A review of the evidence for the effectiveness and costs of interventions preventing the burden of non-communicable diseases:

How can health systems respond?

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Executive Summary

Non-communicable diseases (NCD) are becoming an increasingly important health problem in Latin America and the Caribbean (LAC). This region is in the unique position of experiencing the epidemiological polarity of increasing NCDs, as well as a resurgence of many communicable diseases – a situation which is straining the resources of many countries in the area. The purpose of this review is to present an overview of effective and cost-effective interventions for the primary prevention of non-communicable diseases which have the potential to be successfully implemented in LAC.

Specifically, this review considered the following non-communicable diseases (cardiovascular disease, COPD, diabetes mellitus), and risk factors (hypertension, smoking, obesity, physical inactivity, hypercholesterolemia, low fruit and vegetable intake, food security, airborne particulates, indoor smoke).

This review relied mostly on compiling information from systematic and expert reviews of the various NCDs and risk factors. These were based primarily on research conducted in North America and Europe. Very little published information was found relating to primary prevention of NCDs in LAC. In attempting to generalize the results to LAC caution must be exercised because of the considerable differences in socio-cultural factors, economic factors, and health/education/municipal infrastructure between North America/Europe and LAC, as well as between and within the countries of Latin America and the Caribbean.

Effective and cost-effective community interventions for primary prevention of NCDs shared the following characteristics:

- a combination of community-wide strategies that include education and skill-building components in multiple settings, combined with social and environmental supports (e.g. policy development, legislation, taxation, access to food, increased access to opportunities for physical activity). This combination of interventions was shown to be effective for reducing tobacco use, increasing physical activity, preventing cardiovascular disease, and increasing food security;

- the cost-effectiveness information emphasizes the importance of interventions in the socio-environmental conditions in which we live rather than individual, lifestyle-oriented strategies. For example, taxation

was most cost-effective for reducing smoking, increased access to stoves was cost-effective to improve indoor air quality, and improvement in basic living needs was required for low income populations to improve their heart health;

- Low socio-economic status communities do not participate in "lifestyle" interventions. Those interventions that have the greatest chance of attracting community interest are those that will produce a noticeable improvement in the quality of life of the participants over the short-term. Specifically, interventions to improve indoor air quality in homes, and to address food security and quality are recommended for consideration;

- Schools, workplaces and municipalities are recommended as key foci for action because they provide the opportunity to effectively reach large numbers of people with sustained interventions.

The review of research in this area pointed to the need to support the following research directions, in order to support the development of successful interventions for the prevention of NCDs:

- Socio-cultural research to support a better understanding of how these diseases are experienced by people in Latin America and the Caribbean, why people make certain choices regarding prevention and treatment, and how this information can be used to influence the development of appropriate interventions;

- the creation of better links between the fundamental experimental research in which interventions are developed, and the application of these interventions to the reality of communities in LAC;

- more and better cost-effectiveness research with a particular focus on the cost of implementing community-based interventions in LAC.

1. Introduction

1.1 The context

Non-communicable diseases (NCD) are becoming an increasingly important health problem in Latin America and the Caribbean (LAC). The purpose of this review is to present an overview of effective and cost-effective interventions for the primary prevention of non-communicable diseases which have the potential to be successfully implemented in LAC.

A great deal of research has been done to attempt to understand the etiologies of the different NCDs, as well as to determine which interventions are effective. The vast majority of this research has been conducted in North America and Europe – both of which have social, cultural, economic and infrastructure contexts that differ markedly from that in LAC. The following factors must be considered to place this review into the proper context:

- **Disease profile:** The situation in Latin America and the Caribbean is somewhat unique in the world. The people of LAC are experiencing an epidemiological polarization, where the mortality profile of the population is being affected simultaneously – and in almost equal measure – by both communicable and non-communicable diseases. The increase in NCD has been accompanied by a re-emergence of communicable diseases that were thought to be under control. The people of LAC are being confronted simultaneously by the so-called diseases of poverty and the diseases of wealth.

- **Socio-cultural profile:** The social and cultural backgrounds of the people of LAC differ considerably from those in Europe and North America. In addition, there are many differences both between and within countries related to such factors as settlement patters, urban/rural split, and the role of the aboriginal population.

- **Economic profile:** While the overall economic performance of the countries in LAC has improved over the 1990s, everyone has not shared equally in these gains; this region is home to the most pronounced economic inequity in the world. Approximately 224 million people live in poverty, representing approximately 36% of the population. The level of economic inequity has increased: the median income of the wealthiest 20% of the population was about 12.6 times higher than the poorest 20% in

the 1980s; this ratio rose to 15.8 times by the end of 1999. (PAHO, 2002) In many countries the middle class has almost disappeared over this time period.

- **Globalization:** The influence of North American popular culture has spread throughout the region, having an effect on many aspects of lifestyle. Diet is one of the areas that has experienced the greatest impact as traditional foods are being displaced in favour of "fast foods".

- **Urbanization:** The rate of influx of people from the countryside to the cities in LAC is among the highest in the world. This displacement of people is having a profound effect on areas such as food production and distribution, the economy and employment situation, as well as straining the capacity of municipal infrastructures.

- **Infrastructure:** The public infrastructures of most countries in LAC have been substantially reduced through the period of structural adjustment in the 1990s. The capacity of the health, education, and municipal systems to respond to acute problems, as well as to support sustained campaigns to address issues has been diminished, so there is a much greater tendency to concentrate scarce resources on urgent, pressing issues.

1.2 The research

The initial focus in doing research for this paper was to concentrate on databases such as the Cochrane Collaboration (www.cochrane.org) and the National Health Service Economic Evaluations Database (http://agatha.york.ac.uk/welcome.htm). In each of these a keyword search of the available literature was conducted using the various NCDs (cerebrovascular disease, COPD, diabetes mellitus, ischaemic heart disease) and their risk factors (hypertension, smoking, obesity, physical inactivity, hypercholesterolemia, low fruit and vegetable intake, airborne particulates, indoor smoke). These searches identified numerous individual studies and reviews. Most of these were based on experimental designs, were conducted in Europe and North America, and very difficult to generalize to other settings. It also would have been an extremely time-consuming process to do a systematic analysis of these studies, considering the very broad scope of this review.

This being the case, we decided to consult the expert reviews that have been conducted on these NCDs. Virtually all of these diseases and risk factors have been subject to detailed, systematic reviews over the years, and in some cases excellent clearinghouses have been set up on the web that provide a wealth of information on effectiveness (and somewhat less on cost-effectiveness and cost benefit analysis). Some of the websites consulted in this process include the following:

- WHO (www.who.int)
- PAHO (www.paho.org)
- CDC Guide to Community Preventive Services (www.thecommunityguide.org)
- OECD (www.oecd.org)
- FAO (www.fao.org)
- National Clearinghouse on Tobacco and Health (http://www.ncth.ca/NCTHweb.nsf)
- Health Canada
- Centre for Addictions and Mental Health

Finding data from Latin America and the Caribbean was a significant challenge. An exhaustive review of health promotion research published in Spanish and English conducted just prior to the commencement of this study (Centro para el Desarrollo y Evaluación de Politicas y Tecnologia en Salúd Pública, 2003) identified a total of approximately 81 studies, of which only one was relevant to the primary prevention of NCD; the vast majority were related to communicable disease prevention and maternal-child health, as well as water supply and sanitation. We found a database through the University of New Mexico that was dedicated to the diffusion of research on *medicina social*, (http://hsc.unm.edu/lasm) but there was only a single study related to NCD.

We also consulted several contacts we had in LAC (researchers) and were similarly unable to find relevant published research conducted in a LAC context. It is possible that more relevant research exists, particular in the realm of gray literature, but we were unable to access it for the purposes of this review. It can reasonably be concluded that there has been little research conducted in Latin American or Caribbean countries on the primary prevention of NCDs.

Given the limitations on the research for this study, the conclusions are based on a consultation of the available expert reviews, plus overviews of the regional situation, interpreted through the consultants' experience of having lived and

worked in health promotion and community development programs in five Latin American countries.

2. The evidence base for interventions for the primary prevention of major causes of NCD

The focus of this review is *primary prevention*, referring to actions that prevent chronic diseases from occurring and those that reduce the incidence of chronic disease. These actions occur before the onset of disease and include health promotion and disease prevention. These include: smoking cessation, regular physical activity, good nutrition and many policy interventions such as food labeling and anti-smoking laws. This review will also touch on some aspects of secondary prevention.

Secondary prevention involves the early detection of disease that can minimize or interrupt its progression, and thereby prevent irreversible damage. It includes various kinds of screening (e.g. blood pressure checks, cholesterol checks). Primary and secondary prevention can be closely related (e.g. secondary prevention of hypertension can be primary prevention of strokes).

The purpose of this review is to present an overview of effective and cost-effective interventions for the primary prevention of non-communicable diseases (NCD) which have the potential to be successfully implemented in Latin America and the Caribbean (LAC). In determining the effectiveness of any intervention, it is important to distinguish between efficacy and effectiveness. Efficacy trials "provide tests of whether a technology, treatment, procedure or program does more good than harm when delivered under optimum conditions," (Flay, 1986, p. 451), whereas "effectiveness trials provide tests of whether a technology, treatment, procedure, intervention or program does more good than harm when delivered under real-world conditions". Effectiveness information provides an indication about how well interventions can be generalized and applied to other settings. Spence (2001) suggests that other factors are important to consider in order to determine the impact of an intervention:

- the reach of the program (i.e. the proportion of people with a risk factor who receive or are affected by the program or policy); and

- the implementation of the program (i.e. the extent to which the program is delivered as intended).

We would suggest that it is also essential to consider the following in attempting to generalize programs to the LAC context:

- socio-cultural factors (i.e. are the interventions – which are usually developed in a North American or European context – relevant in the context in which they would be delivered in LAC? Special notice must be paid to the vast socio-cultural differences between and within countries in LAC);

- economic/infrastructure factors (i.e. many of the interventions have been developed – and are effective - based on a North American/European public health/primary care/educational/municipal infrastructure. The ability to generalize these interventions to other settings depends on a comparable infrastructure. In the LAC countries this is a particular challenge because much of the public infrastructure has been drastically reduced over the past 10 years because of structural adjustment policies to deal with debt).

In reviewing the available information on program effectiveness, it is apparent that the vast majority of studies reported in the literature test efficacy rather than effectiveness. In this review we have tried, wherever possible, to locate more comprehensive reviews conducted by experts in the various fields, in order to formulate conclusions on the types of interventions that are likely to be most effective.

All of the factors mentioned above, plus the relative lack of published research conducted in LAC on primary prevention of NCD, means that any attempt to generalize effective health promotion interventions to a LAC setting must be approached with a great degree of caution.

2.1 Smoking

There have been many reviews to compile effective strategies for tobacco control, probably more than in any other single area of health promotion. There is a general consensus among many organizations (e.g., the Task Force on Community Preventive Services, the Office of the Surgeon General, the U.S. Preventive Services Task Force, the Agency for Healthcare Research and Quality) that the following strategies are effective:

Interventions Recognized as Effective Against Smoking and Promoted by National Organizations

To reduce youth initiation of smoking:

• Increase the unit price for tobacco products, particularly through increases in

state and federal excise taxes.
• Develop extensive and extended mass media campaigns, particularly when they are the centerpiece along with other strategies.

To decrease the effects of environmental tobacco smoke:
• Develop laws and regulations to restrict or ban tobacco consumption in workplaces and general areas used by the public.

To assist with smoking cessation from a population orientation:
• Use broadcast and print media to encourage people to quit along with other strategies.
• Increase the unit price of tobacco products.
• Use provider education and have providers implement self-reminder systems to ensure that this issue is raised during the clinical examination.
• Provide telephone counseling and support services along with treatments offered by other strategies.
• Reduce patient out-of-pocket costs for effective cessation treatments.

To assist with smoking cessation from a clinical perspective:
• Screen patients for tobacco use.
• Deliver brief advice or more intense or frequent counseling to quit.
• Use pharmacological treatments (nicotine replacement therapy or bupropion as first-line therapies).
(SOURCE: p. 408, Curry S, Byers T and Hewitt M, 2003):

Reviews of the literature conclude that comprehensive tobacco control programs, if appropriately financed, have been shown to be more effective in preventing the onset of smoking, protecting citizens from exposure to second hand smoke, and increasing smoking cessation rates than programs that focus on one or a few population groups (e.g. women or youth), or those that focus on one or a few approaches. (Ontario Ministry of Health, 1999).

Some of the specific evidence for different components of a tobacco reduction strategy is presented below (Ontario Ministry of Health, 1999):

Comprehensive strategies:

- comprehensive programs in several U.S. states, notably Massachusetts (Massachusetts Dept. of Public Health, 1998), California (Pierce et al, 1998) and Oregon (Pizacani et al, 1999), include elements such as: legislation, enforcement, price increases, mass media, funding of local public health,

community-based prevention programs, school health and youth programs

- per capita consumption of cigarettes declined significantly as a result of these comprehensive strategies:
    - in California, per capita consumption fell 33% between 1989 and 1993 (much more than the national average);
    - in Massachusetts, per capita consumption fell 31% between 1992 and 1997 (compared to a national decline of 7%); and
    - in Oregon, per capita consumption fell by 11% within two years of the program's introduction in 1996 (compared to a national decline of 2% between 1993 and 1996).

Pricing strategies:

- increasing the price of cigarettes is an effective strategy for preventing smoking among young people, because they are much more price-sensitive than adults. This conclusion has been supported by several decades of research.

Public education:

- media strategies have been demonstrated to build support for policy measures; they can explain the real risk of tobacco products, provide information about the behaviour of the tobacco industry, and they are a cost-effective way to deliver prevention messages
- effective public education strategies combine national/provincial/state campaigns with intensive local programming
- schools are a key focus, since the majority of smokers start as children or teenagers. The most effective campaigns to prevent smoking start just before children begin to experiment with tobacco, and continue throughout the high school years (Grades 6-12 at a minimum)
- school programs that are combined with mass media interventions are more effective over the long term than school programming alone.

Packaging of tobacco products:

- plain packaging is likely to reduce smoking by non-smoking youth and contribute to smoking cessation
- health warnings help to change knowledge, attitudes and behaviours

Smoking cessation:

- smokers who quit are more likely to remain non-smokers over the long term in a supportive community environment. Some effective

environmental supports are: increased cigarette prices, health warnings, restrictions on smoking in the workplace and in public places, and mass media messages
- nicotine replacement therapies (in the form of nicotine gum of the transdermal patch) have been demonstrated to increase the success of smokers who are trying to stop. The effectiveness is increased when nicotine replacement is combined with counseling
- nicotine nasal spray and Zyban (buproprion hydrochloride) have been demonstrated to be effective pharmacological aids for smoking cessation

Smoke-free workplaces

- smoke-free workplaces protect non-smokers from the dangers of passive smoking, and also encourage smokers to quit or reduce consumption
- totally smoke-free workplaces are associated with reductions in the prevalence of smoking of 3.8%, and 3.1 fewer cigarettes smoked per day per continuing smoker (Fichtenberg and Glantz, 2002)
- One study stated that 75% of employees reported positive effects from the ban (including increased work performance). Negative effects were reported mainly by smokers and resulted from the additional time they spent going for a cigarette (Hocking, Borland, Owen and Kemp, 1991)
- Other studies suggested the effectiveness of the ban was improved when supported by other health promotion and smoking cessation activities (Stillman, Becker, Swank et al, 1990)
- To achieve a decline in smoking rates equivalent to a workplace ban, it was estimated that tax per package of cigarettes would have to be increased from USD 0.76 to 3.05 in the United States (Fichtenberg and Glantz, 2002)

2.2 ETS (Environmental Tobacco Smoke)

The United Kingdom Special Committee on Tobacco and Health (1998), National Cancer Institute (1999), the WHO International Consultation on Environmental Tobacco Smoke (ETS) and Child Health (1999), and the Expert Panel to Advise the Minister of Health of Ontario (1999) recommend the following strategies as being effective to address the issue of ETS (Ontario Tobacco Research Unit, 2001):

- restricting smoking in public places
- restricting smoking in workplaces

- public education about the risks of smoking in the home, particularly in relation to respiratory diseases in children
- health education to focus on the dangers of ETS in fetal development, and postnatally in Sudden Infant Death Syndrome

In the Latin American context it is important to note that the Tobacco industry has mounted an effort to avoid regulation on second hand exposure to tobacco smoke. This strategy – the so-called "Latin Project" – implemented by Philip Morris International and British American Tobacco, involved the recruitment of well-placed physicians and scientists to generate scientific arguments minimizing second hand smoke as a health hazard, to produce low estimates of exposure, and to lobby against smoke-free workplaces and public places. It was felt this effort has been successful in slowing the development of initiatives to address ETS in Latin America (Barnoya and Glantz, 2002)

2.3 Indoor air quality/COPD

Chronic Obstructive Pulmonary Disease (COPD) is related to two classes of risk factors: host and environmental. The following environmental factors are significant:

- tobacco smoke
- occupational dust and chemicals
- outdoor and indoor air pollution
- infections (a history of severe childhood respiratory infections)
- low socio-economic status

(Global Initiative for Chronic Obstructive Lung Disease, 2003)

Of the environmental factors noted above, tobacco smoke is already considered elsewhere in this report; occupational dust and chemicals is, by definition, occupation-specific, so it will not be considered here; outdoor air pollution is also beyond this review. Indoor air pollution is particularly relevant to this review, and is also associated with childhood respiratory infections as well as COPD.

Indoor air pollution, caused by solid fuels used in traditional stoves, has been identified as the eighth largest global health risk. (Heltberg, 2002) This is a health issue that affects poor women and children disproportionately, with women being affected by acute respiratory infections approximately twice as much as men (the comparison for chronic respiratory illness was not determined). Indoor air pollution causes an estimated 2 million deaths a year,

mostly in developing countries. It primarily affects the poor in rural areas, but exposure is rising among urban populations. (OECD, 2003)

In many countries in LAC firewood remains an important source of fuel, especially for rural and poor households; only the most affluent use gas or electricity. For example, in Guatemala 42% of rural and 17% of urban households use only wood as a cooking fuel, and many more use a combination of wood and modern fuels (Heltberg, 2002). The choice of cooking fuels is influenced by a variety of economic, environmental and cultural factors.

The most effective strategies to deal with indoor air pollution are:

- increasing access to improved cooking stoves where wood is cheap;
- Increasing access to cleaner fuel by increasing the supply and distribution of fuels such as kerosene where wood is expensive;
- Modifying the home environment to improve ventilation, e.g. cooking windows can reduce indoor carbon monoxide levels;
- Programs to change behaviour, such as improving understanding of the link between pollution and ill health and encouraging children to be kept away from smoke during peak cooking times.

(p. 62, OECD, 2003)

2.4 Obesity

The following recommendations on Weight Control and Physical Activity have been proposed by the International Agency for Research on Cancer (an agency of WHO) and endorsed by the National Cancer Policy Board of the United States. These recommendations are consistent with those proposed by CDC (CDC, 2000). The actions address the major causes of obesity, i.e. inadequate nutrition and insufficient physical activity, as the major foci for action.

Recommendations for Public Health Action on Weight Control and Physical Activity to Promote Cancer Prevention, IARC, WHO

Governmental and Nongovernmental Organizations

1. Public education should provide timely and accurate information on the epidemic of obesity and inactivity and on ways this can be addressed.
2. Governments at local and national levels should ensure that schoolchildren at all stages have proper access at school to healthy meals and to recreation and sports facilities.

3. Governments at local and national levels, as well as nongovernmental organizations, should provide adequate funding for effective physical education programs in schools.
4. Communities and buildings should be designed to encourage use of stairs and walking. A proportion of transportation budgets should be allocated for development of bicycle and pedestrian facilities, notably in urban areas.
5. In developing countries there are dietary traditions, behavioral patterns, and infrastructures that potentially could aid weight gain prevention programs. Efforts should be made to prevent the loss of cultural traditions that promote healthy diets and physical activity.

Worksites and Schools

1. Employers should encourage physical activity and weight control by all employees. Methods can include provisions for exercise areas at work; showers; and financial incentives to walk, bicycle, or use public transportation rather than cars.
2. School curricula should include adequate teaching of food, nutrition, and health and on the importance of active living.
3. Schools should include 1 hour of physical education on most days.

Health Professionals and Educators

1. Health professionals should counsel individuals about a healthy range of body weights. For persons currently within the healthy range, it is recommended that weight gain during adult life not exceed 5 kilograms (11 pounds).
2. Medical schools and other health science professional programs should make the study of food, nutrition, and physical activity and their relation to health and disease an integral part of the training of health care professionals.
3. Physicians and health care providers should counsel their patients on the need for an active lifestyle for the prevention of cancer and other noncommunicable diseases.
4. Health care providers and educators should set a personal example by engaging in regular physical activity and controlling their weight to the best of their ability.
5. Health care providers and teachers should take an active role in their communities to support regular physical activity and weight control.

6. Maternal and child health programs can provide a suitable context for promoting awareness of the need for physical activity and preventing weight gain, particularly in developing countries.

Families and Individuals

1. Prevention of overweight and obesity should begin early in life. It should be based on the development of lifelong healthy eating and physical activity patterns. However, it is never too late to benefit from starting to be more active.
2. Individuals should be encouraged to maintain physical activity to promote energy balance and weight control. The primary goal should be to perform continuous physical activity on most days of the week. A total of 1 hour of moderate intensity activity such as walking may be needed each day to maintain a healthy body weight, particularly for people with sedentary occupations. More vigorous activity, such as fast walking, several times a week may give some additional benefits regarding cancer prevention. Therefore, planned vigorous activities such as sports should be undertaken according to individual interests and capabilities.
3. Individuals should, where possible, give priority to the more active alternatives in their daily lives.
4. Parents and individuals should limit the purchase and availability at home of high-energy foods and beverages with low nutritional value, such as soda beverages and baked snacks, and instead should provide healthy foods, in particular, an abundant supply of fruits and vegetables and whole-grain products.

(Source: p. 414, Curry S, Byers T and Hewitt M, 2003)

2.5 Physical Activity

The area of physical activity has been studied extensively, and a good deal is known about the effectiveness of interventions. McKinlay (1995) classifies interventions as downstream, midstream or upstream. Downstream interventions are focused more on the individual, while interventions that focus on supporting larger groups of people to be physically active (e.g. building walking or biking trails in urban areas, or media campaigns) are considered to be mid- to upstream approaches.

Downstream interventions that focus solely on the individual, are program-centred, and which promote high-intensity activity have been tried repeatedly,

and have not been demonstrated to be effective. The most effective interventions are directed at multiple levels on the downstream-upstream continuum and consider factors such as individual dispositions (e.g. self efficacy, attitudes), culture, family support, school programs, community programs, neighbourhood facilities, climate and physical environment (Spence, 2001).

Spence (2001) considered current knowledge regarding both the efficacy as well as the effectiveness of interventions to promote physical activity. He concluded that "modest achievements have been gained in downstream and midstream physical activity interventions, whereas limited data is available for upstream interventions."

His conclusions regarding efficacy are as follows:
"Literature reviews (Dunn, Anderson, & Jakicic, 1998; King, Rejeski, & Buchner, 1998; Simons-Morton, Calfas, Oldenburg, & Burton, 1998; Stone, Mckenzie, Welk, & Booth, 1998) and one meta-analysis (Dishman & Buckworth, 1996) support the idea that physical activity interventions targeting individuals can be efficacious in increasing physical activity behaviour. The bulk of these interventions emphasize self-regulation, focus upon manipulations of cognitive appraisals, and provide the participants with behavioural management skills.

"In their meta-analysis of 127 studies, Dishman & Buckworth (1996) found that large changes in physical activity behaviour (d=0.75) could be brought about by these interventions. Frequency of activity was increased by 10% to 25% in the short term. The most efficacious interventions were based on behaviour modification, utilizing mediated delivery, and promoting low to moderate intensity activity. Further, the success rate of the interventions ranged from 50% to 88%. In summary, the efficacy of our interventions for getting people to be physically active is good.

"One notable exception to the above is a review of literature in which worksite interventions were not found to be very successful for increasing physical activity and/or physical fitness (Dishman, Oldenburg, O'Neal, Shephard, 1998). The authors, however, stated that the scientific quality of the studies reviewed were generally poor making it difficult to draw any definitive conclusions about worksite physical activity interventions…Overall, modest achievements have been gained in downstream and midstream physical activity interventions, whereas limited data is available for upstream interventions."
(p. 14, Spence, 2001)

With respect to effectiveness, much less information is available. The CDC reviewed interventions in the area of physical activity and recommended the following interventions as "effective" (with effectiveness defined as "improvement in health or behavioural outcome produced by an intervention in a community setting"):

Table 6. Recommendations of Effectiveness for Interventions to Promote Physical Activity from the Task Force on Community Preventive Services *(Centers for Disease Control and Prevention, 2001)*

Intervention	Recommendation
Informational Approaches to Increasing Physical Activity	
Community-wide campaigns	Strongly Recommended
"Point-of-decision" prompts to encourage stair use	Recommended
Classroom-based health education focused on information provision	Insufficient Evidence
Mass media campaigns	Insufficient Evidence
Behavioural and Social Approaches to Increasing Physical Activity	
School-based physical education	Strongly Recommended
Non-family social support	Strongly Recommended
Individually-adapted health behaviour change	Strongly Recommended
Health education with TV/Video game turnoff component	Insufficient Evidence
College-age physical-education/health education	Insufficient Evidence
Family-based social support	Insufficient Evidence
Environmental and Policy Approaches to Physical Activity	
Creation and/or enhanced access to places for PA combined with informational outreach activities	Strongly Recommended
Transportation policy and infrastructure changes to promote non-motorized transit	Pending
Urban planning approaches – zoning and land use	Pending

Community-wide Campaigns*: Large scale, high-intensity, community-wide campaigns with sustained visibility. Interventions were multicomponent including mass-media messages, support and self-help groups, physical activity counseling, risk factor screening and education, community events, and walking trails.*

***Point-of-decision Prompts**: Single component interventions using motivational signs placed by elevators and escalators encouraging people to use nearby stairs for health benefits or weight loss.*

***School-based Physical Education**: Modified curricula and policies to increase amount of moderate or vigorous activity, increase the amount of time spent in physical education class, or increase the amount of time students are active enough during physical education class.*

***Non-family Social Support**: Focus is on changing physical activity behaviour through building, strengthening, and maintaining social networks that provide supportive relationships for behaviour change. Interventions typically involved setting up a "buddy" system, contracting with one another to complete specified levels of physical activity, or setting up walking groups or other groups to provide friendship and support.*

***Individually-adapted Health Behaviour Change**: Programs tailored to the individual's readiness for change or specific interests. Designed to help participants incorporate physical activity into their daily routines by teaching them behavioural skills, specifically, 1) goal setting and self-monitoring, 2) building social support, 3) behavioural reinforcement, 4) structured problem-solving, and 5) relapse prevention. All interventions delivered to groups of people either in group settings or by mail, telephone, or directed media.*

***Creation and/or Enhanced Access to Places for Physical Activity Combined with Informational Outreach Activities**: Access to places for physical activity can be created or enhanced by building trails or facilities or by reducing barriers to places such as by reducing fees or providing time for use.*
(pp. 15-16, Spence, 2001)

Although the Community Guide to Preventive Services found there to be insufficient evidence to support population-based mass media campaigns, Spence cites several studies from the United States and Australia which demonstrated significant increases in the awareness of the benefits of physical activity on the part of the population, as a result of these campaigns (Spence, 2001)

2.6 Cardiovascular Disease (CVD) and Cerebrovascular Disease

As the main risk factors for cardiovascular disease and cerebrovascular disease are the same (i.e. hypertension, smoking, overweight and hypercholesterolemia), prevention initiatives will be considered together.

The CDC recommends the following as effective strategies for the prevention of CVD:

- A key strategy for reducing risk factors is to educate the public and health care practitioners about the importance of prevention. People can reduce their risk for cardiovascular disease by controlling high blood pressure and high blood cholesterol levels.
- A class of drugs called statins can reduce deaths from heart disease by reducing cholesterol levels, and medications that reduce blood pressure levels can reduce the risk for heart disease, strokes, and other coronary events.
- Patients who take beta blockers within days or weeks of a heart attack have a greater chance of surviving the heart attack.
- People need to be educated about the signs and symptoms of heart attacks and stroke and the importance of calling 911 quickly. Research indicates that nearly 70% of deaths from heart disease occur before a person can be admitted to a hospital, and about 48% of stroke victims die before emergency medical personnel arrive.
- Other important ways that people can reduce their risk for heart disease and stroke are to avoid using tobacco, adopt healthier diets, and increase their levels of physical activity.

(source: http://www.cdc.gov/nccdphp/pe_factsheets/pe_cvh.htm

It should be noted that only the first and the last of the strategies recommended above fall in the category of primary prevention; the others are either secondary or tertiary prevention.

Much of the learning about primary prevention of CVD has come from five large community prevention trials conducted over the last 30 years: the Stanford Three-City Project (Farquhar, 1978), North Karelia Project (Puska et al, 1995), Stanford Five-City Project (Farquhar, 1990), Minnesota Heart Health Program (Luepker et al, 1994) and the Pawtucket Heart Health Program (Carleton et al, 1995). Although a limitation of these studies is that they were not true experimental designs, the evidence is consistent enough to be useful in guiding policy decisions. They have been shown to be cost-effective and easily transferable to other community settings (Harvey et al, 2002).

The five projects established that CVD is preventable through modifications of established risk factors such as cigarette smoking, elevated blood lipids, elevated

blood pressure and sedentary lifestyle. The projects were based on the premise that community-wide strategies lead to a reduction in disease rates through changes in individual and community risk factors.

These projects used a similar combination of three primary categories of interventions: mass media, program-specific prevention initiatives that provided education and/or skill-building for health behaviour modification in multiple settings, and environmental support through policy development and site-based program development. Three of the programs used strategies that involved extensive community involvement (through trained lay volunteers, as well as partnerships with community organizations such as schools, workplaces and religious organizations). The North Karelia experience was described in detail by Puska et al (1986).

Three of the initiatives were successful in reducing smoking rates, two reported reductions in obesity/body weight, four reported a coronary heart disease risk reduction, three reported a reduction in cholesterol, and three reported a reduction in blood pressure. The North Karelia Project was the only one of the five trials that demonstrated a reduction in coronary heart disease reduction (a drop in the age-adjusted coronary heart disease mortality rate of 72% for men 35-64 years, compared to a 64% drop in all Finland, for the period 1969-1995). In the three studies in the 1980s, the decrease of the risk factors were often small but even a reduction of a few percentage points in a primary cardiovascular disease risk factor has considerable significance at a population level (Harvey et al, 2002).

It must be noted, however, that more current research is starting to challenge the conventional notions of the relationship between CVD the risk factors of smoking, elevated serum cholesterol and high blood pressure. The WHO's large MONICA study (which followed 150,000 people) concluded:

(C)hanging rates of coronary heart disease in different populations did not appear to relate at all well to the change in the standard risk factors, considered one by one, or in a risk factor score. Large differences in the rate of decline occurred across populations with similar trends in risk factors.
(WHO, 1998)

2.7 Diabetes

The WHO and the FAO brought together an expert committee to develop recommendations for reducing the risk for diabetes, many of which echo those for reducing obesity and CVD (WHO, 2002):

- Prevention/treatment of overweight and obesity, particularly in high risk groups.
- Maintaining an optimum BMI, i.e. at the lower end of the normal range. For the adult population, this means maintaining a mean BMI in the range 21--23 kg/m2 and avoiding weight gain (>5 kg) in adult life.
- Voluntary weight reduction in overweight or obese individuals with impaired glucose tolerance (although screening for such individuals may not be cost-effective in many countries).
- Practising an endurance activity at moderate or greater level of intensity (e.g. brisk walking) for one hour or more per day on most days per week.
- Ensuring that saturated fat intake does not exceed 10% of total energy and for high-risk groups, fat intake should be <7% of total energy.
- Achieving adequate intakes of NSP through regular consumption of wholegrain cereals, legumes, fruits and vegetables. A minimum daily intake of 20 g is recommended.

Measures to support people in achieving healthy diets and regular physical activity were felt to be particularly relevant for the poorest regions of the world, where resources for treatment are severely limited (WHO, 2003)

Three studies in diabetes prevention demonstrate the effectiveness of lifestyle changes and community interventions in the prevention of Type 2 diabetes (Tuomilehto et al, 2001; Eriksson and Lindgarde, 1991; Pan et al, 1997). The studies used combinations of dietary treatment and/or an increase in physical activity for individuals at high risk of diabetes. Each of the three studies was able to demonstrate significant decreases in Type 2 diabetes among high risk subjects (i.e. those with impaired glucose tolerance). (Harvey et al, 2002).

2.8 Food/Nutrition

One of the most significant issues confronting the countries of LAC is food insecurity. It is estimated that 53.6 million people in LAC are malnourished. The situation is most severe in parts of the Caribbean (affecting 56% of the population in Haiti), with about 21% of the population in Central America being affected. In general the situation deteriorated through the 1990s, but South America experienced some progress (due to decreases in Brazil and Peru). Some countries

– notably Chile and Costa Rica – have demonstrated that it is possible, through a concerted focus, to push the proportion of malnourished people to below 5% (FAO, 2001a).

FAO has proposed a number of categories of interventions to address the issue of food insecurity:

- increase in food production. This can be accomplished through intensification and diversification of production in a sustainable way. One effective community strategy is the implementation of family gardens, where fruits and vegetables to be grown are selected according to:
    - the quality and quantity of land available;
    - the nutritional quality of the food;
    - its acceptability by the community;
    - its ability to resist disease and pests;
    - the demand for the harvest;
    - support for traditional aboriginal crops;
    - education of the community about the nutritional value of different foods and the nutritional needs of different members of the family;

  This nutritional strategy, when coordinated with agricultural and development strategies, has the potential to be especially significant in rural areas where families have few resources and poor access to primary health care.
- increase access to food. This can be accomplished through helping communities generate other income sources as alternatives to agriculture; programs of credit for farmers to ensure they are not overwhelmed by debt; and food aid programs.
- increase the nutritional content of food. Some strategies include the fortification of foods, as well as more appropriate techniques for growing, harvesting and processing the food.
- increase the nutritional quality of the diet. The diet's nutritional quality may be improved through selecting foods of higher nutritional value, as well as combinations of foods that enhance the absorption of nutrients; raising small animals to augment the availability of protein and some minerals.
- increase the consumption of an adequate diet. This may be accomplished through food and nutrition education programs, and programs to promote nutritious eating habits and positive attitudes. All of this must be done within the context of a family's limited budget and realistic and culturally-appropriate choices.

(FAO, 2001b)

Strategies to enhance food security should have a focus on the most vulnerable groups, and require effective coordination between various sectors: health, education, agriculture, transportation, development and others.

2.9 Poverty/Income Inequities

Years of experience with "lifestyle" interventions has shown that efforts to reduce CVD mortality through lifestyle change and cholesterol reduction have had limited efficacy (Raphael, 2002, citing O'Loughlin et al, 1999; Fitzpatrick, 2001). There is a growing body of literature documenting the association between NCDs – especially CVD and diabetes – and poverty.

Poverty and income inequities are significant factors to consider in examining the question of which interventions would be most effective in addressing NCD in LAC. PAHO estimates that the number of poor people in LAC has climbed to 224 million in recent years, representing 36% of the total population in 1997 (PAHO, 2002). The situation has been aggravated by economic crises over the last decade which has resulted in an impoverishment of the middle class, and a fragmentation or breakdown in many of the traditional supports for communities and families (OECD, 2003b).

This is a particularly important factor when considering interventions to address NCD:

"Poverty and unemployment are associated with adverse lifestyle factors, including higher tobacco use, higher rates of obesity, poorer nutrition, and less physical exercise. Those in the lowest income bracket are two and a half times more likely to smoke than those in the highest income bracket. Wealthier individuals have a lower incidence of high blood pressure and high blood cholesterol, and they live longer. A study in Alameda County, California, found that those living in poor neighbourhoods had a 50% higher rate of hypertension than those living in affluent neighbourhoods, after controlling for age, race, risk factors, access to medical care, social interaction, and range of other variables. In all these cases, there is a clear gradient by social class."

(Colman, 2002 p.54)

Furthermore, improvements in lifestyle behaviours in North America (eating, drinking, smoking, and exercise patterns), and consequent declines in heart disease incidence and mortality, have occurred at a much lower rate among the less educated, less affluent, strata than among higher socio-economic groups. (Colman, 2002)

These figures translate into higher incidence rates for many illnesses, cited in a study by Raphael and Farrell (2002):

"A series of studies in the UK document how those living on lower incomes are more likely to suffer from and die from CVD - and a number of other diseases - at every age (Black and Smith, 1992; Whiteside, 1992; Acheson, 1998). In the USA, lower-income Americans have a higher incidence of a range of diseases. Lower income Americans are much more likely ± risk ratio of 2.52 ± to die from CVD than highest income Americans (US Department of Health and Human Services, 1998).

"In Canada, national examinations of the relationship between income and mortality from diseases use census tract of residence to estimate individuals' income. Canadians living within the poorest 20 percent of urban neighbourhoods have much higher mortality rates for CVD, cancer, diabetes, and respiratory diseases than other income groups (Wilkins et al., 1989; Statistics Canada, 2001).

"In 1996, 23 percent of years of life lost from disease and injuries prior to age 75 in Canada could be attributed to income differences. CVD was the disease most responsible for these differences, accounting for 22 percent of all of these years lost. In terms of absolute CVD mortality, income differences accounted for a 24 percent excess prior to 75 years."
(p. i-ii, Raphael and Farrell, 2002)

Recent research findings have caused some to question the causal mechanisms linking lifestyle risk factors and various NCDs. In the case of diabetes, it has been determined that 90% of the variance in occurrence of metabolic syndrome (associated with Type 2 diabetes) observed in the UK Whitehall studies cannot be accounted for by conventional behavioural risk factors (Brunner and Marmot, 1999, cited in Raphael et al, 2003). The presence of a high level of risk factors affecting the pre-natal and childhood period appears to result in a higher level of relative risk for diabetes that continues through adult life, and which is not offset by a change in lifestyle.

The relationship between income and health is a complex one. A growing body of evidence indicates that the distribution of income in a given society may actually be a more important determinant of population health than the total amount of income earned by society members. Reviewing the evidence, the editor of the British Medical Journal concluded:

"What matters in determining mortality and health in a society is less the overall wealth of the society and more how evenly wealth is distributed. The more equally wealth is distributed, the better the health of that society."
(cited on p. 55 Colman, 2002)

Recent studies have examined more closely the relationship between health status and inequalities. Judge and Paterson (2001) conclude that the effect of income inequality per se as a determinant of population health has been overstated. They go on to say that it the influence of a variety of factors over the course of a lifetime – and including low income – that results in health inequalities, and that policy responses to the issue of health inequality should be broadly focussed:

"The overview of lifecourse studies … has clearly demonstrated that financial circumstances in childhood are an important determinant of an individual's educational attainment and health capital as they enter adulthood. These, in turn, have a significant effect on people's living standards and health in adulthood, and low incomes then also have a detrimental effect on health. The introduction of a range of policies to improve living standards by creating opportunities for employment and education as well as reforming the benefit system are obviously important in tackling poverty and health inequalities, but so too are those which address housing, access to adequate services – such as public transport, supermarkets and leisure facilities – the working environment, crime, and health damaging behaviours such as smoking, drug and alcohol abuse and unhealthy diets. The health system also has its part to play to underpin work on reducing health inequalities, including changes to resource allocation, the performance management of local action on health inequalities, providing illness prevention and health promotion, and a more equitable distribution of GPs. The relative importance placed on each policy within the overarching strategic model is the real challenge for policymakers."
(p. 52, Judge and Paterson, 2001)

These findings have many implications for the development of effective programs and policies to address NCD. Raphael and Farrell (2002b) propose that governments implement policy solutions in three main areas:

- reducing the incidence of poverty and low income;
- reducing the incidence of social exclusion; and
- restoring the supports (family, community and government) by which people have traditionally been assisted in their lifetimes

Although several governments, such as the UK (Acheson Report) and the State of Minnesota (A Call To Action: Advancing Health for All Through Social and Economic Change) have discussed the question of how to address health inequalities, the government of the Netherlands may be the most progressive in actually implementing policies in this area, having adopted the following strategy in 1994:

"Interventions and policies targeting socioeconomic disadvantage

- *Continuation of policies that promote educational achievement of children from lower socioeconomic families*
- *Prevention of an increase in income inequalities through adequate tax and social security policies*
- *Intensification of antipoverty policies, particularly those that relieve long term poverty through special benefit schemes and help with finding paid employment*
- *Further development and implementation of special benefit schemes for families whose financial situation threatens the health of their children*

Interventions and policies to reduce effects of health on socioeconomic disadvantage

- *Maintaining benefit levels for long term inability to work, particularly for those who are totally or partially disabled due to occupational health problems*
- *Adaptation of working conditions for chronically ill and disabled people to increase work participation*
- *Health interventions among long term recipients of social benefits to remove barriers to finding paid employment*
- *Further development and implementation of counselling schemes for school pupils with regular or long term health related absenteeism*

Interventions and policies targeting factors mediating the effect of socioeconomic disadvantage on health

- *Adapting health promotion programmes to the needs of lower socioeconomic groups, particularly by focusing on environmental measures, including introducing free fruit at primary schools and increasing the excise tax on tobacco*

- *Implementing school health promotion programmes that target health related behaviour (particularly smoking) among children from lower socioeconomic families*
- *Introducing health promotion into urban regeneration programmes*
- *Implementation of technical and organisational measures to reduce physical workload in manual occupations.*

Interventions and policies to improve accessibility and quality of health care services

- *Maintaining good financial accessibility of health care for people from lower socioeconomic groups*
- *Relieving the shortage of general practitioners in disadvantaged areas*
- *Reinforcing primary health care in disadvantaged areas by employing more practice assistants, nurse practitioners, and peer educators—for example, for implementing cardiovascular disease prevention programmes and better care for people who are chronically ill*
- *Implementation of local care networks aiming for the prevention of homelessness and other social problems among chronic psychiatric patients"*

(from p. 1029, Mackenbach and Stronks, 2002)

Unfortunately, there has, to date, been very little research to document the effectiveness of interventions intended to address health inequities:

"What evidence that there was about effectiveness tended to be clearer for downstream, individually focused, interventions than for more upstream, population or community level, interventions (Macintyre et al., 2001). A recently published overview of policies to reduce inequalities in health in Europe also found that for many of the domains studied (for example, work policies, food policies, smoking, children, and access to health care) there was "little direct evidence that permits any definitive judgments" (Mackenbach and Bakker, 2002).
(p. 23, Oliver and Exworth, 2003)

It may be concluded, therefore, that when considering which interventions might be most effective with a population - a large proportion of which is experiencing poverty - it is critical to take into account: a) interventions which deal with poverty directly; and/or b) interventions which mitigate against the effects of poverty by increasing quality of life, in order for the interventions to be successful.

2.10 Adherence

One of the biggest issues affecting the effectiveness, and the cost-effectiveness, of any intervention is the ability of the patient or client to "adhere" to the intervention. This issue is particularly relevant to chronic conditions where primary, secondary and tertiary prevention activities may need to be followed over a period of years to achieve the desired effect.

The WHO has just released a major study on this issue (WHO, 2003b). In it, they have defined adherence as follows:

"the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider"
(p. 3, WHO, 2003)

Although drug therapies have been recommended as effective interventions to control NCD risk factors such as hypertension, the effectiveness of these therapies is greatly diminished by low adherence rates. It is estimated that overall adherence to long-term therapies for chronic illnesses is approximately 50% in developed countries, and it tends to be much lower in developing countries (WHO, 2003b).

Adherence has often been treated by many health professionals to be a matter of individual compliance among patients. What becomes obvious in the research is that interventions that are poorly designed (i.e. those that do not take into account the social, cultural, and economic realities of the patient, the capacity of the health care system to support the intervention, the characteristics of the disease) have little chance of succeeding; patients need to be supported – not blamed – for the interventions to be successful. The support of family members and community organizations can play key roles in maintaining adherence. (WHO, 2003b).

2.11 Effective NCD Prevention Strategies

A review of interventions to address NCDs prompted the authors to present the following conclusions about effective strategies to prevent NCDs:

*"**Comprehensive Interventions***

The primary prevention of chronic disease will require multiple strategies that focus on both behaviour change and social and physical environment changes supportive of healthy behaviours and health. To accomplish this will require multiple approaches for communication/information, public policy and prevention initiatives that reach people in multiple settings (workplace, community, home, schools, restaurants, grocery stores) across the age span, as well as priority populations. The behaviour and policy approaches must address multiple risk behaviours and inequalities. Comprehensive interventions require the collaboration of individuals, communities, community organizations and governments.

*"**Integration***

A successful comprehensive intervention needs to be carefully integrated so that the information, policy and prevention initiatives reaching the total population in multiple settings are mutually reinforcing. This will require an integration of information, public policy and prevention initiatives to enhance synergy. Integration also means that primary prevention approaches need to encompass both the total population and those at high-risk. While the low-income sectors of the population have a disproportionate amount of the burden of chronic disease, the vast majority of the total burden rests with those who are outside the low-income strata. Therefore, it is not an "either or" approach, but a comprehensive integrated approach that addresses high, medium and low-income populations.

*"**Sustainability***

Sustainability in this document refers to the ability and capability to sustain the process and the initiatives. Comprehensive interventions need to be developed within the capacity of their settings. This means the ability to maintain the programs with respect to knowledge and technical skills, and capability in terms of resources (monetary and human).

*"**Community-Led***

Community involvement and ownership are crucial to the implementation of comprehensive interventions. Communities need to be a part of the decision-making, and in fact should have a lead role. Communities themselves know how to attain a social ecological perspective that will lead to comprehensive interventions that are integrated, sustainable and fit the social and physical environments.

*"**Disseminate Research Results and Lessons Learned***

"Despite the fact that there is strong evidence of the success of population-based chronic disease prevention strategies, prevention is a low priority among governments and

organizations. Farquhar states that there is a need to raise the priority of chronic disease prevention, especially community-based chronic disease prevention. Widespread sharing of the findings, challenges and successes of prevention studies and programs allows countries and communities to learn from others, reduces cost and time delays of duplication, and allows for adaptation to different environments. Blending education with advocacy, and building health professionals' commitment, skills and freedom to modify the health system's traditional 'top-down' approach with 'bottom-up' community activation for health incorporates the practicalities of 'how-to,' through using real-life examples from research."
(Harvey, 2002, p.27)

Many of these strategies are being supported through CARMEN (Conjunto de Acciónes para la Reducción Multifactorial de las Enfermedades No transmisibles), an international network to support the prevention of NCDs throughout LAC, organized by WHO/PAHO. CARMEN focuses on supporting its member states in three main strategies: integrated prevention, promotion of health equity, and demonstrative effect (the testing of interventions in a demonstrated area to determine effectiveness and acceptability, before expanding the intervention).

3. The costs and revenues associated with interventions effective in the prevention of major causes of NCDs

3.1 Tobacco control

Although many of the studies identified the costs involved in implementing a particular intervention, the costs were confined to the study, and were often not generalized to a broader population. The one area for which there were good cost estimates for a population-based approach for addressing a NCD was for tobacco. The National Centre for Chronic Disease Prevention and Health Promotion (United States) provided estimates for the costs involved in implementing a comprehensive tobacco control program (see below). It must be noted, however, that the cost estimates assume a level of infrastructure in the public health, education and communications systems that exists across the United States. As such, they may not provide a realistic estimate of what it would cost to deliver such interventions in LAC; other lower-cost interventions may be much more appropriate there.

With respect to revenues, the one area of NCD prevention which has the potential to generate significant revenues is the taxation of cigarettes and other tobacco products. Revenue estimates are not presented here. The experience in many jurisdictions has shown that the price-point of tobacco is very sensitive – if the price is raised too high through taxes smuggling is promoted. The deterrent against smuggling depends on the resources committed to law-enforcement organizations; these demands may greatly reduce the revenues to be gained through increased taxes.

The following comprehensive program was recommended, with per capita cost-estimates presented for state-wide implementation:

"Based upon this evidence, specific funding ranges and programmatic recommendations are provided. The local analysis of each State's priorities should shape decisions regarding funding allocations for each recommended program component. The funding required for implementing programs will vary depending on state characteristics, such as demographic factors, tobacco use prevalence, and other factors. Although the type of supporting evidence for each of the recommended nine program components differs, evidence supports the implementation of some level of activity in each program area. In general, States typically have selected a funding level around the middle of the recommended ranges. Current allocations range from $2.50 to over $10; however, no

State is currently implementing all of the recommended program components fully. Approximate annual costs to implement all of the recommended program components have been estimated to range from $7 to $20 per capita in smaller States (population under 3 million), $6 to $17 per capita in medium-sized States (population 3 to 7 million), and $5 to $16 per capita in larger States (population over 7 million).
"The best practices address nine components of comprehensive tobacco control programs:

*"**I. Community Programs to Reduce Tobacco Use** (Base funding of $850,000–$1.2 million per year for State personnel and resources; $0.70–$2.00 per capita per year for local governments and organizations).*

"Local community programs cover a wide range of prevention activities including engaging youth in developing and implementing tobacco control interventions; developing partnerships with local organizations; conducting educational programs for young people, parents, enforcement officials, community and business leaders, health care providers, school personnel, and others; and promoting governmental and voluntary policies to promote clean indoor air, restrict access to tobacco products, provide coverage for treatment, and achieve other policy objectives. In California and Massachusetts, local coalitions and programs have been instrumental in achieving policy and program objectives. Program funding levels range from approximately $1.00 per capita in California to over $2.50 per capita in Massachusetts.

***"II. Chronic Disease Programs to Reduce the Burden of Tobacco-Related Diseases** ($2.8 million–$4.1 million per year).*
"Even if current tobacco use stopped, the residual burden of disease among past users would cause disease for decades to come. As part of a comprehensive tobacco control program, communities can focus attention directly on tobacco-related diseases both to prevent them and to detect them early. The following are examples of such disease programs and recommended funding levels:

- *Cardiovascular disease prevention ($500,000 for core capacity and $1–$1.5 million for a comprehensive program).*
- *Asthma prevention (base funding of $200,000–$300,000 and $600,000–$800,000 to support initiatives at the local level).*
- *Oral health programs ($400,000–$700,000).*
- *Cancer registries ($75,000–$300,000).*

*"**III. School Programs** ($500,000–$750,000 per year for personnel and resources to support individual school districts; $4–$6 per student in grades K–12 for annual awards to school districts).*

"School program activities include implementing CDC's Guidelines for School Health Programs to Prevent Tobacco Use and Addiction, which call for tobacco-free policies, evidence-based curricula, teacher training, parental involvement, and cessation services; implementing evidence-based curricula identified through CDC's Research to Classroom Project; and linking school-based efforts with local community coalitions and statewide media and educational campaigns. Oregon has developed a new funding model for school programs based upon CDC's guidelines and experience in California and Massachusetts. At an annual funding level of approximately $1.60 per student, Oregon was able to provide grants to approximately 30% of their school districts. Assuming 100% coverage of school districts using a funding model similar to the Oregon model, $4–$6 per student in grades K–12 should be budgeted.

*"**IV. Enforcement** ($150,000–$300,000 per year for interagency coordination; $0.43–$0.80 per capita per year for enforcement programs).*

"Enforcement of tobacco control policies enhances their efficacy by deterring violators and by sending a message to the public that community leaders believe that these policies are important. The two primary policy areas that require enforcement activity are restrictions on minors' access to tobacco and on smoking in public places. State efforts should be coordinated with Food and Drug Administration (FDA) and Substance Abuse and Mental Health Services Administration (SAMHSA) Federal programs. California and Massachusetts have addressed enforcement issues as part of community program grants. Florida has taken a more centralized approach by using State Alcoholic Beverage Control Officers to conduct compliance checks with locally recruited youth in all regions of the State.

*"**V. Statewide Programs** (Approximately $0.40–$1 per capita per year).*

"Statewide projects can increase the capacity of local programs by providing technical assistance on evaluating programs, promoting media advocacy, implementing smokefree policies, and reducing minors' access to tobacco. Supporting organizations that have statewide access to racial, ethnic, and diverse communities can help eliminate the disparities in tobacco use among the State's various population groups. Statewide and regional grants to organizations representing cities, business and professional groups, law enforcement, and youth groups inform their membership about tobacco control issues and encourage their participation in local efforts. Both California and Massachusetts have awarded grants to statewide organizations, businesses, and other partners that total about $0.40 to $1.00 per capita per year.

*"**VI. Counter-Marketing** ($1–$3 per capita per year).*

"Counter-marketing attempts to counter pro-tobacco influences and increase pro-health messages and influences throughout a State, region, or local community. Counter-marketing consists of a wide range of efforts, including paid television, radio, billboard, and print counter-advertising at the State and local level; media advocacy and other public relations techniques using such tactics as press releases, local events, and health promotion activities; and efforts to reduce or replace tobacco industry sponsorship and promotions. Counter-marketing activities can promote smoking cessation and decrease the likelihood of initiation. They also can have a powerful influence on public support for tobacco control interventions and set a supportive climate for school and community efforts. Counter-marketing campaigns are a primary activity in all States with comprehensive tobacco control programs. With funding levels ranging from less than $1.00 per capita up to almost $3.00 per capita, the campaigns in California, Massachusetts, Arizona, and Florida have been trendsetters in content and production quality.

*"**VII. Cessation Programs** ($1 per adult to identify and advise smokers about tobacco use; $2 per smoker to provide brief counseling; and the cost of a full range of cessation services including pharmaceutical aids, behavioral counseling, and follow up visits ($137.50 per served smoker covered by private insurance; $275 per served smoker covered by publicly financed insurance).*

"Strategies to help people quit smoking can yield significant health and economic benefits. Effective cessation strategies include brief advice by medical providers, counseling, and pharmacotherapy. In addition, system changes (e.g., tobacco-use screening systems, clinician training, and insurance coverage for proven treatments) are critical to the success of cessation interventions. State action should include establishing population-based treatment programs such as telephone cessation helplines; covering treatment of tobacco use under both public and private insurance; and eliminating cost barriers to treatment for underserved populations, particularly the uninsured. No State currently is fully implementing the Agency for Health Care Policy and Research smoking cessation guidelines. Massachusetts and California are implementing the basic recommended elements. The complete recommended program is being implemented in several large health maintenance organizations around the country.

*"**VIII. Surveillance and Evaluation** (10% of total annual program costs).*

"A surveillance and evaluation system monitors program accountability for State policymakers and others responsible for fiscal oversight. Surveillance is the monitoring of tobacco-related behaviors, attitudes, and health outcomes at regular intervals of time.

Program evaluation efforts build upon surveillance systems by linking statewide and local program efforts to progress in achieving intermediate and primary outcome objectives. Experience in California, Massachusetts, and other States has demonstrated that the standard public health practice guideline of devoting 10% of program resources to surveillance and evaluation is a sound recommendation. State surveillance efforts should be coordinated with Federal tobacco surveillance programs such as SAMHSA's National Household Survey on Drug Abuse.

"IX. Administration and Management *(5% of total annual program costs).*

"An effective tobacco control program requires a strong management structure to facilitate coordination of program components, involvement of multiple State agencies (e.g., health, education, and law enforcement) and levels of local government, and partnership with statewide voluntary health organizations and community groups. In addition, administration and management systems are required to prepare and implement contracts and provide fiscal and program monitoring. Experience in California and Massachusetts has demonstrated that at least 5% of program resources is needed for adequate staffing and management structures."
(Source: Executive Summary, Best Practices for Comprehensive Tobacco Control Programs, National Centre for Chronic Disease Prevention and Health Promotion, 1999)
http://www.cdc.gov/tobacco/research_data/stat_nat_data/bestprac-execsummay.htm

4.0 Cost effectiveness of interventions

"Economic evaluation has been defined as "the comparative analysis of alternative courses of action in terms of both their costs and consequences."

"Four principal types of economic evaluation are usually distinguished:

1. *cost-minimization analysis (CMA), conducted when outcomes (benefits) from the interventions under consideration are the same and the interest is to determine the least costly intervention to achieve the outcome;*
2. *cost-effectiveness analysis (CEA), conducted when the outcomes may differ but are measured in the same units, such as cases completed or life years gained, and the interest is to compare the interventions in terms of cost per unit of outcome;*
3. *cost-utility analysis (CUA), conducted when the outcomes differ both in quantity and quality and the interest is to compare the interventions in terms of cost per utility; and*
4. *cost-benefit analysis (CBA), conducted when both inputs and outcomes of interventions can be expressed in monetary units and the interest is to determine the intervention that achieves the most net benefit.*

"The basic procedure entails drawing up a comprehensive balance sheet of advantages (benefits) and disadvantages (costs) associated with the various choices under consideration; this balance sheet provides explicit criteria that may be useful in deciding among different uses of available resources. Although the specific forms of economic evaluation differ, they all share this "cost-benefit" framework. This attention to both costs and benefits is what distinguishes economic evaluation from effectiveness evaluation, for example, and attention to the broader objectives and benefits of public sector services distinguishes health and social service economic evaluation from private sector accounting.

"There is no such thing as an intervention's "absolute" efficiency, but only its efficiency relative to specific alternatives. Hence, the efficiency of a particular service is 'context specific' and ***cannot*** *be determined by information on the costs and effectiveness of the service in isolation.*

"Estimating the costs (and consequences) of an intervention is also affected by how widely the net is cast in terms of what economists call the perspective of an evaluation. Costs can be estimated from the perspective of society in general, the government, an individual, a specific organization or sector, an employer, etc. Differences in perspective are a major reason why there might be disagreements about the value of a particular intervention, because what is included as a cost and consequence of an intervention will differ on the basis of the perspective adopted.

*"The **direct health and social service costs** will include staff time, supplies, "hotel" services, use of capital equipment, and overhead costs. Costs borne by patients/clients and their families include out-of-pocket expenses for such things as travel and materials. These also are considered part of the direct costs of a problem or issue. So-called **indirect costs** are related mainly to productivity losses, such as income lost by the patient or client because of work absence, but also to voluntary activity and in-kind resources, to loss of leisure time, psychological stress, and pain and suffering experienced by patients and their families. Some authors identify leisure time loss and psychological costs as the third category of costs, which they call **intangible costs.**"*
(Clyne and Edwards, 2003)

Economic evaluators rely on assessments of program effectiveness from experts in the interventions under consideration. Difficulties arise when trying to compare costs and effectiveness of interventions across different points in time, different countries, different perspectives and for different purposes. The costs of implementing a program in Latin America or Zambia differ from establishing a similar program in Canada, plus the assignment of monetary values to program outcomes will differ as the value of the outcome to society differs. There are also differences in assignment of direct, indirect and intangible costs. These issues are common to the integration of all economic evaluations and they are significant in health promotion/disease prevention because the contexts for interventions vary greatly and there have been very few effectiveness studies.

Great caution is required when generalizing cost per unit of effect in one intervention study to another situation. Many variables and assumptions are involved. It was not possible to integrate all of the studies reviewed for this paper in economic evaluation terms and provide conclusions of costs per unit. A summary of non-comparable results from each study is included.

In addition, a key study by CEDETES in Colombia, which searched for economic evaluation literature relevant to health promotion particularly in Latin America, found only 17 studies that met all of the inclusion criteria. In general, the economic evaluation components of these studies were poorly done, with methodological deficits. One of their key conclusions was that it is possible to do economic evaluations to complement the disease prevention effectiveness studies but that it is necessary to develop better economic evaluation methodologies for disease prevention and health promotion interventions. They also note that it was discouraging not to find studies in Latin America and express some caution about applying developed country experiences to developing countries.

4.1 Smoking

The WHO, in considering the available evidence for interventions to prevent smoking, concluded:

"The benefits of anti-smoking interventions for population health (in terms of DALYs) are estimated through the impact of reduced smoking on the incidence of cardiovascular disease, respiratory disease, and various forms of cancer. The interventions, not surprisingly, have a larger impact on population health in regions with a high prevalence of tobacco use… Their cost-effectiveness also varies across regions, not only because of variations in exposure to tobacco but also differences in the efficiency of the tax collection system, the degree of anti-tobacco sentiment, and the amount of smuggling.

"If only one intervention can be chosen, taxation is the intervention of choice in all regions. Not only does it have the greatest impact on population health, but it is also the most cost-effective option. Taxation also raises revenue for governments. For D and E subregions (regions of high and very high child and adult mortality) where price elasticities are generally high, taxation by itself could reduce tobacco consumption significantly. Higher rates of taxation achieve greater improvements in population health and are more cost-effective than lower rates. On purely health grounds, the higher the rate of taxation, the better.

"To achieve even greater improvements in population health, the combination of taxation, comprehensive bans on advertising, and information dissemination activities would be affordable and cost-effective in the majority of subregions. Adding restrictions of smoking in public places increases the costs, but also gains even greater improvements in population health and is still very cost- effective in A, B and C subregions (regions of relatively low child and adult mortality).

"NRT (nicotine replacement therapy) by itself is not in the most cost-effective band of interventions, but does not fall outside the cut-off point of three times GDP per capita in many regions. When added to the other interventions as part of a comprehensive package, it certainly increases the costs of the package, but improves effectiveness as well. Although the additional cost of adding NRT to anti-smoking activities would be considerable, the additional expense would be justified on purely cost-effectiveness grounds in A, B and C subregions (with the exception of WPR-B)."
(Ch. 5, Interventions to reduce specific risks, WHO, 2002)

A cost-benefit analysis of school-based smoking prevention programs conducted by Health Canada concluded:

"The objective of this study was … to compare the costs of developing and delivering an effective school-based smoking prevention program with the savings to be expected from reducing the prevalence of smoking in the Canadian population over time. A smoking prevention program that meets published criteria for effectiveness, implemented nationally in Canada, would cost $67 per student (1996 dollars). Assuming such a program would reduce smoking by 6% initially and 4% indefinitely, lifetime savings on health care would be $3,400 per person and on productivity, almost $14,000. The benefit-cost ratio would be 15.4 and the net savings $619 million annually. Sensitivity analyses reveal that considerable economic benefits could accrue from an effective smoking prevention program under a wide range of conditions."

http://www.hc-sc.gc.ca/hecs-sesc/tobacco/prof/youth/school_based/abstract.html

Finally, an analysis of the costs incurred by employers of having smokers on the workforce reached the following conclusions:

"Dow Chemical Co. discovered that one of its divisions was losing about $600,000 annually from the absenteeism of ill smokers (Sculco, 1992:883). The Congressional Office of Technology Assessment estimates that each of the approximately 15 million smokers in the United States costs their respective employers between $2,000 and $5,000 annually in increased health care and fire insurance premiums, absenteeism, lost productivity and property damage (Warner, 1994:130). The OSHA's proposed ban on smoking in indoor workplaces has the support of the Building Owners and Managers Association, which views smoking as the major cause of fires in office buildings. National data for the United States document that male and female smokers have higher absenteeism rates than non-smokers, are sicker and require more medical care (Rice, Hodgson, Sinsheimer, Browner and Kopstein, 1986)."
http://www.hc-sc.gc.ca/hecs-sesc/tobacco/facts/workplace/part5_economic.html

4.2 ETS (Environmental tobacco smoke)

Both the Canadian and American governments have conducted cost-benefit analyses of federal non-smoking legislation:

"Labour Canada's Regulatory Impact Analysis Statement prepared for the federal Non-smokers' Health Act estimated that $32.2 million (1989) could be saved from reduced smoke and related property damage, depreciation, maintenance and cleaning costs and

savings to the health care system through reduced ill-health effects of ETS exposure (Canada Gazette, 1989:4540). Setting up separately ventilated smoking rooms was projected to cost $19.77 million during 1990, the first year of the Act.

The U.S. EPA assessed the impact of the proposed Smoke-Free Environment Act (U.S. Environmental Protection Agency, 1994). The bill would ban or restrict smoking in all non-residential indoor air environments. The main conclusion of the cost-benefit analysis was that the legislation would produce net benefits of between $39 and $72 billion. The report estimates that only 10-20% of buildings would construct separate smoking lounges, owing mainly to cost and feasibility. These smoking lounges would cost between $0.3 and $0.7 billion. While the study did not establish scientifically that ETS exposure reduces worker productivity, it did predict increased organizational efficiency due to reduced conflicts between smokers and non-smokers. Reduced absenteeism would also boost productivity, as, compared with non-smokers, smokers have about 50% more workdays lost, and former smokers about 30% more. Neither of these cost-benefit analyses assessed the enhanced quality of life accruing from reduced smoking or the reduced exposure of non-smokers to ETS."

http://www.hc-sc.gc.ca/hecs-sesc/tobacco/facts/workplace/part5_economic.html

The biggest challenge to effective action to address ETS has been to demonstrate to the hospitality sector and workplaces that such actions will not have negative economic impacts on those sectors.

A major study assessed the quality of 97 studies on the economic effects of smoke-free policies on the hospitality industry concluded that no-smoking policies in restaurants and bars do not harm business, despite attempts by the tobacco industry to prove otherwise (Scollo, Lal, Hyland and Glantz, 2003). The quality of studies concluding that smoking bans adversely affected revenues was judged to be poor, as these studies were much more likely to use subjective, rather than objective measures to assess impact, they were much less likely to have been peer reviewed, and they were almost entirely funded by the tobacco industry.

A review of the impact of smoke-free laws on the hospitality industry focusing on New York City and Massachusetts analyzed data from sales, surveys of consumers and restauranteurs, employment statistics and complaint data. It was determined that smoke-free restaurant laws do not cause adverse economic consequences; the public supports such laws; and restaurant owners are able to comply with such laws with relative ease. (Journal of Public Health Management and Practice, January, 1999; http://www.ncth.ca/NCTHweb.nsf)

No negative economic impact of smoke-free policies on the hospitality sector has been determined. Employees in this sector are at risk; when they are protected, they experience significant health benefits within a very short period of time. (Ontario Ministry of Health, 1999)

4.3 Indoor Air Quality

The most significant reduction in indoor air pollution comes from increasing access to improved cooking stoves which reduce particulate emissions from traditional fuel. Evaluation of such programs has demonstrated considerable gains. Apart from the economic value of saving on fuel, cost-benefit analysis has shown that health improvements have produced further savings of around USD 25 to USD 100 per stove per year. (OECD, 2003)

4.4 Physical Activity

A comprehensive review of the cost-effectiveness of interventions to promote physical activity concluded the cost-benefit argument for these interventions is strong:

"Costs and benefits are distributed between governmental, private and personal sectors of the economy, although there is much interaction between these three sectors. An evaluation of Ontario Hospital Insurance Plan payments (Quasar, 1976) showed that yearly medical costs were $18.29 lower in active men, and $39.97 lower in active women. Likewise, analysis of worksite fitness programs has demonstrated increased productivity, a decrease in absenteeism & turnover, a decrease in medical costs and occupational injuries and a decrease in premature deaths, with a cost/benefit ratio as high as 5:1. Quasi-experimental studies suggest that medical costs can be reduced by $100/year subsequent to introduction of a fitness program; further, this is achieved with no increase in demand for ECG or orthopaedic services."
(Spence, 2001)

While individually-adapted health behaviour change interventions could be efficacious for increasing physical activity, they are not considered to be cost-effective; because of the limited reach of such interventions they would have less impact and be less effective from a public health perspective. These interventions could be more effective, however, if included as part of a multicomponent community-based intervention. (Spence, 2001)

4.5 Hypercholesterolemia/High Blood pressure/CVD

WHO identified several combinations of interventions to address the risk factors for CVD:

- individual-based treatment and education for systolic blood pressure and cholesterol;
- population-wide combination of interventions to reduce hypertension and cholesterol (e.g. mass media for cholesterol and legislation for salt reduction);
- absolute risk approach (where each individual is evaluated for his/her risk of a cardiovascular event over the next ten years, based on age, sex, body mass index, serum total cholesterol, systolic blood pressure and smoking status). People above a defined threshold level are placed on a treatment regimen including lovastatin, ASA, thiazides and atenolol and are required to make regular visits to a health care provider for evaluation and health education;
- combined population interventions and the absolute risk approach.

The WHO expert panel on CVD made the following conclusions regarding the effectiveness of the above interventions:

"The absolute risk approach for a threshold of 35% is very cost-effective in all subregions and is always more cost-effective than the alternative of treatment based on observed levels of blood pressure and cholesterol alone. As the threshold is lowered, the health benefits increase but so do the costs -- in fact, it gets more and more expensive to obtain each additional unit of health benefit. The exact point at which policy-makers might choose to set the threshold will vary by setting and will take into account many factors in addition to cost-effectiveness, but it is always cost-effective (though not always very cost-effective) to reduce the threshold to 25%. In most subregions, moving to a 5% threshold would be cost-effective even taking into account the increase in side-effects. Overall, the potential to reduce the risk of cardiovascular events through this intervention is very impressive. Population-level effects exceeding a 50% reduction in events are possible.

"The assumptions for the impact of the population interventions evaluated here are conservative and do not take into account long-term impacts such as permanent changes in dietary patterns. Combining population-based cholesterol reduction strategies with interventions to reduce salt intake at the population level is always very cost-effective. In addition, a strategy based on the combination of population-wide and individual-based interventions is also cost-effective in all settings. The most attractive strategy among all

those evaluated appears to be the combination of salt reduction at a population level through legislation or voluntary agreements with health education through the mass media focusing on blood pressure, cholesterol and body mass, plus the implementation of an absolute risk approach to managing cardiovascular disease risks.

"Where resources are very scarce, prime attention would be focused on prevention and promotion, combined with the less intense individual treatment options, for example, treating people whose overall risk of a cardiovascular event over 10 years exceeds 35%. Additional resources would allow consideration of whether the threshold for treatment should be lowered."
(from Ch. 5 Choosing Interventions to Reduce Specific Risks, WHO, 2002,)

It should be noted, however, that a prevention regime based on widespread screening and the use of statins may not be as cost-effective as one based on diet, especially in countries with limited resources (see section 4.6 Food/Nutrition, and section 4.8 Adherence).

4.6 Food/Nutrition

Prevention strategies based on diet have been shown to be highly cost-effective, as well as effective for addressing several chronic conditions.

A British overview of published studies of cost-effectiveness in the primary and secondary prevention of cardiovascular disease found:
"[H]ealth promotion strategies which promote healthy eating are likely to be more cost-effective than strategies involving modern cholesterol-lowering drugs, screening and advice in primary care, and are comparable to or less expensive per year of life saved than anti-smoking strategies (Brunner, Cohen and Toon, 2001)... EU (European Union) wide food based dietary guidelines are potentially the basis of large health gains in Europe, and cost-effectiveness studies tend to support their adoption."
(p. 39, Colman, 2002)

"One U.S. estimate indicates that population-based interventions to encourage reduction of saturated fat intake alone may prevent tens of thousands of cases of coronary heart disease, and save between $6 billion and $18.6 billion in health care costs and lost earnings over 10 years. "
(p.39, Colman, 2002)

Other studies have substantiated these claims for the cost-effectiveness of dietary interventions when compared with medical interventions:

"A study of Seventh Day Adventist church members in California found they had a death rate from digestive tract cancer of 65% of the rate for the rest of the state. The study attributed the results to the dietary restrictions of church members, many of whom follow vegetarian diets, and who are bound by their scriptures to eat "the most healthful diet possible and abstain from the unclean foods" as well as alcohol and tobacco. The study estimated that if this 65% death rate were possible nation-wide, the U.S. would save $863.7 million a year in direct costs and $771.1 million more in indirect costs…

"One literature review concluded that nutrition intervention is a very worthwhile investment in preventing and treating coronary heart disease. Responding to that reality, managed care health plans in the U.S. have increasingly endorsed nutritional screening interventions, with one representative noting that "nutritional care is as good as immunization for babies."
(p. 43, Colman, 2002)

Two areas where nutrition/food programs can have the greatest impact are in schools and workplaces. There is good evidence of cost-effectiveness in both of these settings:

"Worksite interventions can improve health and save money. One U.S. study found that employees participating in a low fat / high activity program cut individual health care claims by more than one-half in three years, from an average of $2,333 in 1988 to $1,085 in 1990. If all high-risk individuals in an 8,000-employee firm made such changes, it was estimated the firm could save $40.4 million over three years".
(p. 41, Colman, 2002)

Mass media advertising and consumer education campaigns (through health facilities, food retailers and food service providers) have been shown to be cost-effective in Australia:

"while there is considerable uncertainty about the impact of a national campaign, it could avert between 6 and 230 deaths and save between 90 and 3700 DALYs. Campaign costs were estimated to be from just under US$ 1 million to US$ 1.8 million. The cost-effectiveness ratio for such a campaign lies between US$ 280 and US$ 9000 per DALY. If cost offsets (health service costs averted for prevented disease) are included -- estimated at US$ 8.2 million -- the intervention is "dominant", that is, health benefits are obtained at a net cost saving." (WHO, 2002)
(from Ch. 5.7 Combining Risk Reduction Strategies, WHO, 2002)

We were unable to find studies to document the cost-effectiveness of various strategies to increase food security; these might be found in the agricultural and development literature, which was not searched for this review.

4.7 Poverty/Income Inequities

As stated in section 2 of this paper, poverty and income inequities have been strongly linked to several NCDs, and appear to play a much more significant role than so-called "lifestyle" factors in their association with diseases such as CVD and diabetes. This relationship has significant implications for the choice of interventions to prevent these conditions.

"(C)onventional behavioural interventions aimed at healthier lifestyles have proved remarkably ineffective in alleviating the deeper influences of poverty and social disadvantage. Even more broadly, analysts have noted that "health promotion strategies focused purely at individual health behaviours are yielding limited success."
(p. 61, Colman, 2002)

Unfortunately, there has been comparatively little research on the cost-effectiveness of interventions directed towards addressing poverty and health inequities. What can be concluded, however, is that interventions which are not directed towards addressing issues which are a priority for the target population will be unlikely to succeed. In LAC, where a large proportion of the population experiences severe or moderate poverty, and where support from the state is very limited (and family support is deteriorating), this becomes a very important consideration. Interventions that do not attract a level of participation that can be sustained over a sufficient period of time (usually several years) will not result in the necessary "dose" required to be effective.

One Canadian example illustrates this point particularly well:
"Evidence indicates that those who are marginalized do not attend smoking cessation and nutrition classes, do aerobics, join gymnasiums, or shop for healthy foods. A comprehensive $1.5 million 5-year cardiovascular disease prevention and lifestyle intervention program in St. Henri, a Montreal neighbourhood where 45% of families live below the poverty line, attracted only 2% participation. The only significant result, compared to a control group, was that more people had their blood cholesterol levels measured. The researchers concluded:
"…unless or until basic living needs are ensured, persons living in low-income circumstances will be unlikely or unable to view CVD [cardio-vascular disease] prevention as a priority."

"Because lifestyle interventions have been most successful in changing the behaviour of those with higher levels of education and income, and least effective for disadvantaged populations who have fewer options and less control over their lives, they have had the unintended effect of deepening health inequalities between socioeconomic levels. More effective interventions to alleviate the negative impacts of poverty on health range from social programs directed towards low-income individuals to wider-ranging social reforms."
(p. 61, Colman, 2002)

Given the interest of the World Bank in working with poor populations, and considering the experiences described above, it can be concluded that successful interventions are likely to be those which will have some kind of noticeable, short-term impact on the quality of life of the people in the communities. (e.g. introduction of new stoves, improvement in food supply); these have the greatest chance to generate the kind of enthusiasm, support and sustainability required to make an impact on NCDs.

5.0 Information and Evidence Gaps

5.1 Lack of published research on NCD prevention in LAC

The process of conducting this review has made it abundantly clear that there has been very little published research on the prevention of NCD in LAC. An extensive state of the art review on Health Promotion in LAC (Centro para el Desarrollo y Evaluación de Politicas y Tecnologia en Salúd Pública, 2003) identified a total of 81 studies. Of these, only one was relevant to NCD promotion (an ethnographic study of body type preference in Barbados to contribute to a strategy for the control of obesity).

Searches through other databases (e.g. Cochrane Collaboration, NHS EED) as well as the WHO, PAHO and other sites resulted in a similar lack of published material. Exchanges by e-mail with personal contacts (Latin American health researchers) were similarly unable to identify additional published material. We speculate there may be three reasons for this:

a) in most LAC countries the resurgence of communicable diseases and the deterioration of the public health/primary health care infrastructure due to the economic crisis of the 1990s has focused the attention of researchers and governments on more pressing issues;
b) studies may have been published in Spanish language journals that are not yet on electronic databases; or
c) whatever research may have been carried out on this topic may be confined to the grey literature that has been inaccessible to this study.

5.2 Lack of research on NCD interventions in a relevant socio-cultural and economic context

The vast majority of research on NCD prevention has been done in a North American/European context. The socio-cultural and economic reality in LAC is vastly different (and there are many differences as well both between and within countries in LAC). LAC has experienced an increase in the macroeconomic indicators for most countries, at the same time as a deterioration in many social indicators. The sicknesses of wealth and poverty co-exist in a way that is unique in the world. In addition, the role of state-funded organizations is different because the state has many fewer resources to provide. Consequently, civil society has also taken on a very different role. All of these factors point to an urgent need for relevant socio-cultural research to be considered as an integral part of any intervention plan.

A unique stream of social research has developed in Latin America in response to these conditions. *Medicina social* takes a critical perspective that distinguishes it from conventional public health research:

- in *medicina social*, the unit of analysis is the population which can be divided into groups according to certain shared characteristics (age, sex, education, income, race, ethnicity), as well as the social institutions that relate to that population; in contrast, in classic epidemiology the characteristics of a group are arithmetic summations of the characteristics of individuals;

- *medicina social* is based on an analysis of the shared economic, social and political characteristics of a group, in a historical context, and how these relate to the issue being studied;

- research in *medicina social* is based on the concept of praxis (the relationship between thought and action), and so is conducted in partnership with the groups most affected by the issues (unions, women's groups, indigenous coalitions and community organizations); in contrast, most public health research is concerned with good experimental design;

- *medicina social* conceptualizes health-sickness as a dialectic process that should be studied over an extended time, rather than dichotomous categories;

- *medicina social* has resisted the monocausal model of sickness in favour of a model that integrates social conditions as determinants of the development of sickness.

(Iriart et al, 2002)

A resource centre has been established at the University of New Mexico with the objective of making *medicina social* research more widely available throughout the Americas. Abstracts are posted to the website in English, Spanish and Portuguese. (http://hsc.unm.edu/lasm)

A search of this database identified a single article with a focus on NCD. The article explores diabetes mellitus from the point of view of those who are living with the disease (in this case, primarily Catholic women from rural areas living under impoverished conditions in Mexico City), and places this experience

within the larger socio-economic context. In this study the women experience diabetes mellitus as one of a series of problems and difficulties in their daily lives. When symptoms first appear their lack of knowledge about the disease creates difficulty in coping with it. Later, the women become "experts" in choosing the remedies they consider most effective. *The majority do not follow medical indications.* Religion plays an important role in their search for support. As patients acquire information and experience, they choose the treatments that will yield the best results in reducing or eliminating discomfort. The availability of economic resources likewise plays an important role in the selection and completion of treatment, as does the patient's gender.
(Mercado Martinez, 1996)

The example of the study mentioned above illustrate the critical importance of research using the approaches of *medicina social* and other forms of social research to understand how people in LAC experience NCDs and the development of interventions which will be consistent with their socio-cultural and economic realities.

5.3 Lack of research on cost-effectiveness

The field of economic evaluation of health promotion is still evolving. There are many challenges that relate specifically to the investigation of the prevention of NCDs:

- the causal mechanisms for many NCDs are still not completely understood. It appears that the contribution of lifestyle factors has been over-estimated, and that of socio-economic factors vastly underestimated. There is a consequent gap in research, particularly as it relates to interventions that address socio-economic factors;
- interventions to prevent NCD are long-term propositions, which must be sustained over years to achieve the desired effect. Similarly, the full benefits of such interventions are realized over a period of many years, and are thus difficult to calculate;
- most published studies on cost-effectiveness have been based on experimental designs which are difficult to generalize to "real life" communities;

There is a great need to improve both the quantity and the quality of cost-effectiveness research to make it more useful as a tool for public policy development and the planning of community interventions.

6.0 Conclusions

6.1 Characteristics of successful interventions

Nissinen, Berrios and Puska (2001) recommended the following as essential elements for a successful community intervention program to address NCD:

"First … include a good understanding of the community (''community diagnosis''), close collaboration with various community organizations, and full participation of the people themselves.

"Second, community-based intervention programmes should combine well-planned media and communication messages with a broad range of community activities, involving such elements as the primary health care services, voluntary organizations, the food industry and supermarkets, work sites, schools and the local media.

"Third, to obtain a reasonable outcome an effective ''dose'' of intervention is needed. Cost-effective intervention modalities should be developed. This is especially important in the developing countries.

"Fourth, the strength of a community intervention programme is derived from its emphasis on changing the social and physical environments in the community through adoption of lifestyles that are healthy or are more conducive to health. Supportive policy decisions are of great importance for achieving this.

"Fifth, an essential component of all community programmes, and especially of national demonstration projects, is a good and reliable monitoring and evaluation system, both for continuous monitoring of the change process and for more comprehensive summary evaluations.

"Sixth, major community intervention programmes will not only benefit the target community, but, as a demonstration programme, can also have a broad impact at the national level. To help achieve this, the results of the experience and evaluation should be disseminated widely, and the project should work in close contact with the national authorities.

"Finally, considering the global health burden of noncommunicable diseases and the impact of globalization on contemporary lifestyles and health, the need for international collaboration is great. Practical networks sharing common guidelines, but adapted to

local cultures in a flexible way, have proved to be very useful. WHO's leadership in these networks has been very valuable."
(p.969, Nissinen A, Berrios X and Puska P, 2001)

We would add to the above that, based on the evidence presented earlier in this report, a further "strength" is the ability of an intervention to address or mitigate the effects of poverty and income inequalities.

6.2 Recommended interventions

The focus of this review has been to identify effective and cost-effective interventions for the prevention of NCD which are the most applicable to LAC. In attempting to draw conclusions from this research it is necessary to consider what data exists on effectiveness and cost-effectiveness, but also the ability to relate these interventions to the LAC context. Given the lack of data from LAC settings we conclude the following:

a) Effective interventions:

- There are non-communicable disease prevention interventions that are effective and cost-effective, particularly in the areas of smoking, environmental tobacco smoke, indoor air quality, physical activity, and food and nutrition. The NCDs affected by interventions in these areas are cardiovascular and cerebrovascular disease, diabetes and obesity.

- To be effective, any disease prevention intervention on any topic should include a combination of community-wide strategies that include education, mass media and skill-building components, plus social and environmental supports.

b) Cost-effective interventions:

- Cost-effectiveness studies emphasized the importance of interventions in the socio-environmental conditions in which we live rather than individual, lifestyle-oriented strategies. For example, taxation was most cost-effective for reducing smoking, increased access to stoves was cost-effective to improve indoor air quality, and improvement in basic living needs was required for low income populations to improve their heart health.

c) Addressing low socio-economic status:

- Lifestyle-oriented interventions by themselves (e.g. smoking cessation programs, fitness campaigns) have been shown to be more attractive to people in higher income levels and less successful for those living in poverty.

- There is strong evidence that low socio-economic status is associated with increased incidence of NCD such as CVD and diabetes. This would argue that interventions aimed at improving socio-economic status, or which mitigate the effects of low socio-economic status (e.g. income supports and free public education) should reduce the burden of NCDs. However, little research has been done to date to support this conclusion.

- Interventions which are likely to result in a noticeable, short-term improvement on the quality of life of people living in poverty (e.g. introduction of new cookstoves and interventions to increase quality and production of food) will likely have a greater chance of being accepted and sustained by this population than interventions promising a longer-term result. Once again, little research has been done to support this conclusion.

d) Focus on key settings:

There are several settings where it makes sense to focus intervention efforts because they have the potential of allowing a high number of people to be reached, and because they provide the potential for combining complementary interventions:

- *Schools* offer the potential to reach millions of children directly (and millions more indirectly through their families) at a critical time in their lives. Much of the literature has documented the effectiveness of delivering a variety of interventions (particularly those addressing nutrition, physical activity, and smoking) in a school setting;

- *Workplaces* also offer the potential of reaching a "captive audience", and may be a particularly good way to reach men, who are often more resistant to health promotion initiatives. Once again, nutrition, physical activity and smoking initiatives are all compatible with workplaces. In addition, the wealth of literature documenting the cost-effectiveness of

workplace health promotion interventions for the employer as well as the employee should be a powerful incentive;

- *Municipal governments* are in a position to have a high degree of impact on their residents because of their responsibility for areas such as: urban planning (e.g. creation of parks, recreation area, bike paths), transportation, housing, health (e.g. regulating smoking in workplaces and public places). Although the Healthy Cities movement is widespread in LAC, it is not known whether any of the cities has focused on the prevention of NCD; this network has the potential to be a focus for action. Anecdotally, we know that the Mayor of Bogota has instituted programs such as "car-free Sundays" in the centre of the city to promote physical fitness and decrease pollution. This program has apparently been very popular with Bogotanos.

6.3 Further research

The section of this report on Information and Evidence Gaps highlighted a number of important areas:

a) Socio-cultural research:

There is a critical need for research to gain a better understanding of the socio-cultural dimensions of how people in LAC view and experience NCDs, and how this will influence strategies to prevent and manage these diseases. The diabetes study mentioned in section 5 is an excellent example of how important this information can be. *Medicina social* offers one approach that seems to be well-suited to investigating these questions. It would be useful to develop partnerships with NGOs that have the experience and expertise to carry out such investigations (e.g. Centro de Estudios y Asesoramiento en Salud in Ecuador; Grupo de Investigación y Capacitación en Medicina Social in Chile; Centro de Estudios Sanitarios y Sociales in Argentina, among others);

b) Linking fundamental research to applied practice:

There is also a need for much more support for the link between fundamental research and applied practice in a community setting. Nutbeam describes a four stage model for this process:

"Stage 1 is Problem Definition and Prioritization, and includes epidemiological and demographic research to investigate the causal health problems, the scope of needed interventions and the priority populations.

"Stage 2 is Solution Generating, and it includes research that assesses the scope for change in behavioural and environmental determinants; identifies priority populations and potential intervention settings; and completes a systematic review of research to determine effective interventions.

"Stage 3 is Solution Testing, and it includes research of interventions in "ideal" conditions and demonstration evaluations of interventions under "normal" conditions, to better ascertain conditions for success.

"Stage 4 is Solution Maintenance, and it is focused on studying how programs can be widely implemented or deployed on a large scale. The research includes monitoring and resource management and ways to disseminate or diffuse programs."
(as quoted in p. 31 Harvey et al, 2002)

The vast majority of research in this area has been concentrated on Stages 1 and 2; Stage 3 evaluative research tends to be concentrated on studies with maximum internal validity (making it of least use to practitioners); Stage 4 research is of the greatest use to practitioners, program managers and policy makers as it makes the direct link to real questions about what can be done in communities, and at what cost. Unfortunately, the amount of Stage 4 research in this field is very small.

c) Cost-effectiveness research:

Because there are so few Latin American cost-effectiveness studies, work needs to be done to fill the gap, especially to write about experiences in health promotion and primary prevention. In a preliminary review of literature on cost-effectiveness of health promotion programs, (de Salazar and Jackson, 2003) projects were compared on the basis of their effectiveness but the cost-effectiveness components were very poorly done. This is a specialized area which requires economic guidance and expertise. The following steps are required in order to conduct economic evaluations:

a) Identify outcome objectives of the project
b) Identify the point of view to be considered (e.g. population perspective or community perspective)

c) Identify options for comparison (e.g. another set of strategies with the same objectives, doing nothing, same project with different population)
d) Collect information on costs of the project
e) Evaluate effectiveness of project in reaching outcomes
f) Choose type of analysis and calculate direct & indirect costs, benefits, intangibles, discounting, opportunity costs, sensitivity analysis etc.
g) Write this up and publish it.

6.4 Recommendations

It is recommended that countries in Latin America and the Caribbean:

1. Focus on interventions designed to prevent non-communicable diseases in whole communities or populations that have been shown to be effective or cost-effective.
2. Use a combination of strategies such as education, mass media and skill-building, plus social and environmental supports to prevent non-communicable diseases.
3. Focus on policies and access to improved products or conditions as key strategies to prevent disease.
4. Be aware of the difficulties that people living in poverty will face in changing behaviours and develop and evaluate new interventions that go beyond lifestyle-oriented strategies.
5. Evaluate and conduct more intervention and socio-cultural research specific to Latin American countries in health promotion and disease prevention.
6. Evaluate and conduct more research on primary prevention interventions in low income populations in Latin American settings.

It is recommended that the World Bank:

1. Encourage its projects in Latin America to identify outcome objectives and evaluation plans and to collect costs of implementation. Each project could also think broadly and identify the direct and indirect benefits and costs.

2. Work with a health economist to conduct economic evaluations of its projects.

3. Support researchers to write up the effectiveness evaluations and cost-effectiveness evaluations for its projects and publish them in order to contribute to the literature.

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Appendix I Analysis of costs and effects of selected interventions

(from WHO, 2002)

Figure 5.3 Cost and effects of selected interventions in subregion AMR-B

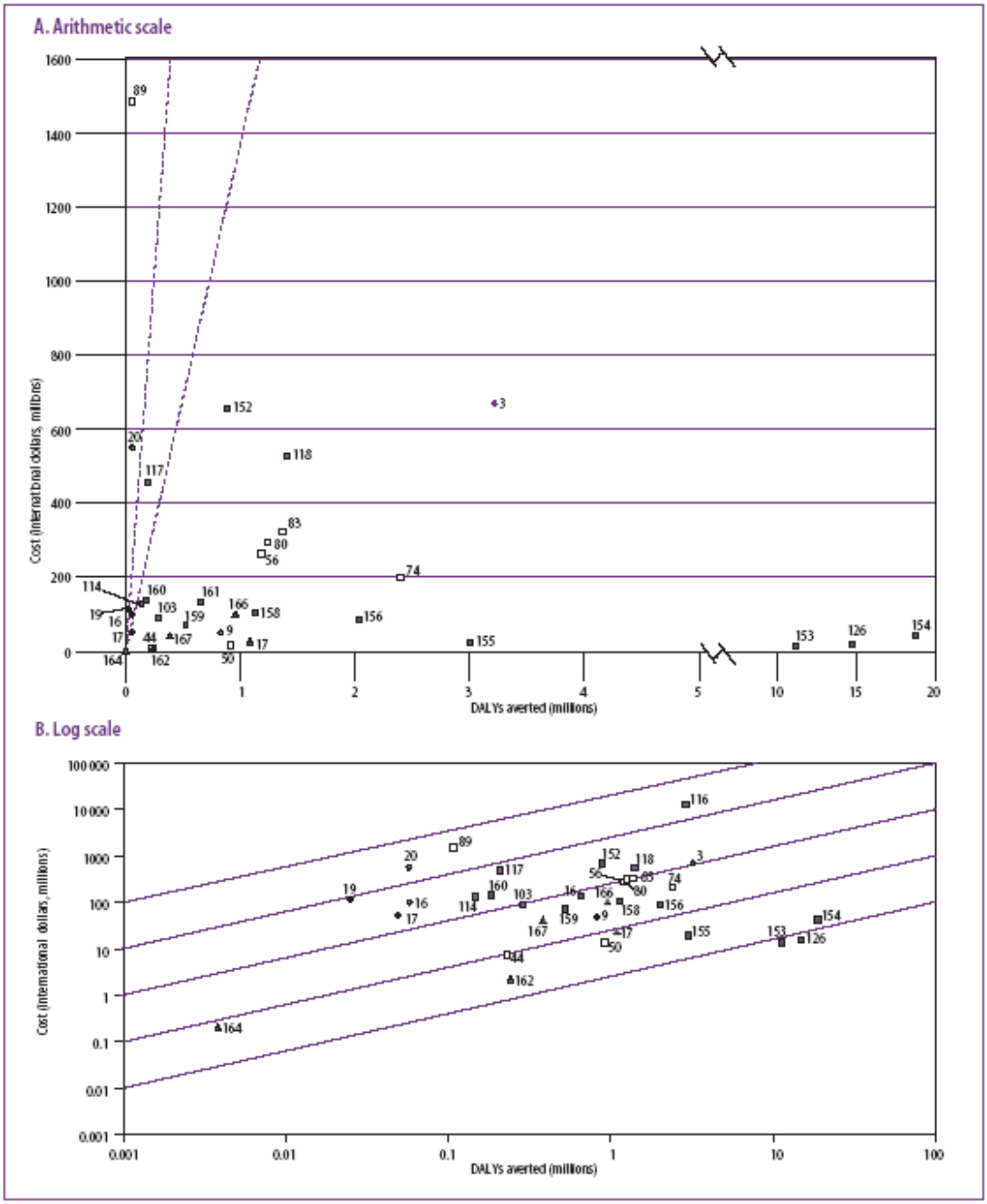
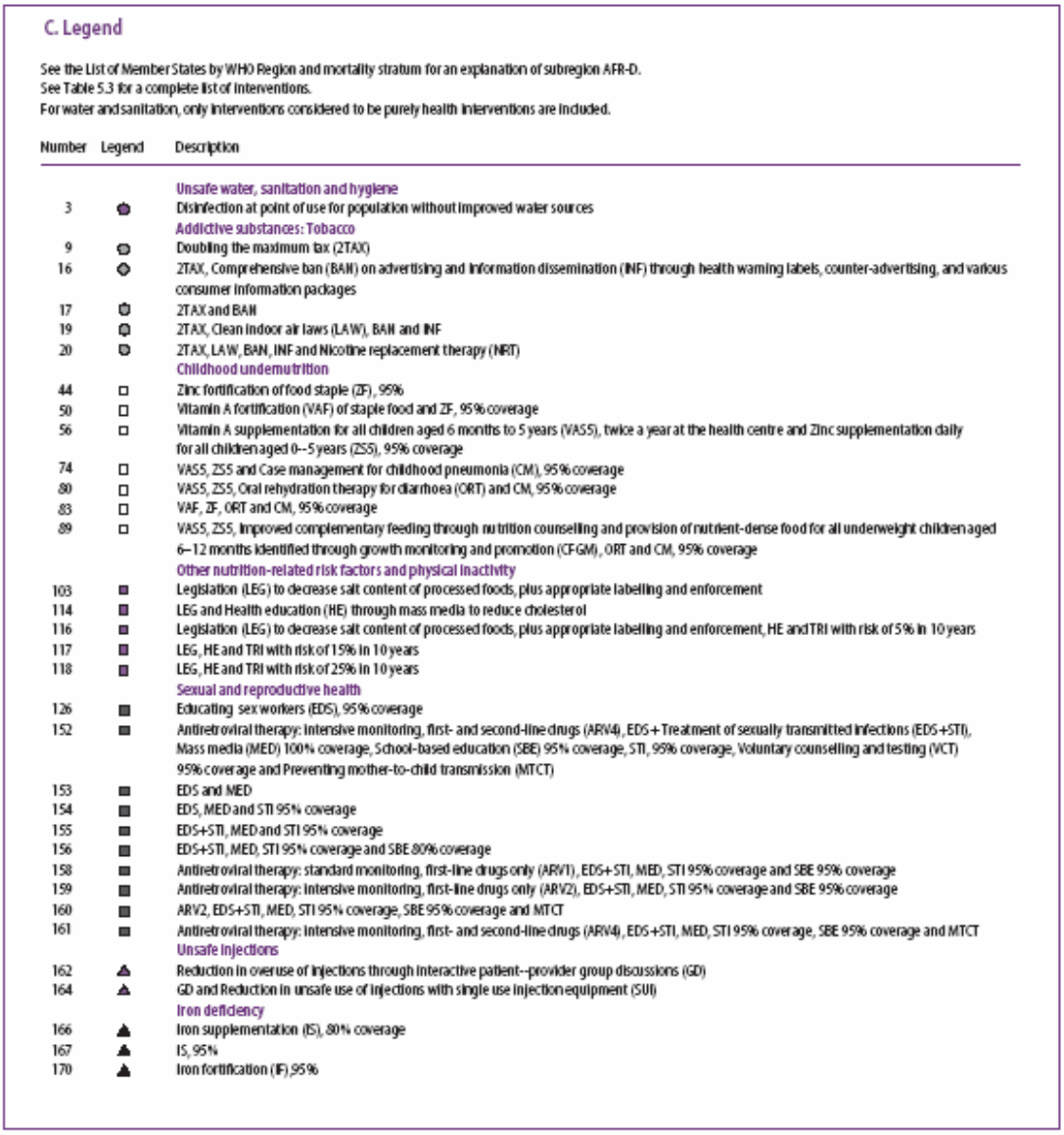


Figure 5.3 Cost and effects of selected interventions in subregion AMR-B



C. Legend

See the List of Member States by WHO Region and mortality stratum for an explanation of subregion AFR-D.
See Table 5.3 for a complete list of interventions.
For water and sanitation, only interventions considered to be purely health interventions are included.

Number	Legend	Description
		Unsafe water, sanitation and hygiene
3		Disinfection at point of use for population without improved water sources
		Addictive substances: Tobacco
9		Doubling the maximum tax (2TAX)
16		2TAX, Comprehensive ban (BAN) on advertising and information dissemination (INF) through health warning labels, counter-advertising, and various consumer information packages
17		2TAX and BAN
19		2TAX, Clean indoor air laws (LAW), BAN and INF
20		2TAX, LAW, BAN, INF and Nicotine replacement therapy (NRT)
		Childhood undernutrition
44		Zinc fortification of food staple (ZF), 95%
50		Vitamin A fortification (VAF) of staple food and ZF, 95% coverage
56		Vitamin A supplementation for all children aged 6 months to 5 years (VAS5), twice a year at the health centre and Zinc supplementation daily for all children aged 0--5 years (ZS5), 95% coverage
74		VAS5, ZS5 and Case management for childhood pneumonia (CM), 95% coverage
80		VAS5, ZS5, Oral rehydration therapy for diarrhoea (ORT) and CM, 95% coverage
83		VAF, ZF, ORT and CM, 95% coverage
89		VAS5, ZS5, Improved complementary feeding through nutrition counselling and provision of nutrient-dense food for all underweight children aged 6–12 months identified through growth monitoring and promotion (CF-GM), ORT and CM, 95% coverage
		Other nutrition-related risk factors and physical inactivity
103		Legislation (LEG) to decrease salt content of processed foods, plus appropriate labelling and enforcement
114		LEG and Health education (HE) through mass media to reduce cholesterol
116		Legislation (LEG) to decrease salt content of processed foods, plus appropriate labelling and enforcement, HE and TRI with risk of 5% in 10 years
117		LEG, HE and TRI with risk of 15% in 10 years
118		LEG, HE and TRI with risk of 25% in 10 years
		Sexual and reproductive health
126		Educating sex workers (EDS), 95% coverage
152		Antiretroviral therapy: Intensive monitoring, first- and second-line drugs (ARV4), EDS+Treatment of sexually transmitted infections (EDS+STI), Mass media (MED) 100% coverage, School-based education (SBE) 95% coverage, STI, 95% coverage, Voluntary counselling and testing (VCT) 95% coverage and Preventing mother-to-child transmission (MTCT)
153		EDS and MED
154		EDS, MED and STI 95% coverage
155		EDS+STI, MED and STI 95% coverage
156		EDS+STI, MED, STI 95% coverage and SBE 80% coverage
158		Antiretroviral therapy: standard monitoring, first-line drugs only (ARV1), EDS+STI, MED, STI 95% coverage and SBE 95% coverage
159		Antiretroviral therapy: Intensive monitoring, first-line drugs only (ARV2), EDS+STI, MED, STI 95% coverage and SBE 95% coverage
160		ARV2, EDS+STI, MED, STI 95% coverage, SBE 95% coverage and MTCT
161		Antiretroviral therapy: Intensive monitoring, first- and second-line drugs (ARV4), EDS+STI, MED, STI 95% coverage, SBE 95% coverage and MTCT
		Unsafe injections
162		Reduction in overuse of injections through interactive patient--provider group discussions (GD)
164		GD and Reduction in unsafe use of injections with single use injection equipment (SUI)
		Iron deficiency
166		Iron supplementation (IS), 80% coverage
167		IS, 95%
170		Iron fortification (IF), 95%

Region of the Americas

Antigua and Barbuda – AMR-B
Argentina – AMR-B
Bahamas – AMR-B
Barbados – AMR-B
Belize – AMR-B
Bolivia – AMR-D
Brazil – AMR-B
Canada – AMR-A
Chile – AMR-B
Colombia – AMR-B
Costa Rica – AMR-B
Cuba – AMR-A
Dominica – AMR-B
Dominican Republic – AMR-B
Ecuador – AMR-D
El Salvador – AMR-B
Grenada – AMR-B
Guatemala – AMR-D
Guyana – AMR-B
Haiti – AMR-D
Honduras – AMR-B
Jamaica – AMR-B
Mexico – AMR-B
Nicaragua – AMR-D
Panama – AMR-B
Paraguay – AMR-B
Peru – AMR-D
Saint Kitts and Nevis – AMR-B
Saint Lucia – AMR-B
Saint Vincent and the Grenadines – AMR-B
Suriname – AMR-B
Trinidad and Tobago – AMR-B
United States of America – AMR-A
Uruguay – AMR-B
Venezuela, Bolivarian Republic of – AMR-B

Mortality strata
A. Very low child, very low adult
B. Low child, low adult
C. Low child, high adult
D. High child, high adult
E. High child, very high adult

Appendix II: Summary Tables

The following tables – *Effective Interventions for Primary Prevention of NCD*, and, *Cost-Effective Interventions for Primary Prevention of NCD* – summarize the information reported in this review. In the first table, the most effective interventions relating to each risk factor or disease are reported, with the accompanying references. In the second, the most cost-effective interventions relating to each risk factor or disease are reported, together with some cost-effectiveness information and references.

Note: These cost-effectiveness data are still very incomplete, and **the cost-effectiveness ratios presented here should not be used for comparative purposes.** There are two reasons for this: 1) There is a lack of good research to determine the cost effectiveness of health promotion interventions, particularly on NCDs using a population approach; 2) In order to make a valid comparison all of the premises of the studies must be considered (e.g. perspective of the study, factors considered in determining costs and benefits, discounting). The purpose in presenting the information here is merely to identify what are currently considered to be the most cost-effective interventions for primary prevention of NCD.

Effective Interventions for Primary Prevention of NCD

Risk Factor/Disease	Effective interventions	Comment/References
Smoking	The most effective interventions have been shown to be comprehensive tobacco control programs that focus on the population as a whole. Comprehensive programs include elements such as: taxation, legislation (e.g. to control smoking in workplaces and public places), enforcement (e.g. of limiting sales to minors), mass media, community-based prevention, school health and youth programs	Strong evidence of population-based approaches . (Ontario Ministry of Health, 1999, citing the following studies: Massachusetts Dept. of Public Health, 1998; Pierce et al, 1998; Pizacani et al, 1999)
Environmental Tobacco	Restricting smoking in public places	Most research has been related to the question of the

Smoke	Restricting smoking in workplaces Public education about smoking in the home and risks for children and fetal development	impact of restricting smoking on workplaces and the hospitality industry. There is strong evidence that strategies mentioned can be effective in addressing ETS. (Ontario Tobacco Research Unit, 2001, citing: The United Kingdom Special Committee on Tobacco and Health (1998), National Cancer Institute (1999), the WHO International Consultation on Environmental Tobacco Smoke (ETS) and Child Health (1999), and the Expert Panel to Advise the Minister of Health of Ontario (1999))
Indoor Air Quality	Aside from limiting smoking, the most effective strategies are: - increasing access to improved cooking stoves where fuel is cheap; - increasing access to cleaner fuel where wood is expensive; modifying the home environment to improve ventilation; and - education programs to improve the understanding of the link between pollution and ill health.	Most research has related to the development and introduction of improved cooking stoves. Effectiveness of this strategy has been well-documented. (Heltberg, 2002; OECD, 2003)
Obesity	See Physical Activity and Food/Nutrition	
Physical activity	The most effective interventions are directed at multiple levels on the downstream-upstream continuum, and consider factors such as individual dispositions, culture, family support, school programs, community programs, neighbourhood facilities and physical environment. Particular strategies that have been shown to be effective include: - community-wide campaigns; - “point of decision” prompts to encourage stair use;	Strong evidence of efficacy; more limited evidence of effectiveness in community settings. (Spence, 2001, citing: review by CDC, 2001)

	- mass media campaigns; - school-based physical health education; - non-family social support; - individually-adapted health behaviour change (as part of a comprehensive program); - creation of and/or enhanced access to places for physical activity combined with informational outreach activities	
Cardiovascular disease (includes risk factors such as hypercholesterolemia, high blood pressure, smoking, sedentary lifestyle)	Effective community—wide programs used a combination of three primary categories of interventions: - mass media; - education/skill-building for health behaviour modification in multiple settings; - environmental support through policy development and site-based program development The successful community-based programs incorporated extensive community involvement (through trained lay volunteers and partnerships with community organizations such as schools, workplaces and religious organizations). Strong association has been established between incidence of cardiovascular disease and low socio-economic status.	Strong evidence based on community-wide trials in Stanford (3 and 5 City Projects), North Karelia, Minnesota Heart Health Program, Pawtucket Heart Health Program. (Harvey et al, 2002, citing: Farquhar, 1978; Puska et al, 1995; Farquhar, 1990; Luepker et al, 1994 ; Carleton et al, 1995) (Harvey et al, 2002, citing Puska, 1986) See Poverty section
Diabetes (risk factors diet and physical activity)	Combinations of dietary treatment and/or an increase in physical activity. Strong association has been established between incidence of diabetes mellitus and low socio-economic status.	Strong evidence. (Harvey et al, 2002, citing: Tuomilehto et al, 2001; Eriksson and Lindgarde, 1991; Pan et al, 1997) See poverty section.
Food/Nutrition	Effective strategies to address issue of food insecurity include:	Most of this literature is agricultural and was not reviewed extensively for this report. The high degree

	- support for family and community gardens - increasing access to food (through increasing access to employment and credit) - increasing nutritional content of food - increasing nutritional quality of the diet - increasing consumption of an adequate diet (e.g. programs to promote nutritious eating habits within an appropriate cultural context)	of appropriateness of these strategies for developing countries strongly suggests they merit further investigation. (recommendations from FAO, 2001b)
Poverty/Income inequalities	Association between low socio-economic status and cardiovascular disease and diabetes mellitus is stronger than for most lifestyle factors. The strongest association is seen in areas where the highest income inequality exists. Research is now concluding that income inequality is but one of a combination of social and environmental factors that impacts health status. Changing rates of coronary heart disease in different populations did not appear to relate well to the change in the standard risk factors, considered one by one, or in a risk factor score. Efforts to reduce CVD mortality through lifestyle change and cholesterol reduction have had limited efficacy. Interventions that only target risk factors without recognizing issues associated with SES status of the community have been shown to be unsuccessful. Effective interventions proposed include:	Strong evidence. (Rafael and Farrell, 2002; Brunner and Marmot, 1999, cited in Rafael et al, 2003) Research evolving. (Judge and Patterson, 2001) Conclusions from the WHO MONICA study (WHO, 1998) (Raphael, 2002, citing O'Loughlin et al, 1999; Fitzpatrick, 2001) Good examples in the literature. (O'Loughlin et al, 1999) Lack of good research on the impact of policies in

	- reducing the incidence of poverty and low income - reducing incidence of social exclusion - restoring traditional supports (from family, community and government)	these areas. (Oliver and Exworth, 2003)
Adherence	Effectiveness of any prevention or treatment intervention will be strongly influenced by adherence. Overall adherence to long-term therapies for chronic diseases is approximately 50% in developed countries, and tends to be much lower for developing countries. Interventions are more effective when they are designed in consideration of the social, cultural and economic realities of the client, the capacity of the health care system to support the intervention, the characteristics of the disease, and when they have the support of family members and community organizations.	Strong evidence. (WHO, 2003b) (WHO, 2003b)

Cost-effective interventions for Primary Prevention of NCD

Risk Factor	Intervention	Cost-effectiveness	Comment/Reference
Smoking	Taxation has been shown to be highly cost-effective in areas where taxes can be collected efficiently and smuggling controlled.	Cost-effectiveness determined to be less than 3times GDP per capita.	Highly cost-effective (WHO, 2002)
	Combination of taxation, comprehensive ban on advertising, information dissemination activities and restricting smoking in public places is cost-effective.	As above.	As above.
	Other cost-effective interventions include: - Nicotine replacement therapy.	Close to 3X GDP per capita.	(WHO, 2002)
	- School-based smoking prevention.	Benefit-cost ratio of 15.4	(Health Canada: http://www.hc-sc.gc.ca/hecs-sesc/tobacco/prof/youth/school_based/abstract.html)
	- Workplace smoking bans.	Savings in absenteeism, productivity and property damage to employers of $2,000 - $5,000/employee/year.	Health Canada: http://www.hc-sc.gc.ca/hecs-sesc/tobacco/facts/workplace/part5_economic.html
ETS	Bans on smoking in workplaces and in the service industry have been show to be cost-effective.	Impact of proposed U.S. Smoke-Free Environment Act (1994) estimated net benefits of $39-72	Strong evidence. (Health Canada, citing US Environmental Protection Agency: http://www.hc-sc.gc.ca/hecs-

		billion (including reduced absenteeism, increased productivity, but not including enhanced quality of life)	sesc/tobacco/facts/workplace/part5_economic.html)
Indoor air quality	Increased access to improved cooking stoves that reduce particulate emissions.	Cost-benefit of $25-100 USD / stove / year (including economic value of saving on fuel and health improvements)	(OECD, 2003). The high degree of appropriateness of this intervention for LAC merits further investigation. More evidence might be available through the development and appropriate technology literature, which was not consulted for this review.
Physical activity	Worksite fitness programs effective in increasing productivity , decreasing absenteeism and turnover, decreasing medical costs and occupational injuries and decreasing premature deaths. They are cost-effective. Individually-adapted health behaviour change interventions not cost-effective by themselves because of limited reach.	Estimates of reductions in medical costs for each employee by $100 CAD/year after introduction of workplace fitness programs. Cost-benefit ratios as high as 5:1.	strong evidence. (Spence, 2001) (Spence, 2001)
CVD	Combining population-based cholesterol reduction strategies with interventions to reduce salt intake at the population level. Most effective combination is salt reduction at a population level (through legislation or voluntary agreement) with health education through mass media focusing on	Very cost-effective Very cost-effective	Strong evidence of effectiveness in community settings. (WHO, 2002) (WHO, 2002)

	blood pressure, cholesterol and body mass, plus implementation of an absolute risk approach to managing cardiovascular disease risks. Only a few studies have documented the cost-effectiveness of population-based prevention approaches (see next column)		The lack of cost-effectiveness studies using a community-wide or population based approach is evident. These examples show the variability of the results reported:
		Action Heart initiative (UK) reports reductions in smoking and dietary fat using a population health approach for and estimated cost/year of life gained of £31.	(Baxter et al, 1997)
		Cost/life year gained for the North Karelia Hypertension project was reported to be £6560 (undiscounted), and £585 when productivity and pension take-up was considered.	(Nissinen A et al, 1986)
		A model to study population-wide education approaches to reduce serum cholesterol, based on data from North Karelia and Stanford estimated cost-effectiveness rations of	(Tosteson et al, 1997)

		$18,100/year of life saved (based on a 1% decrease in serum cholesterol and $4.95 program cost/person) to $88,000/year of life saved (based on a $16.55 program cost/person)	
Food/Nutrition	Interventions which promote healthy eating are likely to be more cost-effective than strategies involving modern cholesterol-lowering drugs, screening and advice in primary care,.	Healthy eating interventions are comparable to - or less expensive per year of life saved - than anti-smoking strategies	(Brunner, Cohen and Toon, 2001) Merits further investigation because of the applicability to developing countries.
	Worksite and school-based strategies have been shown to be cost-effective.	Employees participating in a low fat / high activity program cut individual health care claims by more than one-half in three years, from an average of $2,333 in 1988 to $1,085 in 1990.	(Colman, 2002, citing a review of Cost Effectiveness/Value of Nutrition Services, prepared by the Province of British Columbia, 1996)
	Mass-media and consumer education campaigns (through health facilities, food retailers and food service providers)	The cost-effectiveness ratio for such a campaign lies between US$ 280 and US$ 9000 per DALY. If cost offsets (health service costs averted for prevented disease) are included -- estimated at US$ 8.2 million	(WHO, 2002)
	Unable to document cost-		Information might be found in agricultural

	effectiveness of initiatives to increase food security		literature.
Poverty/Income inequalities	"Lifestyle" interventions have been more successful in changing the behaviour of people with higher levels of education and income; they have been less effective and cost-effective with lower SES populations. Until their basic living needs are met, lower income/marginalized populations will be unlikely or unable to view CVD prevention as a priority. Cost-effectiveness of policy interventions to address poverty and income inequalities has not yet been determined.		(Lyons and Langille, 2000; Colman, 2002) (Lyons and Langille, 2000, citing O'Loughlin et al, 1999) Need for more research