.
- Gracey, M. Annie B Cuning Lecture - Nutrition and infections in Australian Aboriginal children. *Aust NZ J Med* 1991; 21: 921-927.
- Gracey, M, Williams, P, Houston, S. Environmental health conditions in remote and rural Aboriginal communities in Western Australia. *ANZ J Pub Hlth* 1997; 21: 511-518.

Greenhalgh PM. Shared care for diabetes. A systematic review. London: Royal College of General Practitioners, 1994 (Occasional paper 67).

Gregory KD, Kjos SL, Peters RK. Cost of non-insulin-dependent diabetes in women with a history of gestational diabetes: implications for prevention. *Obstet Gynecol* 1993; 81: 782-786.

Griffin S, Kinmonth AL. Diabetes care: the effectiveness of systems for routine surveillance for people with diabetes. In: *The Cochrane Database of Systematic Reviews*. The Cochrane Library. Oxford: Update Software; 1998, Issue 1.

Griffin S. Diabetes care in general practice: meta-analysis of randomised controlled trials. *BMJ* 1998; 317: 390-396.

Gross PA, Hermogenes AW, Sacks HS *et al*. The efficacy of influenza vaccine in elderly persons: a meta-analysis and review of the literature. *Ann Intern Med* 1995; 123: 518-527.

Gyarfas I. Review of community intervention studies on cardiovascular risk factors. *Clin Exp Hypertension Theory and Practice* 1992; A14: 223-237.

Hansson L, Zanchetti A, Carruthers SG *et al*. Effects of intensive blood-pressure lowering and low-dose aspirin in patients with hypertension: principal results of the Hypertension Optimal Treatment (HOT) randomised trial. *Lancet* 1998; 351: 1755-1762.

Heart Foundation. Recommendations for Cardiac Rehabilitation. Canberra: Heart Foundation, 1998.

Hedback B, Perk J. 5-year results of a comprehensive rehabilitation programme after myocardial infarction. *European Heart Journal* 1987; 8: 234-242.

Helmrich SP, Ragland DR, Leung RW, Paffenbarger RS Jr. Physical activity and reduced occurrence of non-insulin-dependent diabetes mellitus. *N Engl J Med* 1991; 325: 147-52.

Hennekens CH, Dyken ML, Fuster V. Aspirin as a therapeutic agent in cardiovascular disease: a statement for health care professionals from the American Heart Association. *Circulation* 1997; 96: 2751-2753.

Hobcraft J. Women's education, child welfare and child survival: a review of the evidence. *Health Transition Review* 1993; 3: 159-175.

Hoy WE *et al*. Low birthweight and renal disease in Australian Aborigines. *Lancet* 1998; 352: 1523-1524.

Huse DM, Oster G, Killen AR, Lacey MJ, Colditz GA. The economic costs of non-insulin-dependent diabetes mellitus. *JAMA* 1989; 262: 2708-13

Ivers R. Healthy adult checks - an evaluation of preventive health activities for adults in two remote Aboriginal communities. MPH thesis. University of Sydney, 1998.

Javitt JC, Aiello LP. Cost-effectiveness of detecting and treating diabetic retinopathy. *Ann Intern Med* 1996; 124: 164-169.

Jennings GLR, Cameron JD, Dart AM, Gatzka CD, Kingwell BA. Targets in hypertension: going nowhere or gone as far as we can go? *Aust NZ J Med* 1999; 29: 189-196.

Johnston F, Beecham R, Dagleish P, Malpraburr T, Gamarania G. The Maningrida 'Be Smoke Free' Project. *Health Promotion Journal of Australia* 1998; 8: 12-17.

Joint National Committee on Detection, Evaluation and Treatment of High Blood Pressure. The Sixth Report. *Arch Intern Med* 1997; 157: 2413-2446.

- Jonsson B, Johannesson M, Kjekshus J *et al.* Cost-effectiveness of cholesterol lowering: results from the Scandinavian Simvastatin Survival Study (4S). *European Heart Journal* 1996; 17: 1001-1007.
- Karlberg J, Jalil F, Lam B, Low L, Yeung CY. Linear growth retardation in relation to the three phases of growth. *Eur J Clin Nutr* 1994; 48: S25-S44.
- Kottke TE, Battista RN, DeFries GH, Brekke ML. Attributes of successful smoking cessation interventions in medical practice: a meta-analysis of 39 controlled trials. *JAMA* 1988; 259: 2882-2889.
- Lacasse Y, Wong E, Guyatt GH *et al.* Meta-analysis of respiratory rehabilitation in chronic obstructive pulmonary disease. *Lancet* 1996; 348: 1115-1119.
- Law CM, de Swiet M, Osmond C *et al.* Initiation of hypertension in utero and its amplification throughout life. *BMJ* 1993; 306: 24-27.
- Leaf A. Dietary prevention of coronary heart disease: The Lyon Diet Heart Study. *Circulation* 1999; 99: 733-735.
- Lee AJ, Bailey PV, Yarmirr D, O'Dea K, Mathews JD. Survival tucker: improved diet and health indicators in an Aboriginal community. *Aust J Public Health* 1994a; 18: 277-285.
- Lee AJ, O'Dea K, Mathews JD. Apparent dietary intake in remote Aboriginal communities. *Aust J Public Health* 1994b; 18: 190-197.
- Little P, Margetts B. The importance of diet and physical activity in the treatment of conditions managed in general practice. *Br J Gen Pract* 1996; 46: 187-92.
- Lorig KR, Sobel DS, Stewart AL *et al.* Evidence suggesting that a Chronic Disease Self-Management Program can improve health status while reducing hospitalisation: a randomised trial. *Medical Care* 1999; 37: 5-14.
- Lowe JB, Balanda KP, Clare G. Evaluation of antenatal smoking cessation programs for pregnant women. *Aust NZ J Public Health* 1998; 14: 379-411.
- Lowe JB, Wakefield M. Smoking and pregnancy: time to implement evidence-based solutions. *Aust NZ J Public Health* 1998; 22: 523-524.
- Lumley J, Oliver S, Waters E. Smoking cessation programs implemented during pregnancy (Cochrane review). *The Cochrane Library*, 1998, disk issue.
- Mackerras D. Evaluation of the Strong Women, Strong Babies, Strong Culture Program. Darwin: Menzies School of Health Research, 1998 (Occasional Paper 2/98).
- MacLean DR. Theoretical rationale of community intervention for the prevention and control of cardiovascular disease. *Health Reports* 1994; 6: 174-180.
- MacMahon S, Sharpe N, Gamble G *et al.* Effects of lowering below average cholesterol levels on the progression of carotid atherosclerosis: results of the LIPID Atherosclerosis substudy. *Circulation* 1998; 97: 1784-1790.
- Malmberg K, Ryden L, Efendic S *et al.* Randomized trial of insulin-glucose infusion followed by subcutaneous insulin treatment in diabetic patients with acute myocardial infarction (DIGAMI study): effects on mortality at 1 year. *J Am Coll Cardiol* 1995; 26: 57-65.
- Management Reporting Unit, Territory Health Services. Quarterly Executive Report, January-March 1999 (unpublished).
- Markey PG, Weeramanthri TS, Guthridge SL. Diabetes in the Northern Territory. Darwin: Diabetes Australia NT, 1996.

- Marmot M, Ryff CD, Bumpass LL, Shipley M, Marks NF. Social inequalities in health: next questions and converging evidence. *Soc Sci Med* 1997; 44: 901-910.
- Marmot MG, Bosma H, Hemingway H, Brunner E, Stansfeld S. Contribution of job control and other risk factors to social variations in coronary heart disease incidence. *Lancet* 1997; 350: 235-239.
- Mayfield JA, Reiber GE, Sanders LJ, Janisse D, Pogach LM. Preventive foot care in people with diabetes. *Diabetes Care* 1998; 21: 2161-2177
- Muñoz E, Powers J, Neihuys T, Mathews J. Social and environmental factors in 10 Aboriginal communities in the Northern Territory: relationship to hospital admissions of children. *Med-J-Aust* 1992; 156:529-533.
- Mudaliar SR, Henry RR. Strategies for preventing type II diabetes: what can be done to stem the epidemic? *Postgraduate Medicine* 1997; 101: 181-189.
- Muir Gray JA. Evidence-based healthcare: how to make health policy and management decisions. New York: Churchill Livingstone, 1997.
- Mullen PD, Ramirez G, Groff JY. A meta-analysis of randomized trials of prenatal smoking cessation interventions. *Am J Obstet Gynecol* 1994; 171: 1328-1334.
- Mullen PD, Simons-Morton DG, Ramirez G et al. A meta-analysis of trials evaluating patient education and counselling for three groups of preventive health behaviours. *Patient Educ Couns* 1997; 32: 157-173.
- Murray CJ, Lopez AD. Global mortality, disability and the contribution of risk factors: Global Burden of Disease Study. *Lancet* 1997; 349: 1436-1442.
- National Aboriginal Health Strategy Working Party. A National Aboriginal Health Strategy. Canberra: AGPS, 1989.
- National Health Strategy. Enough to make you sick: how income and environment affect health. Canberra: National Health Strategy Research Paper no 1, 1992.
- NHMRC. Guidelines for preventive interventions in primary health care: cardiovascular disease and cancer. AGPS: Canberra, 1997a.
- NHMRC Working Party on the Prevention of Overweight and Obesity. Acting on Australia's weight: a strategic plan for the prevention of overweight and obesity. Canberra: AGPS, 1997b.
- NHMRC. The Australian Immunisation Handbook. 6th edition. Canberra: Commonwealth of Australia, 1997c.
- NHMRC. A guide to the development, implementation and evaluation of clinical practice guidelines. Canberra: AusInfo, 1998.
- Nichol KL, Margolis KL, Wuorenma J *et al*. The efficacy and cost effectiveness of vaccination against influenza among elderly persons living in the community. *N Engl J Med* 1994; 331: 778-784.
- Nocturnal Oxygen Therapy Trial Group. Continuous or nocturnal oxygen therapy in hypoxemic chronic obstructive lung disease. *Ann Intern Med* 1980; 93: 391-398
- Nutbeam D, Macaskill P, Smith C, Simpson J, Catford J. Evaluation of two school smoking education programmes under normal classroom conditions. *BMJ* 1993; 306: 102-107.
- O'Connor PJ, Spann SJ, Woolf SH. Care of adults with type 2 diabetes mellitus. A review of the evidence. *J Fam Pract* 1998; 47 (5 Suppl): S13-S22.
- Office for Aboriginal and Torres Strait Islander Health Services. Food and nutrition programs for Aboriginal and Torres Strait Islander Peoples. Canberra: Commonwealth Department of Health and Family Services, 1997.

- Olds DL. Long term effects of home visitation on maternal life course and child abuse and neglect - fifteen year follow-up of a randomised trial. *JAMA* 1997; 278: 637-643.
- Pan X, Li G, Hu Y et al. Effect of diet and exercise in preventing NIDDM in people with impaired glucose tolerance. The Da Qing IGT and Diabetes Study. *Diabetes Care* 1997; 20: 537-544.
- Pell J. Cardiac rehabilitation: a review of its effectiveness. *Coronary health care* 1997; 1: 8-17.
- Petersen C, Stunkard A. Personal control and health promotion. *Social Science and Medicine* 1989; 8: 819-828.
- Pettitt D, Forman M, Hanson R, Knowler W, Bennett PH. Breast feeding in infancy is associated with lower rates of non-insulin-dependent diabetes mellitus. *Lancet* 1997; 350: 166-168.
- Pholeros, Paul; Rainow, Stephan; Torzillo, Paul. (1993) *Housing for Health: Towards a Healthy Living Environment for Aboriginal Australia*. Healthabitat: Newport Beach, NSW.
- Ramaiya K, Swai A, Alberti K, McLarty D. Life style changes decrease rates of glucose intolerance and cardiovascular risk factors: a six year intervention study in a high risk Hindu Indian subcommunity. *Diabetologia* 1992; 35 (Suppl): A60.
- Rodby RA, Firth LM, Lewis EJ. An economic analysis of captopril in the treatment of diabetic nephropathy. *Diabetes Care* 1996; 19: 1051-1061.
- Rose G, Colwell L. Randomised controlled trial of anti-smoking advice: final (20 year) results. *J Epidemiology Comm Health* 1992; 46: 75-77.
- Royal Australian College of General Practitioners. Guidelines for preventive activities in general practice. Melbourne: RACGP, 1996.
- Russell MAH, Wilson C, Taylor C, Baker CD. Effect of general practitioners' advice against smoking. *BMJ* 1979; 2: 231-235.
- Sackett D, Haynes RB, Guyatt GH, Tugwell P. *Clinical Epidemiology: a basic science for clinical medicine*. 2nd edition. Boston: Little, Brown and Co, 1991: 379-391.
- Sacks FM, Pfeffer MA, Moye LA et al. The effect of pravastatin on coronary events after myocardial infarction in patients with average cholesterol levels (CARE). *N Engl J Med* 1996; 335: 1001-1009.
- Sallis JF, Bauman A, Pratt M. Environmental and policy interventions to promote physical activity. *Am J Prev Med* 1998; 15: 379-97.
- Scandinavian Simvastatin Survival Group. Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S). *Lancet* 1994; 344: 1383-1389.
- Scheffler RM, Feuchtbaum LB, Phibbs CS. Prevention: the cost-effectiveness of the California Diabetes and Pregnancy Program. *Am J Public Health* 1992; 82: 168-175.
- Schweinhart L.J., Barnes H.V., Weikart D.P. *et al.* "Significant benefits: "The High Scope/Perry Preschool Study through age 27". Ypsilanti, MI: High/Scope Press, 1993.
- Scrimgeour D. Community control of Aboriginal health services in the Northern Territory. Darwin: Menzies School of Health Research, 1997 (Occasional paper no. 2/97).
- Scrimshaw NS. The relation between fetal malnutrition and chronic disease in later life. *BMJ* 1997; 315: 825-826.
- Segal L, Dalton A, Richardson J. The cost-effectiveness of primary prevention for non-insulin dependent diabetes mellitus. Melbourne: Centre for Health Program Evaluation, Monash University, 1996 (Research Report no.8).

- Segasothy M, Bennett WM. Vegetarian diet: relevance in renal disease. *Nephrology* 1997; 3: 397-405.
- Siegel JE, Krolwewski AS, Warram JH, Weinstein MC. Cost-effectiveness of screening and early treatment of nephropathy in patients with insulin-dependent diabetes mellitus. *J Am Soc Nephrol* 1992; 3: S111-S119.
- Shaheen SO, Barker DJ, Shiell AW, Crocker FJ, Wield GA, Holgate ST. The relationship between pneumonia in early childhood and impaired lung function in late adult life. *Am J Respir Crit Care Med* 1994; 149: 616-619.
- Shepherd J, Cobbe SM, Ford I *et al.* Prevention of coronary heart disease with pravastatin in men with hypercholesterolemia (WOSCOP). *N Engl J Med* 1995; 333: 1301-1307.
- Smith GD, Hart C, Blane D, Hole D. Adverse socioeconomic conditions in childhood and cause specific adult mortality: prospective observational study. *BMJ* 1998; 316: 1631-1635.
- Stein JH and McBride PE. Hyperhomocysteinemia and atherosclerotic vascular disease. *Arch Int Med* 1998; 158: 1301-1306.
- Territory Health Services. The Aboriginal Public Health Strategy and Implementation Guide 1997-2002. Darwin: Territory Health Services, 1998.
- The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med* 1993; 329: 977-986.
- The Diabetes Control and Complications Trial Research Group. Lifetime benefits and costs of intensive therapy as practiced in the Diabetes Control and Complications Trial. *JAMA* 1996; 276: 1409-1415 (published erratum appears in *JAMA* 1997; 278: 25).
- Thomas M. Kidney disease in Australian Aboriginals: time for decisive action. *Med J Aust* 1998; 168: 532-533.
- UK Prospective Diabetes Study Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998a; 352: 837-853.
- UK Prospective Diabetes Study Group. Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes (UKPDS 38). *BMJ* 1998b; 317: 703-713.
- UK Prospective Diabetes Study Group. Cost effectiveness analysis of improved blood pressure control in hypertensive patients with type 2 diabetes (UKPDS 40). *BMJ* 1998c; 317: 720-726.
- US Surgeon General. Physical activity and health. US Department of Health and Human Services and Centers for Disease Control and Prevention, 1996.
- van Poppel F, van der Heijden C. The effects of water supply on infant and childhood mortality: a review of historical evidence. *Health Transition Review* 1997; 7: 113-148.
- Vijan S, Stevens DL, Herman WH *et al.* Screening, prevention, counselling, and treatment for the complications of type II diabetes mellitus: putting evidence into practice. *J Gen Intern Med* 1997; 12: 567-580.
- Werner D, Sanders D. Questioning the solution: the politics of primary health care and child survival. California: Healthwrights, 1997.
- Wilk AI, Jensen NM, Havighurst TC. Meta-analysis of randomized controlled trials addressing brief interventions in heavy alcohol drinkers. *J Gen Intern Med* 1997; 12: 274-283.
- Wilkinson R, Marmot M (eds.) Social determinants of health: the solid facts. Copenhagen: WHO Regional Office for Europe, 1998.

World Bank. World Development Report 1993: investing in health. New York: Oxford University Press, 1993.

World Bank, 1996 (*obtain this reference from Barbara Paterson when she returns from leave*).

World Health Organisation. Report of Expert Committee on Rehabilitation after Cardiovascular Disease. Geneva: WHO, 1993 (WHO Technical Report Series no. 831).

Young D. Successful strategies for an adult immunisation program. Health Promotion Journal of Australia 1998; 8: 59-61.

Zuchelli P, Zuccala A, Borghi M *et al*. Long term comparison between captopril and nifedipine in the progression of renal insufficiency. Kidney Int 1992; 42: 452-458.