

System Dynamics Overview

Application to Oral Health Issues

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Overview

- *System Dynamics Modeling*
- *Use in Chronic Disease Prevention and Control*
- *Application to Oral Health Issues*

System Dynamics

System Dynamics is a method of systems modeling

- *Development of causal diagrams and policy-oriented computer simulation models*
- *Suited for situations involving dynamic complexity*
- *Customized for each problem setting*

System Dynamics

- *Uncovers effects of factors and their interrelationships in systems that drive or resist change*
- *Uses computer simulation to estimate the effects of individual changes or combinations made at different points or times in the system*
- *Not a predictive tool*

Background

- *Computer pioneer Jay Forrester developed - 1st book published in 1961*
- *Applied across business, public policy, and behavioral science realms*

Dynamic Complexity

Complex processes where factors are in a state of interaction and flux.

Factors can bring about changes in a system, but also influence other factors, resulting in changes to system outcomes - with both intended and unintended consequences.

Example:

What is the path of disease prevalence if no change occurs, OR if "X" happens, but "Y" does not?

Testing Alternatives

SD Modeling can simulate the difference in effect between the baseline (no action) and policy alternatives (and the effect of various combinations)

Systematic way to answer “What if” and “Why”

Capacity Planning

- *Estimate required program capacity to implement policy alternations/interventions*
- *Determine what is feasible given available resources*

Methods Framework

Stakeholders join in a facilitated process to discuss:

- *What “drives” the health problem*
- *What inter-relationships are involved*
- *What complexities exist*

Methods Framework

Address key strategic questions through creation of a diagram that:

- “maps” problem “drivers” and their inter-relationships*
- adds “time sequence” components and other factors*

Methods Framework

Specialized System Dynamics software developed to calculate changes to the system resulting from changes in various factors or combinations of factors.

Model results are interpreted to understand and compare the effects of actions over time

Model Boundaries

Mapping requires decisions about factors that will be included in the model

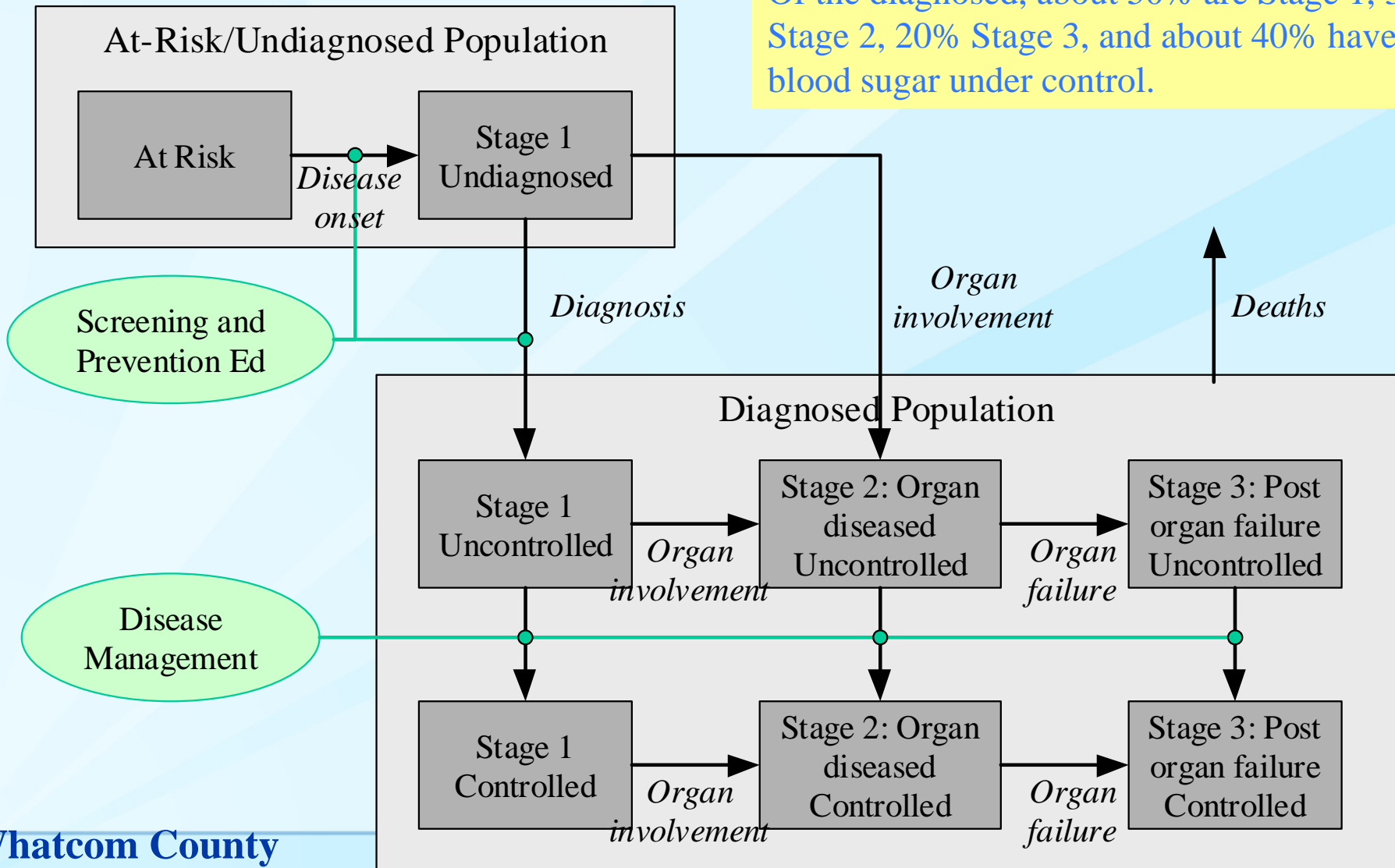
- Does evidence support the relationship?*
- Will it be useful to inform decisionmaking and action?*
- Is a factor affected by and does it affect other factors in the system? If not, it is considered exogenous (i.,e, external) to the system*

Health Care Applications of System Dynamics

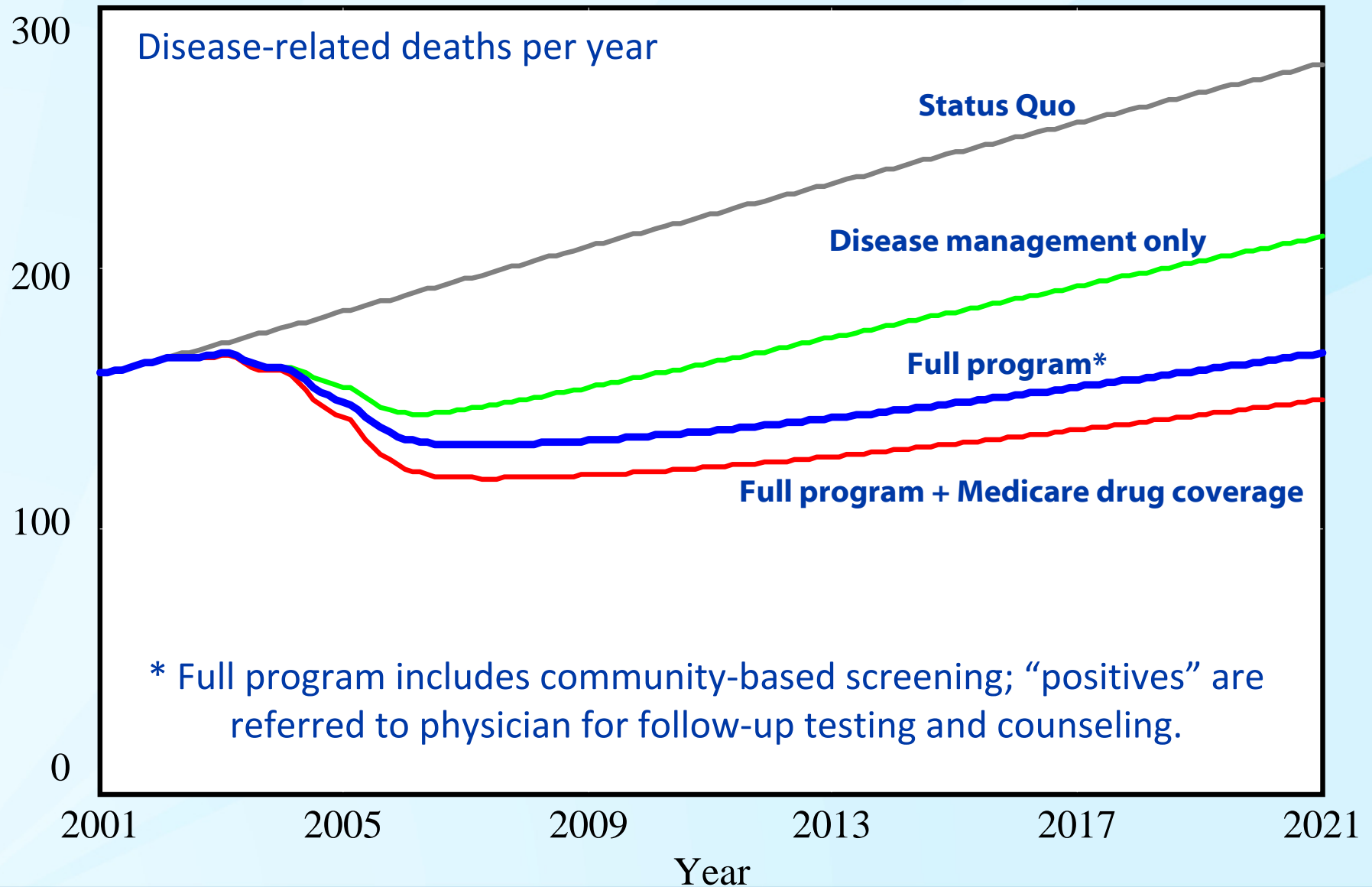
- Community Mental Health
- Drug Abuse and Tobacco Policy
- Oral Health and Dental Manpower Planning
- Emergency Preparedness and Response to Infectious Disease Pandemics
- Health Systems Planning, HMO Planning, and Health Care Microworld
- Chronic Disease Program Planning and Management
 - Diabetes
 - Cardiovascular Disease
 - Obesity
- Health Reform, Health Policy Modeling

Type 2 Diabetes Progression & Care

6-7% of the adult population is diabetic, including 17% of the elderly.
 35-40% of diabetics are undiagnosed Stage 1.
 Of the diagnosed, about 50% are Stage 1, 30% Stage 2, 20% Stage 3, and about 40% have their blood sugar under control.



Deaths from Diabetes 2001-21: Four Scenarios (Whatcom County)



Impacts of CVD Interventions in El Paso County

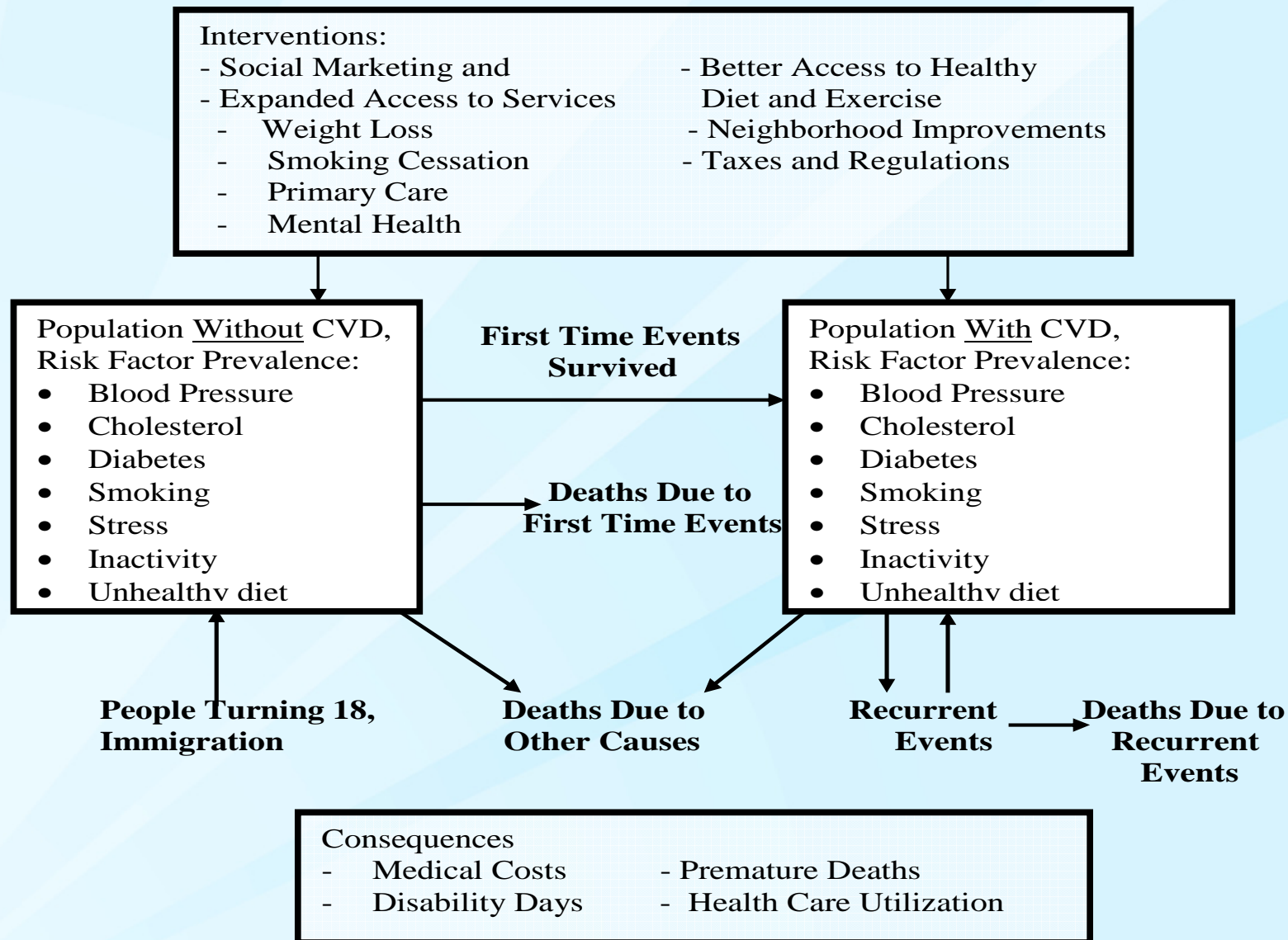
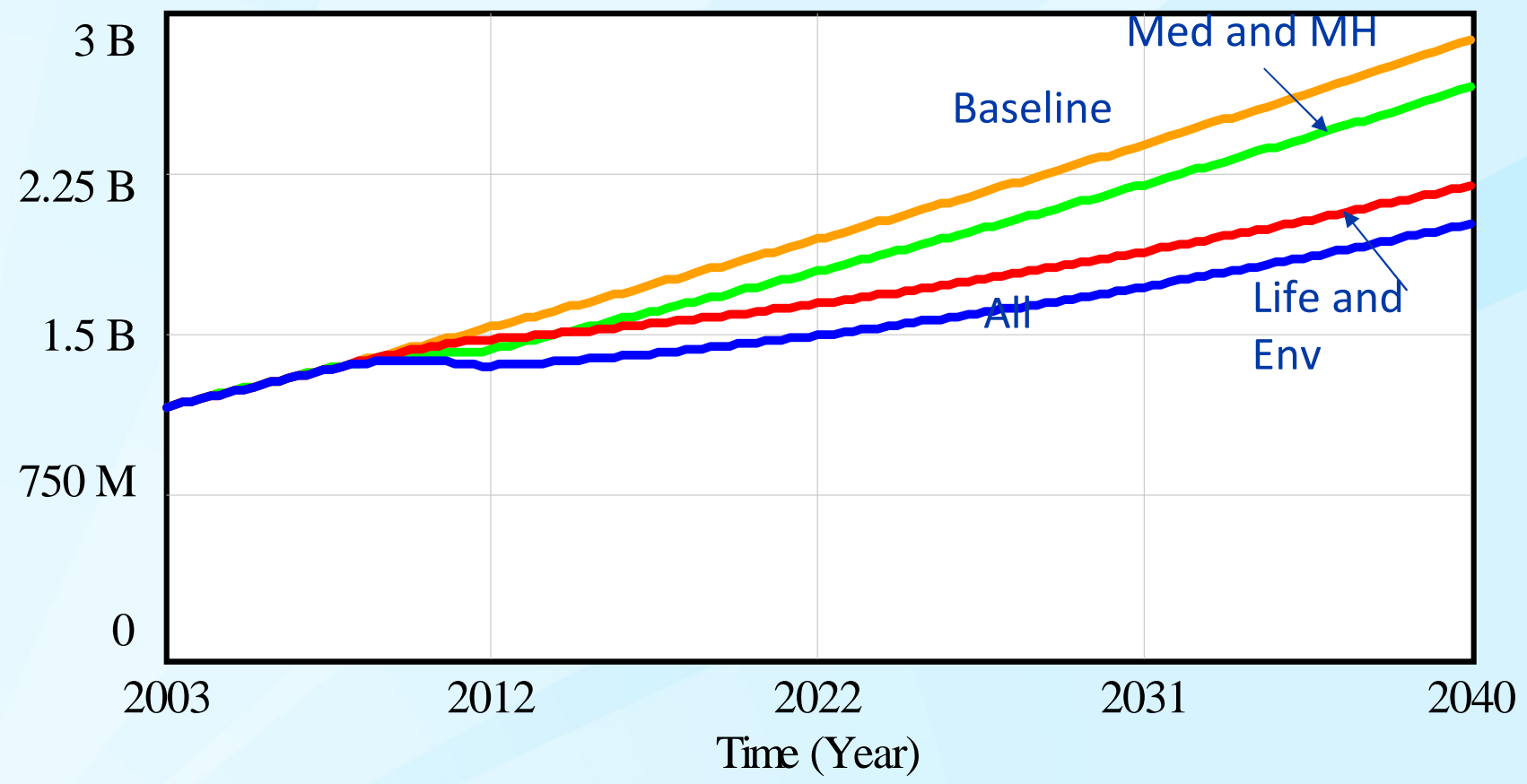


Figure 1: Overview of the Cardiovascular Disease Model

Impacts of Interventions in El Paso County— Total Costs including Risk Factor Management

Total costs Including RF Mgt



- Complic and maint and RF mgmt costs : all programs —————
- Complic and maint and RF mgmt costs : all lifestyle and env —————
- Complic and maint and RF mgmt costs : all med and MH —————
- Complic and maint and RF mgmt costs : baseline —————

Simulation Model - Colorado

- ❑ *Model to simulate interventions for early childhood caries, their effect on caries, and their associated costs*
- ❑ *Considered factors of expanded water fluoridation, fluoride varnish, xylitol for mothers and for children, motivational interviewing, and secondary prevention.*
- ❑ *Findings supportive of water fluoridation, targeting younger children, targeting high-risk children, and combining interventions.*

Thank You

For more information please contact Centers for Disease Control and Prevention

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

National Center for Chronic Disease Prevention and Health Promotion

