REDUCING HEALTH CARE COSTS THROUGH PREVENTION

Working Document

Prepared by
Prevention Institute and The California Endowment
with The Urban Institute

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Prevention Institute is a nonprofit, national center dedicated to improving community health and well-being by building momentum for effective primary prevention. Primary prevention means taking action to build resilience and to prevent problems before they occur. The Institute's work is characterized by a strong commitment to community participation and promotion of equitable health outcomes among all social and economic groups. Since its founding in 1997, the organization has focused on injury and violence prevention, traffic safety, health disparities, nutrition and physical activity, and youth development.

The California Endowment is a private, statewide health foundation established in 1996 with a mission to expand access to affordable, quality health care for underserved individuals and communities, and to promote fundamental improvements in the health status of all Californians. Since its inception, the foundation has awarded more than 9,200 grants totaling approximately $1.7 billion to organizations in California. The Endowment, as well as its Center for Healthy Communities, is headquartered in Los Angeles, CA, with regional offices in Sacramento, San Francisco, Fresno and San Diego. For more information about The California Endowment, please visit www.calendow.org.

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The difficulty of controlling costs and improving outcomes in the US suggest the need for an innovative approach to health reform, one that emphasizes upstream efforts.

HOMER, HIRSCH & MILSTEIN (2007)

The current health care reform debate in California is driven in large part by fundamental concerns about ever-growing, unsustainable costs. Immediate cost-containment efforts are necessary, but they alone will not solve the long-term problem—more lasting changes are needed. Investment in primary prevention has the potential to be part of an enduring solution for improved health and health care.

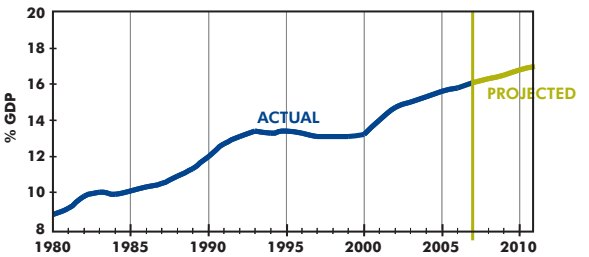
Primary prevention is a systematic process that promotes healthy environments and behaviors *before* the onset of symptoms, thus reducing the likelihood of an illness, condition, or injury occurring. Health and rates of chronic disease are influenced by factors such as toxins in the air, water, and soil; access to healthy foods, parks, and recreational facilities; and the walkability and safety of neighborhoods. Certainly, preventive services, such as screening and disease management, that address populations at-risk and those that already have illness are important and should be part of a high-functioning health system. However, primary prevention—with an emphasis on improving the environments where Californians live, work, play, and go to school—is the prescription for reducing the health care system's burden and thereby reducing the costs associated with paying to treat preventable conditions.

Currently, health care spending is growing at an unsustainable rate (see Figure 1) driven by both rising costs and a growing burden of disease. The costs are bankrupting families and small businesses, putting corporations and industry at a competitive disadvantage, and straining public resources. The long-term solution must involve both cost containment and reduced demand for services.

A vital strategy for creating a sustainable health care system is to improve California's health status through primary prevention. Primary prevention has a track record of improving health and reducing costs and has the potential to save more if applied comprehensively and strategically. A review of the literature shows the following:

FIGURE 1. National health expenditures as a share of Gross Domestic Product (GDP)

Between 2001 and 2011, health spending is projected to grow 2.5% per year faster than GDP, so that by 2011 it will constitute 17% of GDP.



SOURCE: *CMS, Office of the Actuary, National Health Statistics Group.*

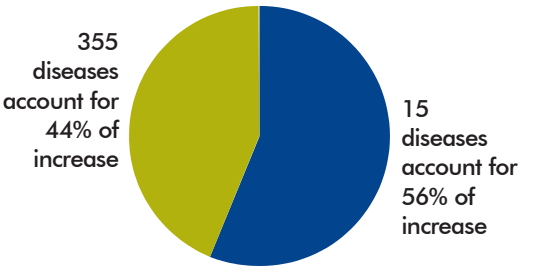
1. A majority of the most costly health conditions are preventable.
2. Health-related resources are not invested in the areas that most influence health.
3. A 5% reduction in preventable illnesses and injuries could lead to substantial savings.
4. Savings have been demonstrated and forecasted for specific prevention initiatives.
5. Prevention has the potential to reduce end-of-life care costs.
6. Savings from prevention accrue beyond the health care sector.
7. Prevention could help improve productivity and competitiveness.
8. New economic models predict potential cost savings from prevention.

Even as California figures out better ways to finance health care and meet the treatment needs of an aging, more diverse population, the State must strive for a leaner, stronger, more efficient system by minimizing the number of people in need of services as well as the reasons a particular individual might need services.

1 A MAJORITY OF THE MOST COSTLY ILLNESSES AND INJURIES ARE PREVENTABLE

Inflation-adjusted national health care expenses rose from roughly $429 billion in 1987 to $628 billion in 2000. Fifteen costly medical conditions, including diabetes, hypertension, trauma, back problems, heart disease, and cerebrovascular disease, accounted for more than half of that overall growth (see Figure 2).[1] These conditions are, at least in part, preventable. Diabetes alone is estimated to cost over $13.5 billion a year in direct medical costs in California.[2]

FIGURE 2. Percentage of health care cost increase attributed to specific diseases, 1987 to 2000



SOURCE: *Thorpe KE, Florence CS, Joski P. Which Medical Conditions Account For The Rise In Health Care Spending? Health Affairs. 2004.*

2 HEALTH-RELATED RESOURCES ARE NOT INVESTED IN THE AREAS THAT MOST INFLUENCE HEALTH

Of the more than $1.7 trillion in health care spent nationally every year, less than 4 cents of every dollar is spent on prevention and public health.[3] Figure 3 shows the discrepancy between the relative influence of the four primary determinants of health and health-care expenditures. It should be noted that behaviors do not occur in a vacuum—they are shaped by environmental factors—so environment likely has even more influence than represented in the graph. Researchers have drawn a similar conclusion looking at the causes of premature death in the US: behavioral factors account for 40%; genetic predispositions, 30%; social circumstances, 15%; shortfalls in medical care, 10%; and toxins and infectious agents, 5%. [4] Medical care has limited determinant power in spite of consuming the vast majority of health spending.

3 A 5% REDUCTION IN PREVENTABLE ILLNESSES AND INJURIES COULD LEAD TO SUBSTANTIAL SAVINGS

The conditions in Table 1 represent only a sampling from the larger landscape of preventable conditions that are costly to California. Potential annual savings for each condition were arrived at by reviewing recent data on incidence rates in California or extrapo-

lating national data to California. The calculated 5% reduction in medical costs is a *conservative* expectation of the impact of a concerted prevention effort. For example, smoking rates have dropped 33% since the passage of Proposition 99,[5] a statewide ballot initiative passed in 1988 which imposed an additional 25 cent tax, used in part to fund community-based tobacco prevention programs, on each carton of cigarettes. The reduction figures were calculated using current disease prevalence. Without prevention, the number of Californians afflicted is predicted to continue increasing, and the costs are predicted to become greater as the population ages and the effects of the conditions become more severe. In addition, chronic diseases such as diabetes and asthma become more expensive over their duration, so recent increases in prevalence portend even greater future costs.

TABLE 1. Potential annual savings from a 5% change in incidence of selected illnesses, injuries, exposures and behaviors

Heart disease	$974,078,000
Tobacco use	$386,650,000
Diabetes (Type II)	$79,102,320
Falls among the elderly	$60,798,775
Breastfeeding	$15,827,863
DUI fatalities and injuries	$93,414,256
Childhood asthma	$12,079,334
Gunshot Wounds	$10,768,131
HIV	$7,056,605
GRAND TOTAL	**$1,639,775,284**

A complete table with sources is available in Appendix C.

4 SAVINGS HAVE BEEN DEMONSTRATED AND FORECASTED FOR SPECIFIC PREVENTION INITIATIVES

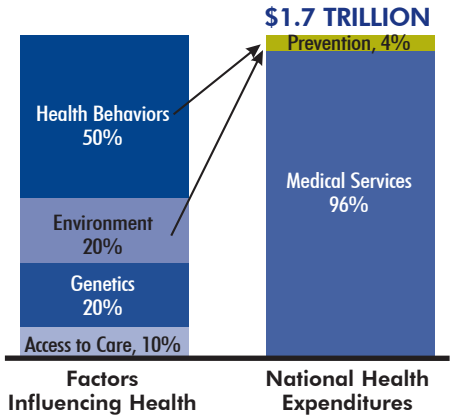
Prevention programs and policies have already demonstrated cost savings to the health care system. For instance:

- Between 1990 and 1998 the California Tobacco Control Program saved more than $3 billion in smoking-caused health care costs.[6]
- In the first 5 years after California passed a motorcycle helmet law, $48 million was saved in reduced direct medical costs,[7] and these savings continue to accumulate.
- Kaiser Permanente concluded that infants who were breastfed for a minimum of six months experienced an average of $1,435 less in health care claims than formula fed infants.[8]

Further, researchers have projected potential savings to the health care system from prevention, such as:

- Hospitals and health care employers in California are expected to save over $100 million per year through reduced testing costs, improved productivity, and reduced medical costs associated with transmitted disease (in particular HIV and hepatitis) after implementing the California Occupational Safety and Health Administration's requirement for safe needle devices.[9]
- A 1% annual decline in adult smoking rates in the US has been estimated to result in over 30,000 fewer heart attacks, over 16,000 fewer strokes, and cumulative health care savings of over $1.5 billion

FIGURE 3. Discrepancy between health determinants and spending



SOURCES: *Lambrew JM. A Wellness Trust to Prioritize Disease Prevention. The Hamilton Project, Brookings Institution. 2007. Discussion paper 2007-04: 1-36. University of California at San Francisco, Institute of the Future, 2000.*

THE GROWING OVERWEIGHT CRISIS: BARIATRIC SURGERY

The US spends $3.5 billion annually on bariatric surgery, an increasingly popular set of procedures to treat overweight people. While potentially important for individuals who are extremely overweight and unresponsive to other interventions, at up to $50,000 per surgery and with a 1-3% mortality rate, it is not a sustainable answer to the growing epidemic of overweight Californians. Rather, the money could be better invested in improving access to nutritious food and promoting physical activity while reserving bariatric surgery as a last resort.[10,11]

over five years, with rapidly growing annual savings in the following years.[12]

- Increasing the percentage of breastfeeding to the surgeon general's recommended level (75% in-hospital and 50% for 6 months) would substantially improve post-natal health and annually save a minimum of $3.2 billion nationally.[13]

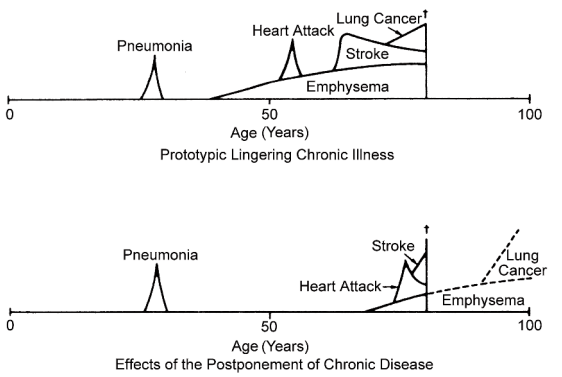
5 PREVENTION HAS THE POTENTIAL TO REDUCE END-OF-LIFE CARE COSTS

End-of-life care expenses are often discussed as a virtual fixed cost, one which can be delayed but not avoided. In fact, prevention can help reduce end-of-life care costs in several ways. First, there is an inherent benefit to delaying the onset of end-of-life medical care and expenses, in terms of increased healthy life spans, reduction in the burden on the health care system in the relative short-term, and a reduction in the average annual expense across the life span. Second, prevention supports compressing morbidity by delaying the onset of chronic illness.[14,15] Figure 4 shows two probable "health lives." The top one represents a typical course for someone with a significant risk factor such as tobacco addiction in which chronic illness begins early and builds along with other conditions for extended end-of-life medical care use. The bottom example reflects the benefits of reducing risk factors: more disease free years, a shortened period of morbidity, and a reduction in the number of conditions experienced at the end of life. Thus that period can be both shorter and less expensive. As Dr. James Fries has noted, "Longitudinal studies now link good health risk status with long-term reductions in cumulative lifetime disability; persons with few health risks have only one-fourth the disability of those who have more risk factors, and the onset of disability is postponed from 7 to 12 years."[16] Third, prevention that targets and limits injury and illness helps to minimize the costly occurrence of comorbidities: when one condition builds upon another and the consequences are multiplied. For instance, a broken hip can lead to significantly lower physical activity, which can lead to diabetes, which in turn increases the likelihood of stroke. Decreasing the risk of a fall could significantly reduce medical consequences and cost.

6 SAVINGS FROM PREVENTION ACCRUE BEYOND THE HEALTH CARE SECTOR

In addition to savings within the health care sector, California could expect to see a return on its investment in prevention in other sectors. For example, between 1990 and 1998, the California Tobacco Control Program saved an estimated $5.4 billion in

FIGURE 4. The compression of morbidity



SOURCE: *J.F. Friesand, L.M. Crapo, Vitality and Aging (San Francisco: W.H. Freeman, 1981)*

non-medical smoking-caused costs.[19] Lead abatement in public housing has been demonstrated to return almost $2 for every $1 invested as the result of a combination of reduced medical and special education costs and increased productivity.[20]

Other areas in which savings could accrue include:

- Reduced workers compensation payments
- Reduced disability claims
- Reduced employee absenteeism, including family absenteeism (caretaking of relatives)
- Reduced school absenteeism (affecting school attendance and school finances)
- Improved worker productivity

7 PREVENTION COULD HELP IMPROVE ECONOMIC PRODUCTIVITY AND COMPETITIVENESS

Good health is fundamental for broad economic sustainability. In order to remain competitive with other states and countries, California needs a healthy workforce and, because employers are the main purchasers of health insurance for workers, its health care costs must remain within the range of other industrialized nations. The US has the highest per capita health care spending in the world, nearly double the spending in Switzerland, which has the next highest. In recent years, many companies have moved their operations overseas, laying-off thousands of workers in the process, in part, to be spared the burden of skyrocketing health care costs. California will lose its competitive edge if its population's health declines and if it continues to spend so much more on health care than any other developed nation. As one of the top ten economies in the world, with both wealth and innovation, California's goal should be the best health, not the most expensive services.

Companies, such as General Motors, Johnson and Johnson, Motorola, Safeway, and Cigna, to name a few, have come to recognize the economic value of prevention and have designed programs aimed at employee wellness (see box).[24] A 21-year study of wellness programs by the University of Michigan Health Management Research Center found that comprehensive year-round health programs yielded cost savings of $3 for every $1 spent.[25] By adopting worksite wellness programs—with elements including fitness classes, stress management, ergonomic equipment policies, and on-site farmers' markets (at over 20 Kaiser Permanente sites in California)—companies have improved employee health and productivity, while reducing employee absenteeism and the business costs associated with poor health conditions. As Safeway's Chief Executive, Steve Burd notes, "If we can create a health care plan that contains costs or drives them down, that improves the health of the employee and extends their life, and avoids catastrophic illness and doesn't cost them any more money, why would anybody quarrel with that plan?"[26]

EXAMPLES OF NON-HEALTH CARE COSTS ASSOCIATED WITH POOR HEALTH

- In year 2000 dollars, physical inactivity, obesity, and overweight cost California per year an estimated $388 million in workers' compensation and $11.2 billion in lost productivity.[17]
- In 2002, the total economic impact of asthma totaled $14 billion. Indirect costs alone accounted for $4.6 billion including 14 million lost school days, 14.5 million lost work days, and the productivity loss of the approximately 5,000 who died from asthma.[18]

PRODUCTIVITY AND COMPETITIVENESS IN THE MAKING THROUGH PREVENTION

- Motorola's Wellness Program saves the company $3.93 for every $1 invested in wellness benefits.[21]
- Caterpillar's Healthy Balance Program is projected to result in long term savings of $700 million by 2015.[22]
- Johnson and Johnson's Health and Wellness Program has produced annual health care savings of $244.66 per employee.[23]

8 NEW ECONOMIC MODELS PREDICT POTENTIAL COST SAVINGS FROM PREVENTION

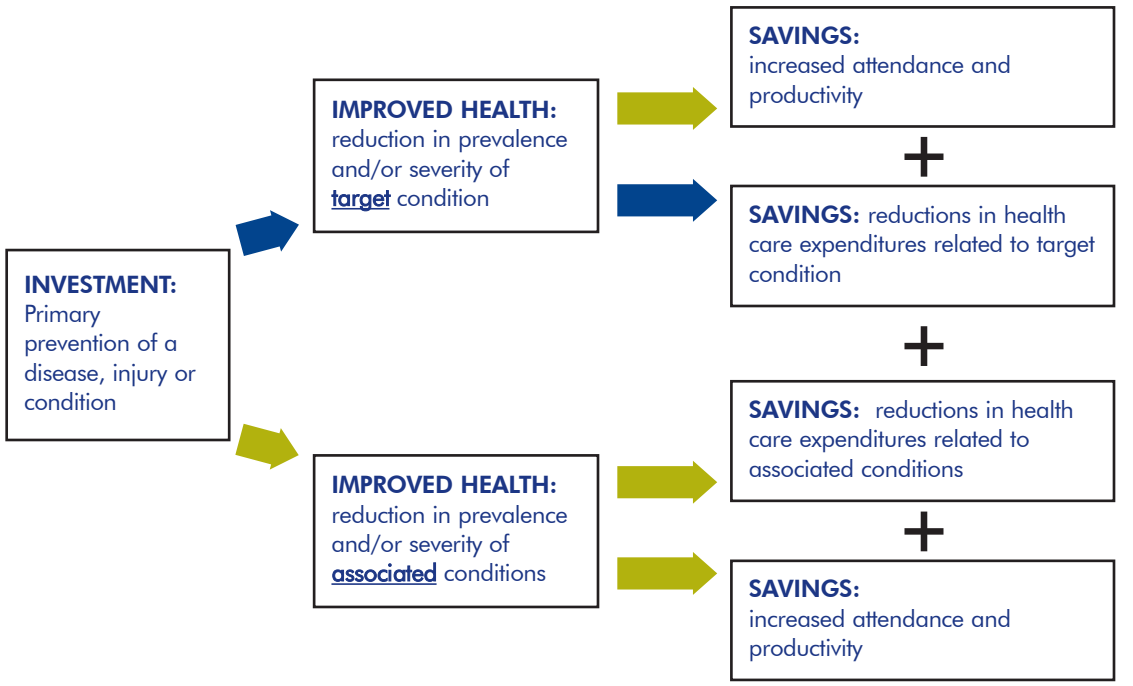
As part of the research and analysis conducted for this brief, Prevention Institute and The Urban Institute developed an economic model of the impact of prevention. The model is based on available literature and interviews with researchers. Application of the model suggests that substantial savings are possible from an investment in prevention.

The model is based on traditional models analyzing the efficacy of prevention and the costs associated with treating preventable conditions. These traditional models have been limited in three crucial respects.

First, results are measured almost exclusively based on the effect of prevention measures on single conditions. This misses the impact that those measures have on other related conditions. Programs to lower the incidence of diabetes by increasing physical activity could also improve outcomes for stroke and cardiovascular disease.* Initiatives that reduce smoking affect cancer rates and also emphysema and childhood asthma. Policies aimed at improving mobility among senior citizens can reduce the incidence of falls as well as improve mental health and hypertension. Second, the models look chiefly at medical system costs, which, though a crucial measure of cost savings, are an incomplete measure because improved health results in savings beyond the health care sector. Therefore, one initiative could result in reduced costs in a number of different areas, including medical care, workers com-

** David Chenoweth's recently published Topline Report on the costs to California of physical inactivity and obesity clearly illuminates the ways in which addressing one factor influencing health such as physical inactivity increase costs across a wide spectrum of health issues including diabetes, hypertension, and cardiovascular disease.*

FIGURE 5. Multiplier effects



The cumulative benefits of primary prevention:

The blue arrows indicate the customarily studied savings pathway, but investments in primary prevention result in improved health in conditions other than the one targeted and savings accrue in three areas not captured by conventional models.

pensation payments, and disability claims. It could also result in improved worker productivity. Finally, the models generally focus on a short time frame, two to six years, while the benefits of prevention are likely to accrue over a much longer period. Illnesses and injuries typically become more expensive the older the afflicted individual is and the longer the duration of the problem, so the greatest savings from prevention will accumulate not in the immediate future but the further out as the individual remains disease-free.

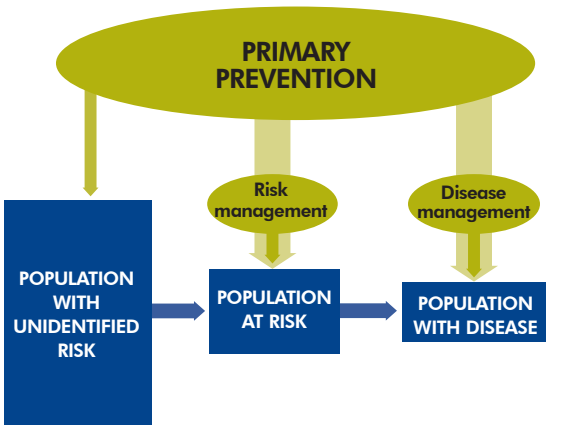
These limitations mean that the models do not show all possible savings resulting from prevention measures. Due to the inadequacies of the available data, the model presented here shares these limitations—it is an attempt to refine existing approaches and better capture the actual savings potential of primary prevention—and as a consequence the results and conclusions drawn here should be considered to be very conservative. For instance, researchers who have looked at the relationship between savings to the health care system and returns in other areas from improved health have concluded that the direct medical costs savings should be multiplied to account for the overall savings (see Figure 5). Estimates of the multiplying factor range from two to twelve times the medical cost savings.[27,28]

OVERVIEW OF THE URBAN INSTITUTE MODEL

The model developed for this brief is based on a stock-and-flow conception of the health process. That is, it takes into account the number of people that are potentially at risk of a particular condition and the factors that influence whether the individual progresses to that condition over time. It then considers the influence of primary prevention on that process, the resulting prevalence of the condition, and the implications for health care expenditures. (The full model is presented in Appendix B.) The key features of the model are:

- Individuals are presumed to be in one of three groups with respect to a given condition
  - Not identified as at risk
  - Identified as at risk
  - Having the disease/condition.
- For each group, there is a knowable probability of moving to another group:
  - Individuals not identified as at risk may be so identified (e.g., a child may be recognized as at risk for asthma when s/he develops wheezing)
  - Individuals at risk may progress to full-blown disease (e.g., someone with pre-diabetes may develop diabetes)
  - Individuals with disease may get their condition under control (e.g., someone with hypertension may achieve normal blood pressure through some combination of weight control, exercise, diet, and medication)
- Primary prevention affects all three groups by changing the probability that the individual will move to another group (see Figure 6). For individuals identified as at risk or with the condition, primary prevention increases the effectiveness of the risk management or disease management offered by the health care system and may reduce disease severity as well as incidence (e.g., improving the walkability of a neighborhood improves access to physical activity for individuals in all three groups).

FIGURE 6. The influence of primary prevention



- Health care expenditures vary with both the prevalence of the targeted condition and the severity.
- The net benefit of prevention takes into account the reduction in disease and disease severity as well as the cost of the prevention intervention.

CONCLUSION

The current attention focused on improving health care presents an opportunity for policymakers to take action that creates a sustainable, cost-effective approach to health. Although more research should be conducted to better understand primary prevention's benefits, the information currently available makes a compelling argument for including primary prevention measures as a significant component of the State's health care reform plans.

Individuals have a responsibility for their own health. Equally, the State has an interest in creating health-promoting environments that support individuals. Californians depend on Government to address basic health determinants such as clean air and water and safe food, and it is just as appropriate for the State to promote health in response to the more complex challenges of the current day. Building upon individuals' responsibility for their own health by enhancing health-promoting environments and practices requires implementation of quality prevention at the State level.

Government is the only entity with the ability to recognize the short- and long-term benefits of prevention, the breadth to enact systematic change, and a stake in the health of all Californians. With the increases in chronic disease and an aging population, government is going to end up expending increasing resources on health and would be wise to invest in prevention now. As researchers who have studied Vermont's investment in prevention concluded, "Prevention may be a "bargain" only in relation to more costly alternatives we face if we don't invest preventively. Prevention can reduce demand for high-cost services, permitting more discretion in the use of existing resources. Lower demand created opportunities for continuing prevention investments, further lessening long-term demand."[29]

If a patient meets with a doctor and is displaying clear early signs of a condition, and the doctor does not respond to this information, we'd consider that doctor careless or neglectful. The doctor has missed a vital chance to protect the patient's health. Decision makers about California's health care system are in the same circumstance: investing a comparatively small amount now in primary prevention would yield important benefits. Not only does primary prevention leave individuals and communities physically healthier by preventing debilitating illnesses and injuries, it would make the State—and its economy—fiscally healthier for many years to come.

ALIGNING GOVERNMENT ACTIVITY WITH HEALTH:

Recommended Policies

In asking the question, "*What determines health?*" many researchers have reached the conclusion that environmental and behavioral factors are more powerful determinants than genetics or access to medical care.[30-32] According to the Institute of Medicine, "evidence is emerging … that societal-level phenomena are critical determinants of health…. Stress, insufficient financial and social supports, poor diet, environmental exposures, community factors and characteristics."[33] California can incorporate this understanding of health into its health care reform to help improve overall health of the population and thereby lower health care costs and ensure a more sustainable system over the long run.

RECOMMENDATION 1:

Institute an Executive level council to establish common goals for health and ensure that State actions and priorities support health outcomes for Californians and are coordinated.

Government makes decisions and expends resources every day in ways that can improve or detract from health and reduce health care costs. Such decisions, including infrastructure and economic development, transit and transportation, educational programming, and housing priorities, are made as part of everyday business of the State. Establishing health goals as part of the consideration of multiple agencies and departments could improve health outcomes, thereby reducing health care costs.

For instance, the Department of Transportation decisions impact traffic injuries, diabetes, and asthma among others and it could make a positive health contribution by supporting non-motorized transit through bike lanes and attention to walkability; the Department of Agriculture decisions impact coronary heart disease, asthma, diabetes, and stroke and it could support expanding trial programs allowing the use of food stamps at farmers' markets and subsidizing healthy foods; and the Department of Housing and Community Development could partner with the Department of Public Health to identify and limit asthma producing factors in new housing units (e.g., mold, materials such as carpeting, proximity to freeways). When a choice is made between two equal-cost alternatives that have differential health implications, choosing the option that leads to better health amounts to ***cost-free prevention***.

Coordinating these efforts could ensure greater synergy and impact. Other states, including Vermont, Connecticut, Minnesota, and Oregon, have instituted policies supporting interdepartmental collaboration to address health concerns more efficiently.[34-36] A Health Coordinating Committee made up of top level staff from departments such as Transportation, Agriculture, Health and Human Services, and Economic Development, along with at-large citizen and professional representatives could:

- Require health analysis by all agencies, coordinated by Department of Public Health
- Report what each agency is currently doing and what they can do differently to promote health
- Require collaboration between agencies to develop multifaceted approaches to complex health issues

Further, there is a need to better align internal activities and funding policies with health objectives. The State is the largest employer in California and has a great opportunity to both support the health of those employees and provide a model and precedent through prevention-oriented policies and practices. Examples of such policies and practices include healthy food at meetings, encouraging use of the stairs and walking during the workday, and incentives

for wellness and stress reduction activities. In addition, the State should explore expanding health guidelines for State spending and investment to ensure that State funds support health objectives in the same way that contracting policies are used to discourage drug use.

RECOMMENDATION 2:
Pilot community makeovers

There is emerging evidence regarding the efficacy of transforming communities to improve health statistics. Governor Schwarzenegger's proposal to establish local assistance grants for community makeover funds presents an opportunity to build the evidence base in California and inspire further investment in comprehensive efforts to create the types of communities in which all Californians would want to live, work, play, and raise families. The makeovers should promote community-driven processes for prioritizing issues to be addressed and initiatives on which to expend funds. Funds should also be made available to evaluate makeover efforts to determine which approaches are the most effective and to guide replication. This approach has been endorsed by California's Strategic Alliance for Healthy Food and Activity Environments, a coalition of advocates from across the State. Elements of community makeover programs that could improve health include:

- Supporting healthy food retail in underserved areas (e.g., grants for small corner stores to begin carrying fruits and vegetables)
- Ensuring full and equitable access to parks, open space, and public facilities (increasing programming, rehabilitating existing facilities, expanding staffing, increasing transit options)
- Adopting and implementing "complete streets" policies (bike lanes, lighting, trees, pedestrian paths)
- Supporting local government in utilizing planning and zoning decisions to improve health outcomes (improving access to open space; increasing density and integration of retail, housing and transportation)

RECOMMENDATION 3:
Index prevention investment to health care spending and reinvest savings. Specifically, set a standard percentage for prevention spending in relationship to health care delivery spending (both public and private) and reinvest savings from preventive measures into other prevention activities.

Indexing funding for health protection activities to overall expenditures on health could lead to significant cost savings. A recent analysis looked at the impact of spending $5 for health protection (prevention) for every $100 of personal health care spending. The model showed that the investment paid for itself in just over 20 years and after 30 years, the $1.28 trillion in prevention spending would have led to a reduction in health care spending of $2.75 trillion, a cumulative savings of $1.46 trillion nationally. The model is documented in a soon-to-be-released report from a group led by the lead researcher at the Centers for Disease Control and Prevention's Syndemics Prevention Network, Bobby Milstein, PhD. In assessing the relative benefits of medical and preventive approaches to improving health, the authors conclude that medical approaches are an inefficient and costly way of improving health.[37] The optimal percentage of spending devoted to prevention is not evident, but even modest increases from current levels have the potential to return significant savings.

As has been noted previously, spending on prevention is a tiny percentage of total spending on health. When an investment is made in prevention, the money saved is not reinvested in creating a healthier population. For instance, when California's motorcycle helmet law led to $48 million in savings in direct medical costs in five years, none of those funds were passed on to support other prevention measures. California can take the national lead by making a commitment to long-term fiscal and physical health through dedicating investment in prevention.

APPENDIX A: APPLYING THE MODEL

DIABETES

We used conservative estimates of the effect of primary prevention interventions reported in the literature and applied them to estimates of the California population with pre-diabetes, diabetes, and no known diabetes. We assumed that primary prevention would reduce the rate at which non-diabetics progressed to pre-diabetes and pre-diabetics progressed to diabetes by 10%. The average annual health care expenditure for someone with diabetes is over five times that for someone without the condition. We conservatively assumed that newly diagnosed diabetics would have health care expenditures of twice those of non-diabetics. Even this small reduction in the rate of new diabetes cases would result in an estimated annual savings to Californians of about $82 million in 2007. Using estimates of the costs of a recent primary prevention program in Somerville, Massachusetts,* we estimate that the cost of a similar program implemented statewide would be approximately $83 million. (Details of the estimation are included in Appendix B.)

This estimate of the potential net benefit of primary prevention on diabetes is conservative in that it does not take into account:

- Savings associated with a reduction in conditions other than diabetes
- Benefits not associated with the health care system
  - Reduced worker absenteeism and improved productivity
  - Improved quality of life
  - Indirect medical care costs.
- Community benefits from the intervention not associated with individuals.
- The continuing benefits of lower diabetes incidence over time.

EMERGING STRATEGIES TO ADDRESS DIABETES: THE BUILT ENVIRONMENT

Increasing physical activity is one element of strategies to reduce prevalence and severity of diabetes. The cost of adopting land-use policies supporting increased physical activity is being studied:

- A cost benefit analysis of bike/pedestrian trails in Lincoln Nebraska concluded that for every $1 investment in trails there was a $2.94 medical benefit, in savings due to the physical activity levels of trail users).[38]
- A draft comparative cost analysis commissioned by EPA found that a prospective new development in Mt. Pleasant, South Carolina that incorporated land use designs that would foster walking and bicycling could cost slightly more or as much as 40% less to build compared to conventional car-focused suburban design.[39]
- The estimated collective medical cost savings of city residents who use parks to meet their physical activity recommendations in Washington DC is $34,194,000 and $78,042,000 for the City of Boston.[40]

CHILDHOOD ASTHMA

The prevalence of asthma appears to have risen significantly over the last twenty years although changes in rates of diagnosis make it difficult to track the trend accurately over time. What is certain is that expenditures on asthma-related care for children is a large and growing part of health care expenditures, estimated to reach over $9 billion nationally in

* *"Shape Up Somerville, Eat Smart, Play Hard" is a comprehensive community-based initiative focused on elementary children in grades one through three. The effort aims to improve every element of a child's day by increasing opportunities for physical acitivity, improving availability of healthy foods, and discouraging high calorie foods. With the support of community members, changes have been instituted in school and after school environments as well as at a broader community level, through strategies such as healthier restaurant options and Safe Routes to School. Preliminary results after 8 months of intervention found that the rate of weight gain slowed among elementary school children.*

APPENDIX A: APPLYING THE MODEL

PROMISING PRIMARY PREVENTION APPROACHES TO REDUCING ASTHMA

Siting of schools

There is growing evidence of the link between local and regional air pollution and asthma rates. For example, during the 1996 Atlanta Olympic Games, when driving was reduced and ambient ozone levels fell by 27.9%, emergency room visits for asthma dropped by 41.6%. Asthma is common among school children and is extremely disruptive. Over 5 million children in the US suffer from asthma, causing 14 million lost school days per year.[41] Siting of schools affects both the amount of driving required in transit to school and the air quality in and around the school. For instance, acute respiratory symptoms increase 5 to 8% at schools close to traffic.[42]

Breastfeeding

Numerous studies have identified a significant reduction in the risk of childhood asthma if exclusive breastfeeding is continued for at least the four months after birth. Breastfeeding is a good example of the multiplier effect—an intervention having effects beyond the target condition and benefits to sectors other than health care.[43]

Restriction of pesticide use near parks and schools

There is growing evidence of the correlation between pesticide use and asthma episodes. In particular, studies indicate that exposure to organophosphate pesticides disrupts the part of the nervous system that regulates the motor functioning of the lungs.[44]

2007.[45] In California, over a third of expenditures on asthma are paid by Medi-Cal.

Approximately 25% of children with asthma have severe or persistent asthma. It is these children that account for the vast bulk of expenditures with costs up to 28 times those for the least severely affected, $3,532 as compared with $122 (2007 dollars).[46] Preventive activities targeted at these children could lead to important savings to the health care system and allow these children to participate fully at school and their parents to miss less work while attending to their needs.

Since the causes of asthma are not known, primary prevention, which is aimed at preventing development of disease, is not strictly possible. What is known is that children exposed to air pollution, even at levels that are within EPA guidelines, are more prone to developing respiratory symptoms.[47] Children who live near freeways, where NO_2 and SO_2 levels are high are at particular risk.[48] Asthma is produced by a complicated interaction between genes and the environment. Experts in the field are clear that separating out these two determinants is extremely difficult. In spite of that fact it is believed that up to 99% of childhood hospitalizations for asthma are preventable as are up to 95% of emergency department visits.[49] Prevention aimed at reducing environmental asthma triggers would likely result in significant savings, and these savings would likely be realized in the very near term.

There are over 14,000 hospitalizations of children with asthma in California each year.[50] If we assume that interventions targeted at environmental triggers of asthma could reduce preventable incidence by 10%, from 95% to 86%, and that there would be a commensurate drop in hospitalizations, we would expect 1,260 fewer hospitalizations per year. The average cost of asthma hospitalization in California (2004) was over $19,000,[51] for a savings of over $23.9 million.

Some of the environmental triggers for asthma are within the home, such as pet dander, insect infestations, and secondhand smoke, and are primarily under individual control though landlord responsibility and government regulation can play important roles. Intensive indoor environmental control has been shown to be clearly cost effective. Disease and risk management activities such as intensive indoor environmental control or patient education on self-management have been shown to be cost effective with returns estimated at $4 to $22 per $1 of pro-

gram costs.[52] Interventions targeted at high risk households have seen the greatest returns. Other interventions come from the broader environment and would be amenable to government action. Local environmental actions can be taken that would likely lead to reduced costs associated with asthma. These include siting of schools and recreational areas away from freeways and other sources of air pollution and planting trees to provide natural air filtration in residential areas. Over time, investment in public transportation and support for other alternatives to cars and trucks for transportation and shipping could reduce traffic overall and, as a result, reduce traffic-related emissions.

FALLS AMONG THE ELDERLY

Falls are the leading cause of injury for those over age 65 in California.[59] Over the last decade, falls have been the cause of 75% of all seniors' hospitalizations in the state (over 500,000 hospitalizations).[60] In 2004, over 70,000 California seniors were hospitalized for fall-related injuries and more than 1,400 died. Each year $1 billion is spent in California on hospital care for senior falls. This represents the hospital charge for the first stay, but the total cost is much greater. When accompanied by a brain injury, lengthy physical and occupational therapies have been needed to try to regain cognitive and motor skills.

Falls are also the immediate reason for 40% of all nursing home admissions, with hip fractures being the most common, severe, and costly consequence of a fall. Many of those seniors never recover sufficiently to return home and Medi-Cal assumes the burden of long-term care.[61]

California has more than 3.6 million adults over the age of 65, the largest older adult population in the nation, which will nearly double by 2040. The growth in the number and proportion of older adults is unprecedented due to increasing longevity and aging baby boomers, who begin turning 65 in 2011.

POTENTIAL PRIMARY PREVENTION APPROACHES TO REDUCING FALLS AMONG THE ELDERLY

Physical activity

Improving balance and strength among older people has been demonstrated to be effective in reducing falls.[53] In one randomized controlled study, a group of 200 seniors, 70 years and older, who underwent Tai Chi training (a form of Chinese martial arts) two times a week for 15 weeks reduced falls by 47.5% compared with a matched group that attend a discussion-only meeting.[54] Moderate walking has also been found to be protective leading to a 41% reduction in risk of hip fracture.[55]

Environmental modifications to public space

Researchers have found that up to 65% of falls among seniors occurred while walking on a familiar route outside the home.[56] Due to the difficulty in isolating the effectiveness of a single intervention, cost-savings data has not been developed, but it is clear that certain factors such as curb heights and sidewalk surfaces impact the risk of falls. Many cities are taking mitigating steps such as spray painting sidewalk cracks with fluorescent paint in advance of repair, helping seniors with poor vision to see and avoid the hazard and setting building codes for curb and stair heights.[57]

Calcium

The estimate of the five-year (2005-2009) net savings in hospital, nursing facility, and physician expenditures resulting from a reduction in the occurrence of hip fractures among those over age 65, through daily intake of 1200 mg of calcium with vitamin D is $13.9 billion. Approximately 734,000 hip fractures could be avoided over the five year period.[58]

Evidence shows that multifaceted intervention programs, which use a combination of medical and fall risk assessment, medications management, exercises to increase strength and balance, and environmental hazard reduction, decrease the number of times that participants fall.[62] One major study reported that intervention patients sustained fewer injuries and required less medical care for falls.[63] The average cost of target-

ed multifaceted interventions was $891 per participant. For falls requiring medical care, the mean cost per fall is $17,483.[64] In 2004, there were 79,310 non-fatal falls that required hospitalization among elderly Californians.[65] A 10% reduction in the number of non-fatal falls would mean 7,931 fewer falls and health care savings of $138.6 million. Even this significant level of savings does not mean that an intervention applied to seniors at random would be cost saving (a 20% reduction in fall risk would be necessary to justify that investment, and the data about success rates is inconclusive). However, interventions targeted at high-risk seniors have been demonstrated to return as much as $8.60 for every dollar spent.[66] This is especially compelling since the initial medical costs are only the beginning of the fiscal impact of a fall. For instance, Medi-Cal reimbursement for long-term care would likely be required if the injury resulted in permanent disability and falls often precipitate a reduction in mobility leading to increased risk for other health concerns including heart disease, diabetes, and mental health issues.

ENDNOTES

1 Thorpe KE, Florence CS, Joski P. Which Medical Conditions Account For The Rise In Health Care Spending? *Health Affairs*. 2004; Web exclusive:w4.437-445. Available at: http://content.healthaffairs.org/cgi/content/abstract/hlthaff.w4.437v1.

2 Hogan P, Dall T, Nikolov P. Economic Costs of Diabetes in the US in 2002. *Diabetes Care.* 2003;26:917-32.

3 Lambrew JM. A Wellness Trust to Prioritize Disease Prevention. The Hamilton Project, Brookings Institution. 2007. Discussion paper. Available at: www3.brookings.edu/views/papers/200704lambrew.pdf.

4 McGinnis JM, Williams-Russo P, Knickman JR. The case for more active policy attention to health promotion. *Health Affairs* (Millwood). 2002;2:78-93.

5 Behavioral Risk Factor Surveillance System (BRFSS) 1984-1992 and California Adult Tobacco Survey data 1993-2004. California Department of Health Services, Tobacco Control Section. 2005. Presented in: Confronting a Relentless Adversary A Plan for Success. Master Plan of the Tobacco Education and Research Oversight Committee for California. 2006 Available at: www.dhs.ca.gov/tobacco/documents/pubs/MasterPlan05.pdf.

6 Economic and Health Effects of a State Cigarette Excise Tax Increase in California. California Department of Health Services. 2006. Available at: http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1065&context=ctcre.

7 Max W, Stark B, Root S. Putting a Lid on Injury Costs: The Economic Impact of the California Motorcycle Helmet Law. *J Trauma*. 1998;45:550-556.

8 Hoey C, Ware JL. Economic advantages of breast feeding in an HMO setting: a pilot study. *Am J Manag Care*. 1997;3:861–5.

9 Bloodborne Pathogens/Sharps Injury Prevention. Title 8/4. Health and Safety. 5193. June 24, 1999.

10 Encinosa W, Bernard D & Steiner C. National Trends in the Costs of Bariatric Surgery. *Bariatrics Today* 2005; 3, 10-12.

11 Thiesen K. Bariatric Surgery: Separating Fat from Fiction. *National Underwriter*. January 2005; 109, 2.

12 Lightwood JM, Glantz SA. Short-Term Economic and Health Benefits of Smoking Cessation — Myocardial Infarction and Stroke. *Circulation*. 1997; 96:1089-1096.

13 Weimer J. The Economic Benefits of Breastfeeding, Food Assistance and Nutrition Research Report No. FANRR. United States Department of Agriculture. 2001. Available at www.breastfeedingtaskforla.org/econ-review-bf2002.pdf.

14 Fries JF, Koop CE, Sokolov J. Beyond Health Promotion: reducing need and demand for medical care. *Health Affairs.* 1998;17:70-84. Available at: http://content.healthaffairs.org/cgi/reprint/17/2/70.pdf.

15 Wilmoth J, Horiuchi S. Rectangularization Revisited: Variability of Age at Death within Human Populations. *Demography*. 1999;36:475–96.

16 Fries JF. Measuring and Monitoring Success in Compressing Morbidity. *Annals of Internal Medicine.* 2003;139:455-459.

17 Chenoweth D. The Economic Costs of Physical Inactivity, Obesity, and Overweight in California Adults: Health Care, Workers' Compensation, and Lost Productivity. Topline Report. California Department of Health Services. 2005. Available at: www.dhs.ca.gov/cdic/cpns/press/downloads/CostofObesityToplineReport.pdf.

18 Trends in Asthma Morbidity and Mortality. American Lung Association Epidemiology & Statistics Unit. March 2003. Available at: www.lungusa.org/atf/cf/%7B7A8D42C2-FCCA-4604-8ADE-7F5D5E762256%7D/ASTHMA1.PDF.

19 Miller V, Ernst C, Collin F. Smoking-attributable medical care costs in the USA. *Social Science and Medicine*. 1999;48:375-391.

20 Brown M. Costs and Benefits of Enforcing Housing Policies to Prevent Childhood Lead Poisoning. *Medical Decision Making*. 2002;22:482-492.

21 Prevention Makes Common "Cents." US Department of Health and Human Services. 2003. Available at: http://aspe.hhs.gov/health/prevention/.

22 Ibid.

ENDNOTES

23 Ozminkowski R, Ling D, Goetzel R, et al. The Long Term Impact of Johnson & Johnson's Heath & Wellness Program on Health Care Utilization and Expenditures. *Journal of Occupational Environmental Medicine*; 2002: 44:21-29

24 Prevention Makes Common "Cents." US Department of Health and Human Services. 2003. Available at: http://aspe.hhs.gov/health/prevention/.

25 20th century cost benefit analysis and report 1979-2000. University of Michigan Health Management Research Center. 2000. Order at: www.hmrc.umich.edu/research/cost-ben.html.

26 Colliver V. Preventive health plan may prevent cost increases: Safeway program includes hot line, lifestyle advice. *San Francisco Chronicle.* February 11, 2007. Available at: http://sfgate.com/cgi-bin/article.cgi?f=/c/a/2007/02/11/BUG02O20R81.DTL.

27 Ibid.

28 Shiell A, McIntosh K. Some Economics of Health Promotion: What We Know, Don't Know and Need to Know Before Spending to Promote Public Health. *Harvard Health Policy Review*, 2006;7: 21-31.

29 Hogan C, Murphey D. Toward an Economics of Prevention: Illustrations from Vermont's Experience. The Finance Project. 2000. Available at: www.financeproject.org/Publications/vermont.htm.

30 McGinnis JM, Williams-Russo P, Knickman JR. The case for more active policy attention to health promotion. *Health Aff* (Millwood). 2002;21:78-93.

31 Blum HL. *Planning for Health: Generics for the Eighties.* New York: Human Sciences Press; 1981.

32 Adler NE, Newman K. Socioeconomic disparities in health: pathways and policies. *Health Affairs.* 2002;2:0-76.

33 A Social Environmental Approach to Health and Health Interventions. In: Smedley BD, Syme SL, eds. *Promoting Health: Intervention Strategies from Social and Behavioral Research*. Washington, D.C.: National Academy Press; 2000:3.

34 Hogan C, Murphey D, Toward an Economics of Prevention: Illustrations from Vermont's Experience. The Finance Project. 2000. Available at: www.financeproject.org/Publications/vermont.htm.

35 Connecticut Food Policy Council. Accomplishments. Available at: www.foodpc.state.ct.us/accomplishments.htm. Accessed August 22, 2007

36 A Call to Action: Advancing Health For All Through Social and Economic Change. Minnesota Department of Health. 2001. Available at: www.health.state.mn.us/divs/cfh/ophp/resources/docs/calltoaction.pdf.

37 Milstein B, Homer J, Hirsch G. Chronic Illness in a Complex Health Economy: The Perils and Promises of Downstream and Upstream Reforms. *System Dynamics Review* (50th Anniversary Edition); 2007.

38 Wang G, Macera C, Scudder-Soucie B, et al. A Cost-Benefit Analysis of Physical Activity Using Bike/Pedestrian Trails. *Health Promotion Practice.* 2005;6:174-179.

39 Comparative Infrastructure & Material Analysis. US Environmental Protection Agency. 2007. In Press.

40 Urban Trees and Municipal Value: Communicating What a Park System is Worth to a City. Trust for Public Land. 2007. In Press.

41 Travel and Environmental Implications of School Siting. US Environmental Protection Agency. 2003. Available at: www.epa.gov/dced/pdf/school_travel.pdf.

42 Kim JJ, Smorodinsky S, Lipsett M, et al. Traffic-related Air Pollution near Busy Roads, The East Bay Children's respiratory Health Study. *Am J Respir Crit Care Med*. 2004;170:520-6.

43 Oddy WH, Holt PG, Sly PD, et al. Association Between Breast Feeding and Asthma in 6 year old Children: Findings of a Prospective Birth Cohort Study. *BMJ*. 1999;319:815-819.

44 Eskenazi B, Bradman A, Castorina R. Exposures of children to organophosphate pesticides and their potential adverse health effects. *Environ Health Perspect*. 1999;107:409-419

45 Smith, DH, et al., 1997. A National Estimate of the Economic Costs of Asthma, *American Journal of Respiratory Critical Care*, 188: 787-93. Estimates trended forward from 1994 by The Urban Institute using the Medical Consumer Price Index.

ENDNOTES

46 Data from Community Action to Fight Asthma (CAFA), no date. "Asthma in California," www.calasthma.org, accessed August 21, 2007. Estimates trended forward from 1996 to 2007 by The Urban Institute using the Medical Consumer Price Index.

47 See, for example, Gauderman, WJ, 2005. Childhood Asthma and Exposure to Traffic and Nitrogen Dioxide, *Epidemilogy*, 16(6):737-43.

48 Landrigan, PJ, et al., 2002. Environmental Pollutants and Disease in American Children: Estimates of Morbidity, Mortality, and Costs for Lead Poisoning, Asthma, Cancer, and Developmental Disabilities. *Environmental Health Perspectives* 110(7):721-8.

49 Summer, L, et al., 2001. Asthma Care for Children: Financing Issues, A CHCS Chartbook.

50 Community Action to Fight Asthma, (CAFA) no date. "Asthma in California," www.calasthma.org, accessed August 21, 2007.

51 Ibid.

52 Hoppin, P, and M Jacobs, *Investing in Best Practices for Asthma, A Business Case for Educational and Environmental Interventions*, Boston: Asthma Regional Council of New England, April 2007.

53 Wolfson L, Whipples R, Judge J, et al. Balance and Strength Training in Older Adults: Intervention Gains and Tai Chi Maintenance. *J Am Geriatr Soc.* 1996;44:498-506.

54 Wolf S, Barnhart HX, Kutner N, et al. Reducing Frailty and Falls in Older Persons: An Investigation of Tai Chi and Computerized Balance Training. *J Am Geriatr Soc.* 1996;44:489-497.

55 Feskanich D, Willett W, Colditz G. Walking and Leisure time Activity and Risk of Hip Fracture in Post-menopausal Women. *JAMA*. 2002;288:2300-2306.

56 Gallagher EM, Brunt H. Head Over Heels: Impact of a Health Promotion Program to Reduce Falls in the Elderly. *Canadian Journal of Aging*. 1996;15:84-96.

57 DaVanzo J, Dobson, A, Dollard KJ, Tanamor M, Mc Pheron H. Improving Public Health, Reducing Health Care Costs: An Evidence Based Study of Five Dietary Supplements. The Lewin Group. September 2004.

58 Office of the Provincial Health Officer, Prevention of falls and injuries among the elderly. British Columbia Ministry of Health Planning; 2004. Accessed at http://www.health.gov.bc.ca/library/publications/year/2004/falls.pdf.

59 Ellis, A. and Trent, R. "Do the risks and consequences of hospitalized fall injuries among older adults in California vary by type of fall?" *J Gerontol A Biol Sci Med Sci*. Series A. 2001;56:786-92

60 Hausdorff JM. Gait Variability, and Fall Risk: a One-Year Prospective Study. Arch Phys Med Rehabil. 2001;82:1050-1056.

61 Cross J, Trent R, Adekoya N. Public Health and Aging: Nonfatal Fall-related Traumatic Brain Injury Among Older Adults - California, 1996-1999. *MMWR*. 2003;52:276-278.

62 Gillespie LD, Gillespie WJ, Robertson MC, et al. Interventions for Preventing Falls in Elderly People. *Cochrane Database Syst Rev.* 2003; (4): CD000340.

63 Tinetti ME, Baker DI, McAvay G, et al. A Multifactorial Intervention to Reduce the Risk of Falling Among Elderly People Living in the Community. *N Engl J Med*. 1994; 331:821-827.

64 Roudsari B, Ebel B, Corso P, et al. The Acute Medical Care Costs of Fall-related Injuries Among the US Older Adults. *Injury*. 2005;36:1316-1322.

65 California Department of Public Health, EPIC Branch, Senior Fall Injuries, 1991 to 2004 Nonfatal Hospitalized Injuries California Residents. Available at www.applications.dhs.ca.gov/epicdata/scripts/broker.exe?_SERVICE=Pool2&_PROGRAM=programs.st_srfall.sas&REGION0=XXX&ANALYSIS1=F&REGION=California&OUTPUT=HTML

66 Health Resources and Services Administration, Injury Prevention: What Works? A Summary of Cost-outcome Analysis. Pacific Institute for Research and Evaluation. Calverton MD. September 2005.

How Prevention Activities Work to Save Health Care Dollars:

A Model of Effects and Savings

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Treatment of chronic disease accounts for an increasing share of health care expenditures in the United States. The prevalence of chronic disease increases with age. With the aging of the baby-boom population, it is inevitable that the burden of chronic disease will continue to grow. Or is it? Much of chronic illness is preventable. If a share of the expenditures now devoted to treating chronic illness were instead directed to preventing its development, the growth in chronic disease and the expenditures associated with its treatment could be slowed and perhaps reversed.

It is intuitive that preventing illness is a good thing to do. Not only are the costs of treating illness avoided, but the quality of life of people who are not ill is also improved. Healthy children are better able to learn, and healthy workers are more productive. Absenteeism would be reduced at both school and work. Why, then, has there not been more investment in prevention? There are many contributing factors, from the way the U.S. health care system is structured to the nature of the development of chronic illness. There have been useful studies of the effect of the health care payment structure;[1] here, we explore how prevention affects the development of chronic illness and the costs associated with its treatment, and how these factors might influence investment in prevention.

The key features of chronic illness that complicate tracking the effect of prevention on costs of its treatment include:

- It is caused by multiple interacting factors.
- It takes years to develop.
- It is difficult to identify who is most at risk so interventions must be broadly based.
- Prevention interventions may have multiple effects so it is difficult to identify all associated benefits.
- Preventing disease development often requires individual behavioral change.
- Some risk factors are in the environment and so are not under individual control.

We have developed a model that attempts to sort out the roles of each of these factors and so illuminate the critical role of prevention at the individual and at the environmental level. We then use this model to estimate the potential return to investment in primary prevention.

THE MODEL

Prevention and disease[2]

Individuals can be thought of as belonging to one of three groups with respect to a given chronic disease or condition:

- Not identified as at risk
- Identified as at risk
- Having the disease

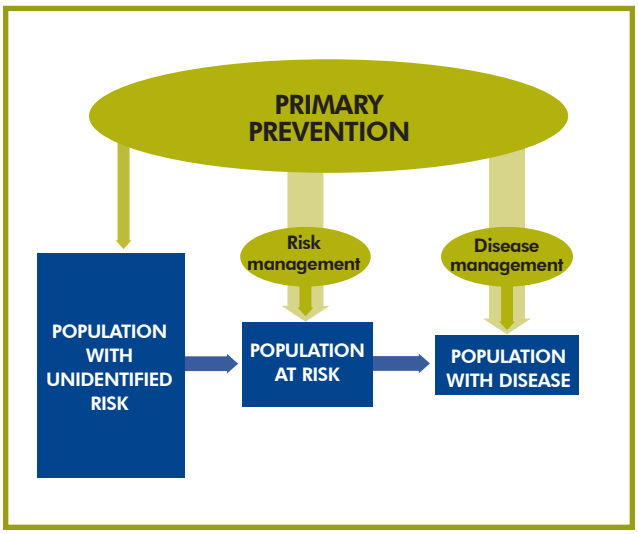
APPENDIX B: A MODEL OF EFFECTS & SAVINGS

For example, an individual may have normal blood pressure, borderline hypertension, or hypertension; or he may have normal glucose metabolism, pre-diabetes, or diabetes; a senior citizen may be healthy, at risk of falls, or have a history of falls; or a child may have normal breathing, a history of wheezing, or have asthma. In each case, individuals in the first group may be at risk because of individual characteristics or characteristics of their environment, but the risk has not been identified. Because individual risk has not been identified, prevention of disease at this stage must target all members of the community.

Once risk has been identified, prevention can target the individual. For individuals with disease, prevention aims to at least reduce the severity of the disease and at best to return the individual to a pre-disease state. This type of prevention is often called disease management. For individuals identified as at risk of disease, prevention can at least delay onset of disease and at best avoid disease altogether. Identification of individuals at risk of disease so that their risk can be managed is often called secondary prevention. Interventions to affect progression to disease are often called risk management. For example, weight loss and increased exercise can bring hypertension under control. For both these groups, prevention activities are directed at the individual. The cost of prevention depends on how many people are in each of the groups. The effect of the interventions can be measured by tracking the progress of the individuals in each group.

Broadly based prevention interventions seek to reduce the risk of developing disease among all individuals in the community. Because they are broadly based they can affect all groups – those not identified as at risk, those identified as at risk, and those with the disease. Such risk reduction interventions, usually referred to as primary prevention, are aimed at reducing the probability that an individual in the community will develop the precursors to disease and so be at risk of disease. The effect of broadly based interventions is difficult to measure because the target group is the community, the level of risk within the community is not known precisely, individuals may move into or out of the community and so receive different intensity of the intervention, and the effects may not be seen immediately.

It is likely that there are interactions between risk reduction interventions and both risk management and disease management. For example, suppose an individual identified as having pre-diabetes is counseled to improve his diet and increase daily exercise. If he lives in a community where traffic calming measures have been put in place, sidewalks have been well-maintained, local grocery stores stock fresh fruits and vegetables, and local restaurants offer healthy options, he is better able to comply with the recommended behavioral changes. In the model, these interactions are represented as a multiplier effect on risk management and disease management interventions, and serve to make these individually targeted interventions more effective.



APPENDIX B: A MODEL OF EFFECTS & SAVINGS

Cost of prevention and the cost of disease

Prevention interventions cost money. Reduced disease saves money. Good stewards of society's resources should ask whether the cost of prevention is justified by the returns to society. The model presented here provides a framework for answering that question.

Specifically, the model includes the effects of primary prevention/risk reduction (RR) interventions, risk management (RM), and disease management (DM), and the interactions of these activities, on the number of individuals with pre-disease and with disease over time. It then provides a way to compare the cost of prevention programs with the change in health services associated with the condition that is the target of prevention. This comparison is a conservative estimate of the net benefits of prevention since it looks only at benefits in the form of reduced need for health care services for the target condition. It does not include any spillover effects on the need for health services for other conditions, e.g., reductions in adult smoking might be targeted at reducing the incidence of emphysema but would also affect asthma attack rates among children of smokers. Nor does it include the effect on productivity at work and at school or the improved quality of life associated with lower disease rates.

The number of people in each of the groups (call them A, B, and C_s, where s denotes the severity of the disease) after a prevention intervention (A_1, B_1, C_{s1}) is a function of the number in the group before the intervention (A_0, B_0, C_{s0}), the probability that an individual will move from one group to another (P_{ab}, P_{bc}, P_{cb}), and the effect of the prevention interventions on those probabilities ($RR*P_{ab}$, $RR*P_{bc}$, $RR*P_{cb}$, $RM*P_{bc}$, and $DM*P_{cb}$) and the interaction of community-based interventions and individual interventions ($RM*RR_b*P_{bc}$, $DM*RR_c*P_{cb}$) with the probabilities. (For all, subscripts represent the group affected.) Thus,

$$A_1 = A_0 - (RR_a * P_{ab}) * A_0$$
$$B_1 = B_0 - [((1 - RM_b) * P_{bc}) * B_0] - [((1 - RM_b) * RR_b * P_{bc}) * B_0]$$
$$C_{s1} = C_{s0} - [((1 + DM_c) * P_{cb}) * C_{s0}] - [((1 + DM_c) * RR_c * P_{cb}) * C_{s0}]$$

(Group B_1 would also include any people moving from disease to pre-disease (from C to B) and any people moving from no disease to pre-disease (from A to B), which are not presented here for ease of explication.)

Disease management is also expected to affect the severity of disease both directly and in interaction with risk reduction. Disease severity after the intervention is

$$s_1 = s_0 + (1 - DM_s) * s_0) - ((1 - DM_s) * RR_s * s_0)$$

The cost of health services (HS_s) is assumed to be a function of the severity of disease, which is assumed to be affected by both disease management and risk reduction. Thus, the health services cost is

$$HS_0 = \sum_s (HS_s * C_{s0}), \text{ before the intervention}$$

and

$$HS_1 = \sum_s (HS_s * C_{s1}), \text{ after the intervention.}$$

APPENDIX B: A MODEL OF EFFECTS & SAVINGS

The net benefit (in direct medical costs) of the three types of interventions is the savings in health services after the interventions less the cost of the interventions ($RR_{\$}$, $RM_{\$}$, and $DM_{\$}$), i.e.,

$$\text{Net benefit} = (HS_0 - HS_1) - (RR_{\$} + RM_{\$} * B_0 + DM_s * C_0).$$

Other considerations

The net benefit calculation ignores two important aspects of prevention. The first is the effect of sustained intervention over time. The model shows an expected decrease in the growth of the pre-disease and disease populations. With a lower number of individuals with pre-disease or disease (if not absolutely, at least with respect to trend), the total costs associated with risk management and disease management, which are a function of the number of individuals treated, will be lower. It is important to take this saving into account since it will not be realized until the second round of prevention activities. Furthermore, because these are costs avoided rather than visible cost savings, they are often not recognized as real benefits of the initial intervention. The time lag in realizing benefits can be compounded in the case of interventions that take a long time to show an effect. Improved asthma management is likely to yield savings in health expenditures within a very short time frame, one to two years. In contrast, reductions in lung cancer following a smoking cessation initiative may not be evident for many years.

The second aspect of net benefits of prevention is related to the time lag as well. Because health expenditures are most often financed by insurance plans and plan members may change plans over time, traditional insurance plans have little incentive to invest in preventive services for individuals who may be members of another plan by the time the returns to that investment are realized. While it appears that there are net benefits to many prevention interventions, the distribution of costs and benefits is less clear.

Application of the model to diabetes

A review of the literature shows that some of the parameters needed to estimate the model with respect to the prevention of diabetes are available with a reasonable degree of consistency. For others, however, the estimates are inconsistent or conflicting, and for some there are no estimates available. Here, we review briefly what is known about these parameters and consider the implications for calculation of the net benefits of prevention. A review of the literature shows that some of the parameters needed to estimate the model with respect to the prevention of diabetes are available with a reasonable degree of consistency. For others, however, the estimates are inconsistent or conflicting, and for some there are no estimates available. Here, we review briefly what is known about these parameters and consider the implications for calculation of the net benefits of prevention.

Size of the population. There are reasonably consistent estimates of the number of individuals with diabetes (diagnoses and undiagnosed) and individuals with pre-diabetes. Extrapolating the national figures to the California population,[3] we estimate that there are 6.6 million California identified as at risk of diabetes and 1.8 million with a diagnosis of diabetes.

Probability of disease conversion. The prevalence of diabetes is increasing in the US.[4] Because many people with diabetes are undiagnosed, it is difficult to determine the rate at which individuals convert from a healthy state to pre-diabetes. As a conservative estimate, we calculate the conversion rate that would be necessary to maintain the size of the pre-diabetic population constant, given the rate at which pre-diabetics convert to diabetic status. We extrapolate the conversion

to diabetic status from the results for control groups in published studies of interventions at 2.4% to 5.5%.[5] That implies a conversion rate to pre-diabetic status of 0.7% to 1.4%. The literature suggests that the rate of conversion from diabetes back to pre-diabetes is negligible in the absence of intervention.

Effect of risk reduction (primary prevention) activities. The range of activities that have been proposed as risk reduction for diabetes is large. Many proposed interventions act via an effect on weight or exercise; others aim to improve the content of diet. Some are designed to affect weight loss or level of exercise directly while others look for correlates of physical activity or nutrition within the environment that might be replicated as interventions elsewhere. There is evidence of the effect of many of these activities within a causal chain that plausibly leads to reduction in rates of conversion to pre-diabetes from a non-diabetic state and to diabetes from pre-diabetes. However, we have been unable to find any study in the literature linking such activities directly to the rate of diabetes.

Even without a specific study linking particular interventions to the rate of diabetes, the evidence of likely effect is convincing. For example,

- Studies have found correlations between physical characteristics of neighborhoods that contribute to "walkability" and the level of physical activity of individuals in the neighborhood.[6] Other studies have shown that increased physical activity is linked to lower incidence of diabetes with the reduction in incidence correlated to the level of exercise for both moderate and vigorous activity.[7] Still others have shown improved insulin sensitivity, a marker of risk of diabetes, with small increases in exercise.[8]
- Studies have shown that interdisciplinary interventions among school children targeting physical activity and improved nutrition can result in lower body mass index and reductions in sedentary activities.[9] Lower body mass in children is correlated with lower body mass when the children become adults, which is correlated with lower rates of diabetes.
- Studies looking at the correlation between the availability of grocery stores and supermarkets and obesity levels in the community have shown mixed results.[10] This topic merits further exploration.

Effect of risk and disease management interventions. Intensive interventions with individuals that have been identified as having pre-diabetes or have been diagnosed with diabetes show that diabetes can be reduced by 31% to 58% over four to six years.[11] The results of these studies over time suggest, however, that the interventions must be maintained over time, albeit at lower intensity, in order to maintain the results. Furthermore, attrition rates suggest that maintaining the participation rate in these interventions can be difficult.

Interaction between risk reduction (primary prevention) and risk or disease management. We have found no published studies documenting the interaction between primary prevention and risk or disease management. Nonetheless, the literature on primary prevention and neighborhood correlates of healthy behavior cited above again strongly suggests that such an interaction exists. If neighborhood characteristics affect the health behaviors of community residents in general, it is plausible that these effects would be stronger for individuals who have been motivated by their health care providers. Studies should be undertaken to test this hypothesis.

Cost of risk reduction activities. The cost of risk reduction activities is not well documented in the literature. The cost of the interventions described in research studies often includes the costs of the research agenda as well. Participation rates are likely also to be influenced by the research pro-

tocol, which would affect the per participant or per resident cost. In the case of neighborhood correlates of healthy behavior, the cost of replicating the identified characteristics would depend on the characteristics of the receiving neighborhood.

Cost of risk and disease management activities. Program costs for risk and disease management are not often reported in the literature. One large study reported a per participant cost of $3540 over three years (2003), which implies an annual cost of $1180, although costs in the first year are likely to be higher than in subsequent years.[12] The costs of risk management and disease management are most often documented as cost per, for example, life year saved, diabetes case avoided, or quality adjusted life year (QALY), rather than as total program costs. These latter represent measures of cost and effectiveness and so provide useful information for planner, though not within the framework of the current model. One study estimated the cost per diabetes case prevented by risk management lifestyle interventions was estimated at $17,200 (in 2003 dollars).[13] Another estimated the cost per QALY as $16,000 (in 1997 dollars).[14] The range of net cost per life year saved was estimated from below zero (i.e., the intervention would be cost saving) to $2400 in 1998 depending on the program and the success rate of the intervention.[15] Success depends greatly on patient compliance, which can be difficult to achieve in "real world" settings and, as several of these studies document, to maintain over time.[16]

Cost of health services. The total cost of diabetes care in the US has been estimated at $132 billion in 2002.[17] Given California's share of the population, this total implies a cost of $16.1 billion in the state. Overall average health care expenditures for people with diabetes has been estimated (in 2002 dollars) at $13,243 as compared with $2,560 for people without diabetes.[18] Costs increase with the severity of the disease.

Other costs and benefits. The only costs we have so far been considering are the medical costs associated with disease and the only benefits of a given intervention are those associated with the disease in question. A full picture of the costs and benefits of proposed interventions would include estimates of other costs and other benefits. Chief among the benefits of reduced incidence of diabetes is improved quality of life for the individual. Quality of life benefits accrue to the individual, but the societal corollary of improved quality of life is increased productivity in the workplace for adults and improved performance at school for children. These benefits are difficult to quantify. Estimates of their magnitude vary in the literature depending on which benefits are included. The social cost of illness, for example, has been estimated at two to three times the medical costs.[19] These costs, which would be avoided with a reduction in illness, include lost productivity, absenteeism, and diminished quality of life.

Additional benefits of prevention interventions include spillover effects on other diseases. For example, increased exercise, whether as directed by a physician or encouraged by neighborhood improvement, is associated not only with reduced incidence of diabetes but also with reduced incidence of falls among the elderly. Weight loss affects an individual's risk of cardiovascular disease in addition to the risk of diabetes. Primary prevention interventions can also have benefits beyond health. For example, increased "walkability" of a neighborhood can affect a neighborhood's economic development by making local stores more accessible to residents, decreasing social isolation among seniors, and improving child safety.

PUTTING IT ALL TOGETHER: POTENTIAL NET BENEFITS TO INVESTMENT IN PREVENTION

Despite the lack of studies directly measuring the effect of primary prevention on the incidence of diabetes, the literature taken as a whole provides support for investment in prevention as a productive use of societal resources. Continuing with the diabetes example and using conservative assumptions about the cost of interventions and their effects, we compare the likely costs and outcomes to the cost of medical care avoided. For this estimate, we ignore the likely spillover effects to other diseases, savings other than avoided medical care, and benefits other than reduction of disease.

Working backward from the cost of diabetes, we first inflate the 2002 estimates of the cost of care for individuals with diabetes as compared with the cost of care for individuals without diabetes to 2007 dollars using the Medical Consumer Price Index. In 2007 dollars, the average annual cost of care for individuals with diabetes would be $16,314 and for those without diabetes, $3,154. In other words, average annual medical care costs for diabetics is about 5.2 times that for non-diabetics. The costs for individuals with diabetes represent average costs for all individuals with diabetes. We assume that costs rise with severity of disease and that cases avoided by primary prevention generally represent less severe cases. Therefore, we assume that cost multiplier for new cases would be closer to two than five, that is, about $6,308. The question then becomes if society avoids over six thousand dollars in medical care for each case of diabetes that it is able to prevent, do the interventions that would be required to prevent each case cost less than six thousand dollars? If so, primary prevention can be seen as a worthwhile investment. Given the other benefits of lower disease prevalence that would accrue to individuals and to society, this calculation represents a very conservative estimate of the returns to primary prevention.

If we assume conservatively that primary prevention would reduce the rate at which people in the community become pre-diabetic by ten percent, there would be a reduction of about 17,700 in the number of new pre-diabetics in California.[20] Similar calculations suggest that primary prevention could reduce the number of individuals converting from pre-diabetes to diabetes by 25,080, from 250,800 to 225,720.[21] At an estimated annual average savings of $6,308 per case avoided or delayed, the medical cost savings from investment in primary prevention would be around $158 million for pre-diabetics. For the estimated 17,700 non-diabetics who do not convert to pre-diabetes, the medical cost savings would be those associated with risk management interventions. One estimate of the cost of intensive lifestyle interventions as risk management from the literature is $970 per year per participant.[22] If we assume that not all pre-diabetics will get intensive risk management, then the savings might be half this amount per participant, for a total estimated savings from primary prevention among non-diabetics of about $8 million. There would likely be additional savings associated with the decreased severity of disease among diabetics, but we did not find any estimates of this effect in the literature and so did not include those benefits in our calculations.

The combined estimated annual savings of $166 million applies to the whole state of California. Primary prevention interventions, however, are most often targeted at communities. In order to get an idea of the cost of such interventions, we take the example of a multifaceted intervention in a community with a population of about 78,000. A research project implemented a three-year project aimed at influencing physical activity and diet throughout the community with a particular focus on schools. Weight loss among children, the only group for whom measurements were taken, was significant. The combined research and intervention budget was approximately $1.5 million over three years.[23] The research component has ended but the intervention continues to date throughout

the community with grant funding. Assuming that no more than half of the project budget was attributable to the intervention, as opposed to research, the per capita cost of the intervention was about $3.20 per year. Applying this per capita cost to the 26.1 million community residents in California yields a cost of $83 million, which is half of our conservative estimate of expected savings from reduced diabetes incidence. Additional savings could be expected from reduction in other diseases associated with overweight and physical inactivity.

DISCUSSION

The case for investment in primary prevention is intuitively appealing. Reducing the incidence of disease and injury not only contributes to lower medical expenditures, but also to better quality of life and improved productivity at work and school. While the literature is replete with studies of the effects of the individual components of our prevention model, we did not find a study that put all of the pieces together. Our assessment of net benefits is based on what we believe are reasonable assumptions, but nonetheless they are assumptions not facts. Once other benefits are taken into account, there is little doubt that prevention has the potential to figure prominently in efforts to slow the rise in health care expenditures. Lowering the growth of health care costs while improving the productivity of workers and the quality of life of individuals can be a force for renewed economic growth.

The potential benefits are large. However, as noted above, the question of who pays for these interventions is not straightforward. The relative invisibility of disease or injury that does not occur combined with the time lags associated with return on investment complicates consideration of who should pay for prevention. It is highly likely that the disconnect between investment and returns to investment is a contributor to the mismatch between health expenditures and the factors affecting health often cited in the literature. This failure of the market to provide the correct incentives for investment in health argues for outside intervention in the market to better align incentives in the provision of health care with the needs of individuals and the State.

Endnotes

1 See, for example, Shiell A, and K McIntosh, 2006. Some Economics of Health Promotion: What We Know, Don't Know and Need to Know Before Spending to Promote Public Health, *Harvard Health Policy Review* 7(2):21-31.

2 Prevention can be targeted at chronic disease or other health problems, such as injuries. In this report, we refer to disease only for ease of exposition, while recognizing that not all targets of prevention are diseases.

3 Estimates for diagnosed and undiagnosed diabetes nationally are found in Centers for Disease Control and Prevention (CDC), National Center for Health Statistics, National Health and Nutrition Examination, 2006. *Health, United States, 2006*, table 55 (Diabetes among adults 20 years of age and over, by sex, age, and race and Hispanic origin: United States, 1988-1994 and 2001-2004.) We assume that the California population is 12.2% of the national population, based on 2005 US Census estimates. California's population is somewhat younger than the national population, which would suggest a lower prevalence of diabetes, but also has a somewhat larger share of Hispanics, which would suggest a higher prevalence. For the sake of simplicity, we have assumed that these two effects cancel each other and so the prevalence of diabetes in California should be similar to that of the nation as a whole.

4 CDC, op. cit.

5 Kriska, AM, et al. 2004. Lifestyle Intervention for the Prevention of Type 2 Diabetes: Translation and Future Recommendations. *Current Diabetes Report* 4:113-118.

6 Saelens BE, et al. 2003. Neighborhood-Based Differences in Physical Activity: An Environment Scale Evaluation. *American Journal of Public Health* 93:1552-8; Frank LD, Andresen MA, and TL Schmid, 2004. Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars. *American Journal of Preventive Medicine* 27:87-96; Frank LD, et al. 2005. Linking Objectively Measured Physical Activity with Objectively Measured Urban Form Findings from SMARTRAQ. *American Journal of*

Preventive Medicine 28:117-25; Frank LD, et al. 2007. Urban Form Relationships With Walk Trip Frequency and Distance Among Youth, *Health Promotion* 21:1-7.

7 Hu, FB, et al., 1999. Walking Compared With Vigorous Physical Activity and Risk of Type 2 Diabetes in Woman. *Journal of the American Medical Association* 282(15):1433-9.

8 "Dramatic Health Benefits After Just One Exercise Session," *Science Daily*, June 15, 2007.

9 Economos, CD, et al., 2007. A Community Intervention Reduces BMI z-score in Children: Shape Up Somerville First Year Results. Obesity 15:1325-36. See also Gortmaker, SL, et al. 1999a. Reducing Obesity via a School-Based Interdisciplinary Intervention Among Youth, Planet Health. *Archives of Pediatrics and Adolescent Medicine* 153:409-18; and Gortmaker et al., 1999b. Impact of a School-Based Interdisciplinary Intervention on Diet and Physical Activity Among Urban Primary School Children. *Archives of Pediatrics and Adolescent Medicine* 153:975-83.

10 See, for example, Wang, MC, et al., 2007. Socioeconomic and food-related physical characteristics of the neighborhood environment are associated with body mass index. *Journal of Epidemiology and Community Health* 61:491-8.

11 See Kriska, op. cit., Hu, op. cit.; Hamman, RF, et al. 2006. Effect of Weight Loss With Lifestyle Interventions on Risk of Diabetes. Diabetes Care 29:2102-7; Jeon, CY, et al., 2007. Physical Activity of Moderate Intensity and Risk of Type 2 Diabetes, A systematic review. *Diabetes Care* 30:744-52.

12 Diabetes Prevention Program Research Group, 2003a. Costs Associated With the Primary Prevention of Type 2 Diabetes Mellitus in the Diabetes Prevention Program. *Diabetes Care* 26(1):36-47.

13 Diabetes Prevention Program Research Group, 2003b. Within-Trial Cost-Effectiveness of Lifestyle Intervention or Metformin for the Primary Prevention of Type 2 Diabetes. *Diabetes Care* 26(9):2518-23.

14 Eastman, RC, et al., 1997. Model of Complications of NIDDM: II. Analysis of the health benefits and cost-effectiveness of treating NIDDM with the goal of normoglycemia. *Diabetes Care* 20(5):735-44.

15 Diabetes Prevention Program Research Group, 2003b.

16 Swinburne B, and G Egger, 2001. Prevention needs to reduce obesogenic environments. Letter to the *British Medical Journal* 323:997; Swinburne, BA et al., 2001. Long-term (5-year) effects of a reduced-fat diet intervention in individuals with glucose intolerance. *Diabetes Care* 24(4):619-24.

17 American Diabetes Association, 2003. Economic Costs of Diabetes in the U.S. in 2002. *Diabetes Care* 26(3):917-32.

18 Ibid.

19 Shiell, op. cit., Chenoweth, D. 2005. The Economic Costs of Physical Inactivity, Obesity, and Overweight in California Adults: Health Care, Workers' Compensation and Lost Productivity, Topline Report for the California Department of Health Services.

20 Assume that the rate of conversion from pre-diabetes to diabetes without primary prevention is 4% (range in the literature is 2.4 to 5.5. (See Kriska, op. cit.; and Milstein, B, et al., 2007. Charting Plausible Futures for Diabetes Prevalence in the United States: A Role for System Dynamics Simulation Modeling, Preventing Chronic Disease, Public Health Research, Practice, and Policy 4(3):1-8.) There are an estimated 6.6 million Californians with pre-diabetes. Reports in the literature of the annual reduction in diabetes among pre-diabetics from risk management range from a 5.1% to 14.5% (See Kriska, op. cit.; and Milstein op. cit.) If we assume, conservatively, that without primary prevention interventions that enhance the effects of risk management, the conversion rate would be at the high end of this range and that with primary prevention interventions the effect would be at the low end of this range, these calculations suggest that with risk management but no primary prevention, 250,800 would convert from pre-diabetes to diabetes, and with primary prevention and risk management, only 225,720 would convert. Thus, risk reduction interventions combine with risk management to reduce the number of new diabetics by about 25,080 over the number of cases that would be avoided with risk management alone.

21 Assume that the rate of conversion from pre-diabetes to diabetes without primary prevention is 4% (range in the literature is 2.4 to 5.5. See Kriska, op. cit.; and Milstein, B, et al., 2007. Charting Plausible Futures for Diabetes Prevalence in the United States: A Role for System Dynamics Simulation Modeling, Preventing Chronic Disease, Public Health Research, Practice, and Policy 4(3):1-8.) There are an estimated 6.6 million Californians with pre-diabetes. Reports in the literature of the annual reduction in diabetes among pre-diabetics from risk management range from a 5.1% to 14.5% (See Kriska, op. cit.; and Milstein op. cit.) If we assume, conservatively, that without primary prevention interventions that enhance the effects of risk management, the conversion rate would be at the high end of this range and that with primary prevention interventions the effect would be at the low end of this range, these calculations suggest that, without intervention, 177,000 would convert to pre-diabetes, and, with primary prevention, only 159,300 would convert. Thus, risk reduction interventions combine with risk management to reduce the number of new diabetics by about 11,880 over the number of cases that would be avoided with risk management alone.

22 Christina Economos and Elizabeth Nahar, Friedman School of Nutrition Science and Policy, Tufts University, personal communication with the author, August 2007.

23 Elizabeth Nahar, Friedman School of Nutrition Science and Policy, Tufts University, personal communication with the author, August 2007.

APPENDIX C: POTENTIAL COST SAVINGS MATRIX

Even modest (5%) changes in the rates of preventable disease and health determining behaviors could return considerable savings in California. The table below presents such savings for a sample of issues based on the most recent and readily available data. Please note that the totals presented here should be considered conservative; the costs reflect only medical care usage. Other costs, such as lost productivity, would likely multiply these totals. The cost data have all been trended forward to 2007 dollars using the Medical CPI calculator, while the incidence data is from various years. The data come from reliable sources, but other sources may yield different results. Nonetheless, any inaccuracy introduced in either of these ways is likely to be very small.

Conditions	Costs	Number of Incidents in CA Annually	Potential Savings from 5% Reduction in CA Incidence New calculations
TOBACCO	Excess medical care costs are estimated at $2,035 per smoker in CA.[1]	In 2005, the number of adult smokers in CA was 3.8 million.[2]	$386,650,000
DIABETES (Type II)	The average annual medical care cost difference for diabetics versus non-diabetics is $6,308 in the first year.	There are approximately 1.7 million diabetics in CA.[3] There are approximately 250,800 new diabetics in CA each year.[4]	$79,102,320
CHILDHOOD ASTHMA	The average cost of hospitalization for a child with asthma is $15,270.[5]	In 2000, there were 15,821 asthma hospitalizations in CA for children ages 0-14.[6]	$79,102,320
HIV	Early stage HIV infections cost $17,892 annually.[7]	There is an estimated average of 7,888 new HIV infections per year.[8]	$7,056,605
DUI	The average alcohol-related (vehicular) fatality in the US cost $30,828. The estimated cost per injured survivor was $59,064.[9]	In 2005, alcohol-related crashes in CA killed 1,574 and injured an estimated 30,810 people.[10]	$2,426,164 in fatalities $90,988,092 in injuries Total saving: $93,414,256
CHILD ABUSE	The average total medical care cost per incident of child abuse is $685.[11]	In 2001, 128,251 CA children were victims of abuse or neglect.[12]	$4,392,597
HEART DISEASE	The medical costs for an individual with heart disease in CA are on average $11,879 higher than those for all Californians.[13]	1.64 million Californians suffer from heart disease.[14]	$974,078,000
BREASTFEEDING	Infants who are breastfed for a minimum of six months experienced an average of $2,114 less in health care claims than formula-fed infants in the first year of life.[15]	Roughly 40.5% of CA mothers exclusively breastfeed their infants.[16] In 2004, there were 544,685 live births in CA.[17]	$15,827,863 (based on a 5% *increase* in breastfeeding)

APPENDIX C: POTENTIAL COST SAVINGS MATRIX

Conditions	Costs	Number of Incidents in CA Annually	Potential Savings from 5% Reduction in CA Incidence New calculations
FALLS	The mean hospitalization cost per fall is $19,780.[18]	In 1999, there were 61,475 hospitalizations from falls among seniors.[19]	$60,798,775
GUNSHOT WOUNDS (fatal and non-fatal)	The mean medical cost per injury is approximately $28,382.[20]	In 2004, 7,588 gunshot wound victims were admitted to hospitals in CA.[21,22]	$10,768,131
INTIMATE PARTNER VIOLENCE AGAINST WOMEN	The mean medical care cost per incident of IPV physical assault is $675.[23]	Over 257,000 women a year experience serious IPV in CA.[24]	$8,673,750

ENDNOTES

1 Max W, Rice DP, Sung HY, Zhang X, Miller L. The Economic Burden of Smoking in California. *Tobacco Control* 2004; 13: 264-267. Figure reflects $3,331 per smoker, 54% in direct medical costs= $1,799.

2 California Department of Health Services. Adult Smoking Prevalence. Available at www.dhs.ca.gov/tobacco/documents/pubs/AdultSmoking06.pdf.

3 Lund, L. Prevalence of Diabetes in California Counties: 2003 Update. California Department of Health Services, Center for Health Statistics. Available at: www.dhs.ca.gov/chs/OHIR/reports/countyhealthfacts/diabetes2003.pdf.

4 See Appendix B of this document.

5 Office of Statewide Health Planning Data, Discharge Data for Asthma, Children Aged 0-18 Years. 2003.

6 *California Asthma Facts*. California Department of Health Services, Vol. 1, Iss. 1, May 2003.

7 Chen RY, Accortt NA, Westfall AO, et al. Distribution of Health Care Expenditures for HIV-Infected Patients. *Clinical Infectious Diseases*. 2006;42:1003–1010

8 HIV/AIDS Statistics. San Francisco AIDS Foundation. Available at: www.sfaf.org/aidsinfo/statistics/#3.

9 Blincoe L, Seay A, Zaloshnja E, Miller T, Romano E, Luchter S, et al. The Economic Impact of Motor Vehicle Crashes, 2000. Washington (DC): Dept of Transportation (US), National Highway Traffic Safety Administration (NHTSA); 2002. Figures were arrived at by combining medical and emergency costs based on table 12. Non-fatal costs are a weighted average based on the number of each category of injury.

10 California Office of Traffic Safety. Drunk Driving Fact Sheet. Available at: www.ots.ca.gov/campaign/2006/duicrackdown/pub_facts.asp.

11 US Department of Justice, National Crime Victim's Rights Week—Resource Guide. Available at www.ojp.usdoj.gov/ovc/ncvrw/1997/cost.htm.

12 Fight Crime: Invest in Kids. Available at: www.fightcrime.org/reports/CANstate2pager/CANca.pdf.

APPENDIX C: POTENTIAL COST SAVINGS MATRIX

13 Anderson G, Analysis of Medical Expenditure Panel Survey (MEPS) data for selected chronic conditions, 2002, cited in CHCF, Chronic Disease in California, Facts and Figures, 2006. Available at www.chcf.org/documents/chronicdisease/ChronicDiseaseFactsFigures06.pdf.

14 California Health Interview Survey (CHIS), UCLA, 2005. Accessed at www.chis.ucla.edu/.

15 Costs of NOT breastfeeding: Kaiser Permanente Study. Kaiser Permanente, 1997. Available at: www.visi.com/~artmama/kaiser.htm.

16 The California WIC Association and the UC Davis Human Lactation Center. Reducing Obesity from the Start: California Hospitals Must Increase Exclusive Breastfeeding Rates. A Policy Brief on California Breastfeeding and Hospital Performance. Available at: www.calwic.org/docs/pk!/bfrates_brief.pdf.

17 CDC, National Center for Health Statistics. Available at: www.cdc.gov/nchs/fastats/popup_ca.htm.

18 Roudsari, B.S., Ebel, B.E., Corso, P.S., Molinari, N.A., and Koepsell, T.D. The acute medical care costs of fall-related injuries among the U.S. older adults. *Injury*, Vol. 36, No. 11, pp. 1316-22, Nov 2005.

19 CDC. Public Health and Aging: Nonfatal Fall-Related Traumatic Brain Injury Among Older Adults – California 1996-1999. *MMWR*. 2003; 52(13); 276-278.

20 Cook, P.J., Lawrence, B.A., Judwig, J., and Miller, T.R. The Medical Costs of Gunshot Injuries in the Unites States. *JAMA*, 1999; Vol. 281, No. 8, pp. 447-454.

21 2004 Fatal Hospitalized Firearm Injuries, California Residents. California Department of Public Health, Vital Statistics Death Statistical Master File Available at: www.applications.dhs.ca.gov/epicdata/scripts/broker.exe?_SERVICE=Pool2&_PROGRAM=programs.st_firearm.sas&REGION0=XXX&ANALYSIS1=G&REGION=California&OUTPUT=HTML.

22 2004 Non-fatal Hospitalized Firearm Injuries, California Residents. California Department of Public Health, Vital Statistics Death Statistical Master File Available at: www.applications.dhs.ca.gov/epicdata/scripts/broker.exe?_SERVICE=Pool2&_PROGRAM=programs.st_firearm.sas&REGION0=XXX&ANALYSIS1=H&REGION=California&OUTPUT=HTML.

23 National Center for Injury Prevention and Control. *Costs of IntimatePartner Violence Against Women in the United States*. Atlanta (GA): Centers for Disease Control and Prevention; 2003. Available at: www.cdc.gov/ncipc/pub-res/ipv_cost/IPVBook-Final-Feb18.pdf.

24 Lund L, *Incidence of Non-Fatal Intimate Partner Violence Against Women in California, 1998-1999*. California Department of Health Services, Epidemiology and Prevention for Injury Control (EPIC) Branch. May 2002; 4. Using only "serious IPV" leads to a very conservative estimate, but the impact of less serious IPV is difficult to assess.