# Local Interventions for Reducing Cardiovascular Disease Risks: What Can They Achieve?

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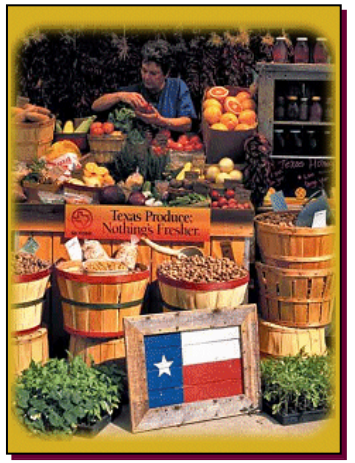
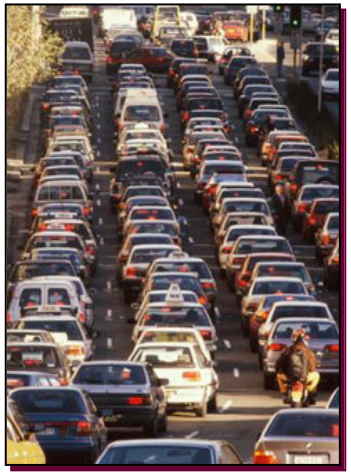
# Abstract

Public documents identify broad strategies for reducing the burden of cardiovascular disease (CVD) in the U.S., but they do not specify **how best to allocate limited resources**. Such specific guidance is lacking in part because of gaps in data on intervention costs and effect sizes, but also because the many factors contributing to cardiovascular risk interact through pathways and stock-flow structures that defy simple calculation. The **U.S. Centers for Disease Control and Prevention**, with support from the National Institutes of Health, is using SD modeling to better understand these complexities and to evaluate potential intervention strategies in terms of their impacts on adverse events and costs over the coming decades. The project considers **interventions that might be undertaken at a city or county level**, including interventions to improve health care, physical activity, nutrition, mental health, tobacco control, and indoor and outdoor air quality. Construction of the model has involved working with subject matter experts as well as collaborating with the **Austin/Travis County, Texas, health department**, which has gathered a broad spectrum of local data on population health and interventions over the past several years. This collaborative effort is helping to translate the science of cardiovascular disease into a form that is policy relevant and that can help many communities do a better job of allocating their public health resources.

# Questions

- How do **local conditions** affect multiple risk factors for cardiovascular disease (CVD), and, in turn, population health and costs?
- How would different **local interventions** affect risk, health, and costs over time?
- How might local health leaders **better balance their policy efforts** given limited resources?



Homer J, Milstein B, Wile K, Pratibhu P, Farris R, Orenstein D. Modeling the local dynamics of cardiovascular health: risk factors, context, and capacity. *Preventing Chronic Disease* 2008;5(2). Available at http://www.cdc.gov/pcd/issues/2008/apr/07_0230.htm

# Data/Information Sources

- **Census**
  - Population, deaths, births, net immigration, health coverage
- **AHA & NIH statistical reports**
  - Cardiovascular events, deaths, and prevalence (CHD, stroke, CHF, PAD)
- **National Health and Nutrition Examination Survey (NHANES)**
  - Risk factor prevalences by age (18-29, 30-64, 65+) and sex (M, F)
  - Chronic disorder diagnosis and control (hypertension, high cholesterol, diabetes)
- **Behavioral Risk Factor Surveillance System (BRFSS)**
  - Diet & physical activity
  - Primary care utilization
  - Lack of needed emotional/social support (proxy for chronic stress)
- **Medical Examination Panel (MEPS) / National Health Interview (NHIS)**
  - Medical and productivity costs attributable to smoking, obesity, and chronic disorders
- **Research literature**
  - Framingham-based CVD risk calculator, and relative risks from secondhand smoke, air pollution, obesity, and inactivity
  - Medical and productivity costs of cardiovascular events
- **Questionnaires for CDC and Austin teams (expert judgment)**
  - Potential effects of social & services marketing on utilization behavior
  - Effects of behavioral services on smoking, weight loss, stress reduction
  - Relative risks of stress for high BP, high cholesterol, smoking, and obesity

# Simulation Set-Up

## Fit to history

- Reproduced 1990-2004 trends in risk factor prevalence among non-CVD population by gender and age group–-by adjusting uncertain inflow rates: Onset of high blood pressure, high cholesterol, diabetes, smoking, obesity
- Reproduced 2003 data on CVD events and deaths in formerly non-CVD population by gender and age group –-by adjusting uncertain coefficients for translating individual-level 4-year risk to population-level 1-year risk

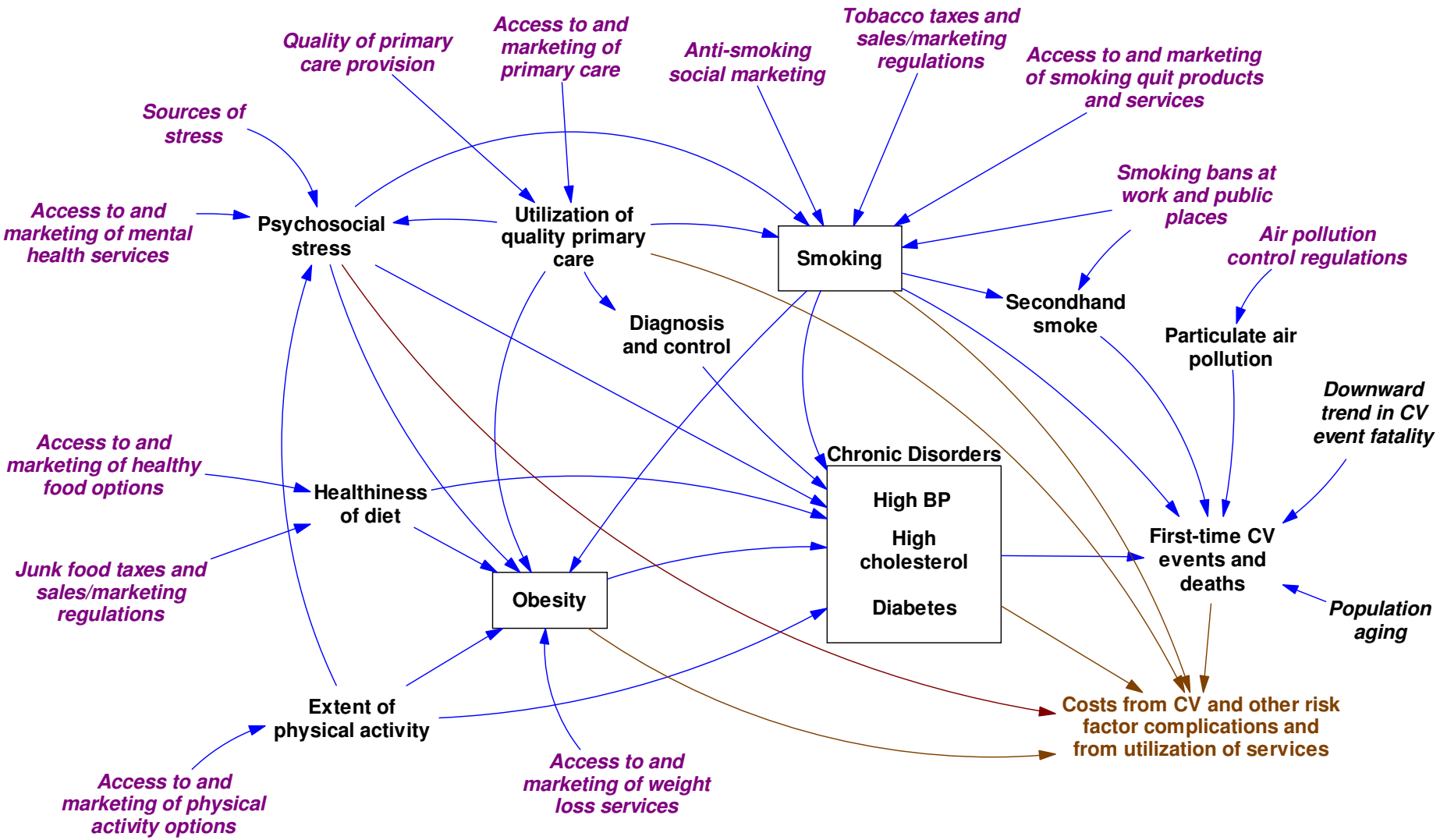
## Base case

- Assumed no changes after 2004 in risk drivers (e.g., access to services, stress, air quality) nor any further decline in CVD case fatality
- Any changes in risk prevalence after 2004 are due to “bathtub” adjustments and population aging–-results in continuation of past trends but gradual deceleration and leveling off
- No price inflation–-cost increases due to volume only

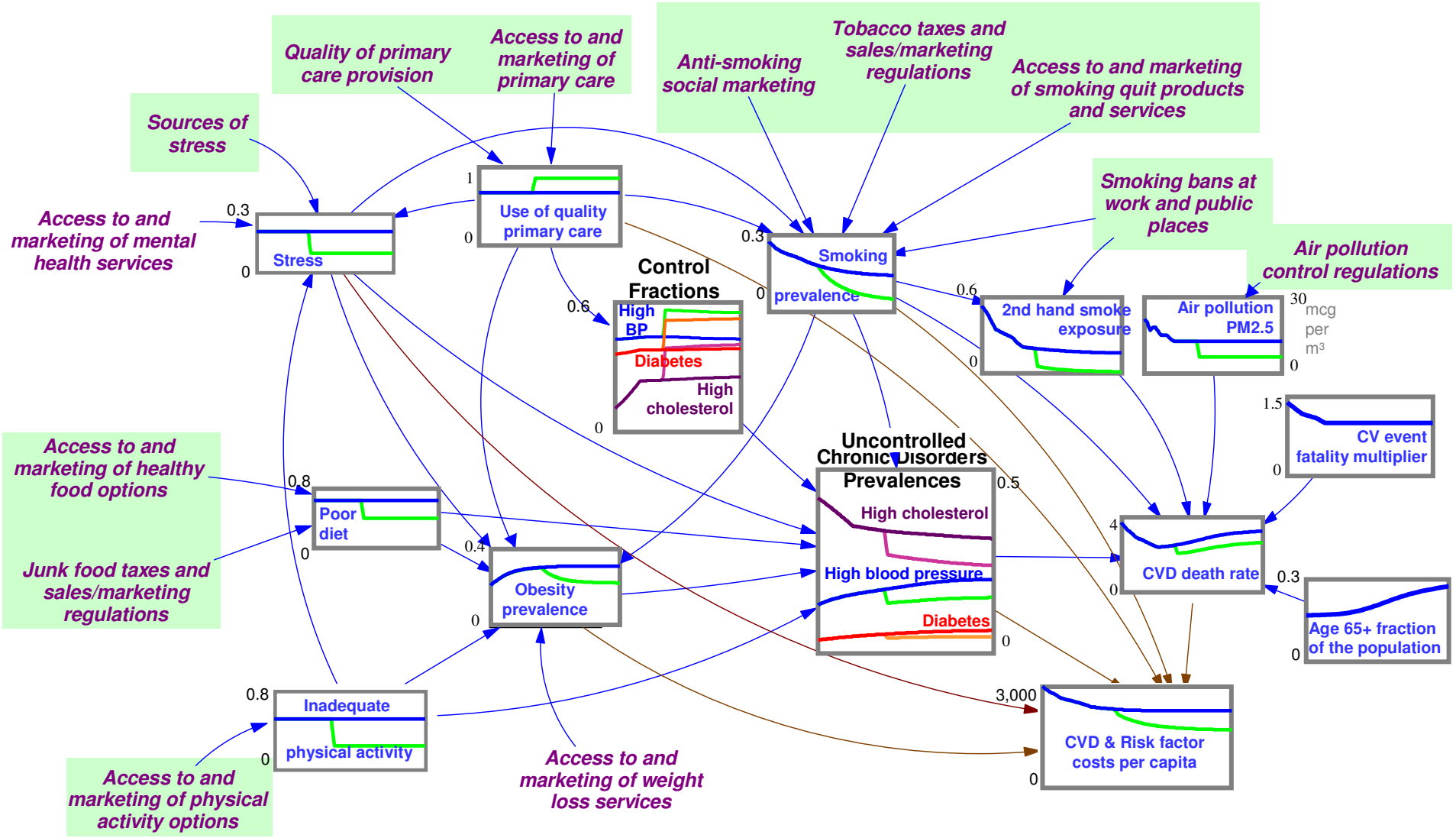
## Intervention scenarios

- Tested 19 plausible interventions in 5 clusters—Nutrition/Activity/Stress, Primary care, Mental health care, Weight loss services, Smoking/Air quality
- Examined impact on total service and outcome costs—as a result, rejected the 4 Mental health care and Weight loss service interventions as costing more than they save with respect to cardiovascular risk

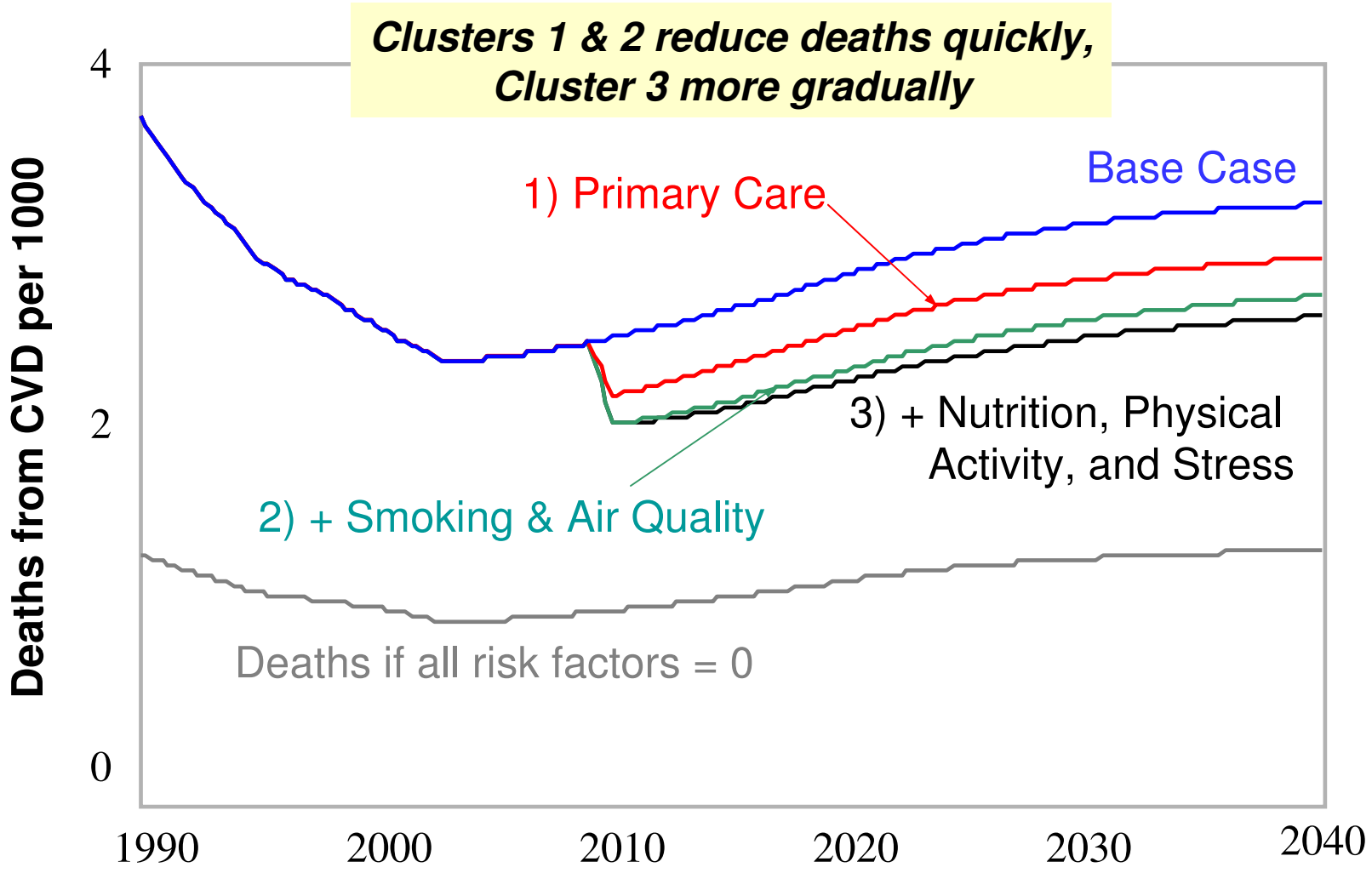
# Overview of Model Structure



# Base Case & Multi-Pronged Intervention Trajectories 1990-2040



# Combined Contributions of Three Intervention Clusters to Deaths from First-Time CVD Events



# Adding Up the Costs

## Cardiovascular event costs

- Medical costs (ER, inpatient, rehab)—for non-fatal & fatal events
- Productivity (morbidity) losses from non-fatal events
- Productivity (premature mortality) losses from fatal events

## Non-cardiovascular complications of risk factors

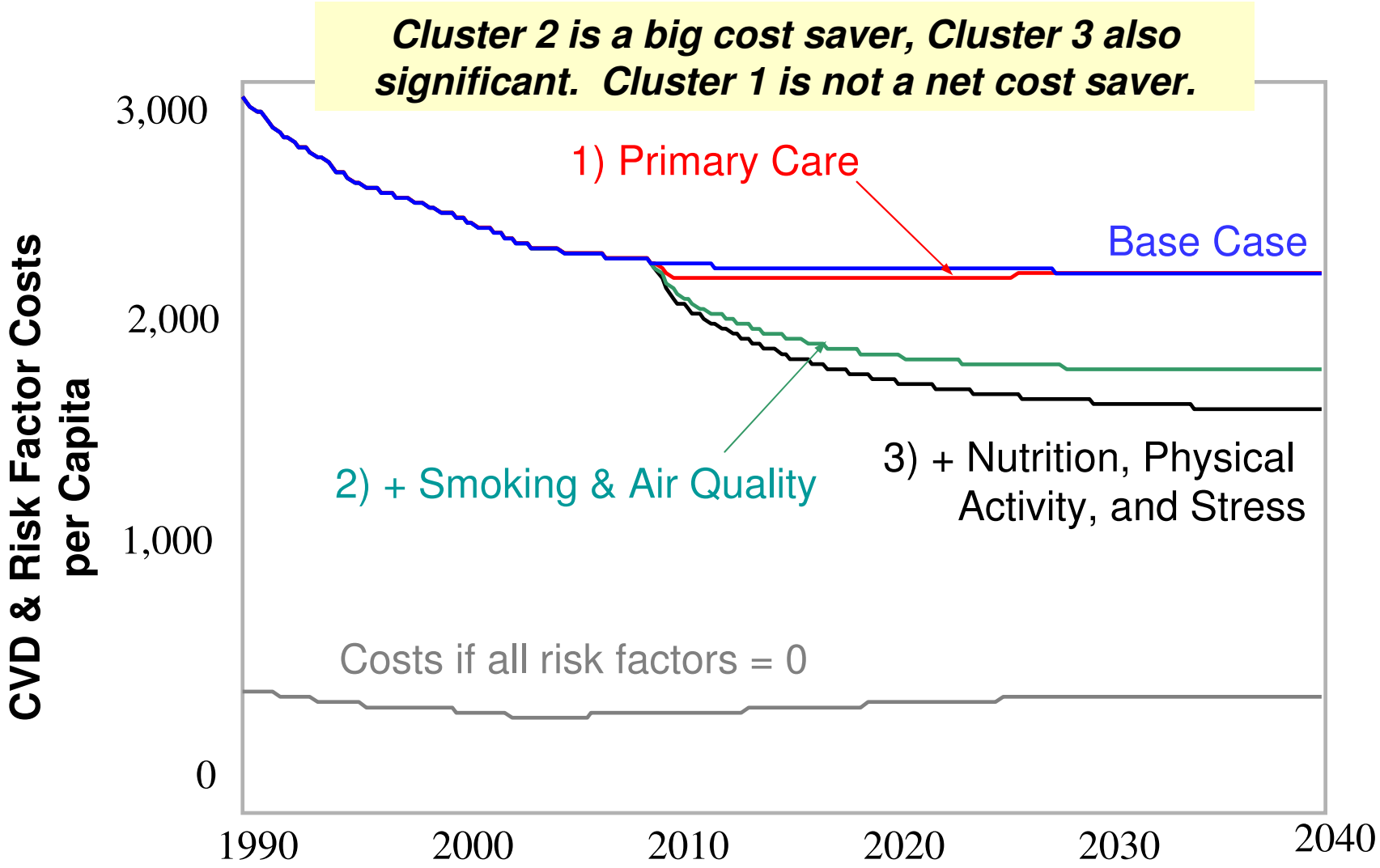
- Hospital costs due to non-CV complications of diabetes (e.g., kidneys, eyes, feet), high BP, & smoking
- Productivity (morbidity) losses from non-fatal complications of diabetes, high BP, smoking, & obesity
- Productivity (premature mortality) losses from fatal complications of smoking (e.g., cancer, COPD), diabetes, high BP, & obesity

## Costs of managing risk factors

- Medications & visits for diabetes, high BP, high cholesterol—by level of care (high quality = 2 – 2.5x cost of mediocre care)
- Other services: Mental health services, Weight loss services, Smoking quit services & products

**Total cost savings may be viewed as *maximum economically justifiable spending* for implementing an intervention**

# Combined Contributions of Three Intervention Clusters to Total Costs



# Conclusions

## Policy findings

- 15 of 19 intervention types considered have potential to reduce CVD deaths without increasing total costs
- Smoking & air quality interventions save lives quickly and can justify hundreds of dollars per capita in ongoing intervention spending
- Nutrition/activity/stress interventions save lives over a longer period of time but can also justify significant intervention spending

## Caveats

- Some potentially significant parameter uncertainties remain
- We have not yet quantified the costs of poor diet, inactivity, and stress apart from CVD risk factors (e.g., certain cancers and musculoskeletal disorders)

## Follow-on work

- Funding in place for next 2 years to continue work with Austin and to apply model to Mississippi Delta region with high CVD burden and disparities
- Model will be extended to consider impacts on (a) post-CVD population, and (b) people with borderline conditions (pre-hypertension, borderline high cholesterol, pre-diabetes)
- We also plan to study interventions in detail to get a better idea of which can be implemented at a cost below their maximum justified amount