

Using Modeling to Improve Outcomes: Archimedes example

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 ARCHIMEDES
Quantifying Healthcare

Overview

- Healthcare modeling company
- Based in San Francisco
- Core technology - Archimedes Model
 - Mathematical model of human physiology, diseases, interventions, and healthcare systems
 - Highly detailed
 - Carefully validated
 - In development since 1993
 - Founders
 - David Eddy MD, PhD
 - Len Schlessinger PhD
- Owned by Kaiser Permanente
 - Spun out as independent organization 2006



Archimedes Clients and Collaborators

(Not all can be shown)



Using the Model to Examine Heart Disease Population Interventions

Targeting a Specific Population with a Drug Combination to Improve Health Outcomes and Reduce Costs (A-L-L)



Structure of Simulation

WHO

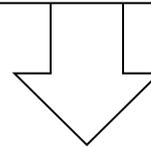
Patients with CAD and all diabetics over 55 years in KP California

WHAT

- Experimental Group: Aspirin, Lisinopril, Lovastatin
- Reference Group: 1% HbA1c reduction
- Control Group: Current care

WHEN

25-year simulation
(followed by 2-year real trial)



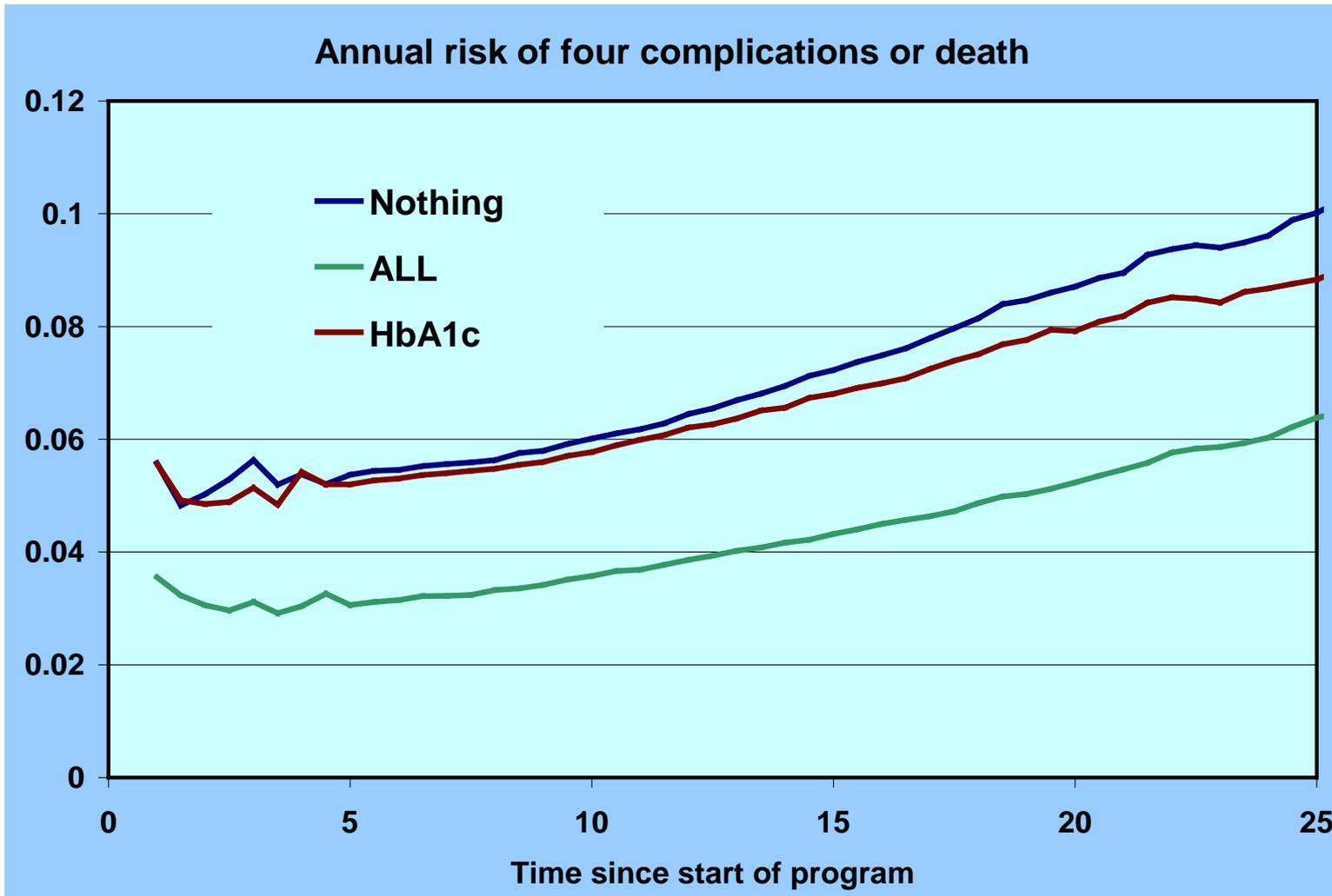
OUTCOMES

- Annual risk of: MI, stroke, ESRD, blindness, death
- Annual cost

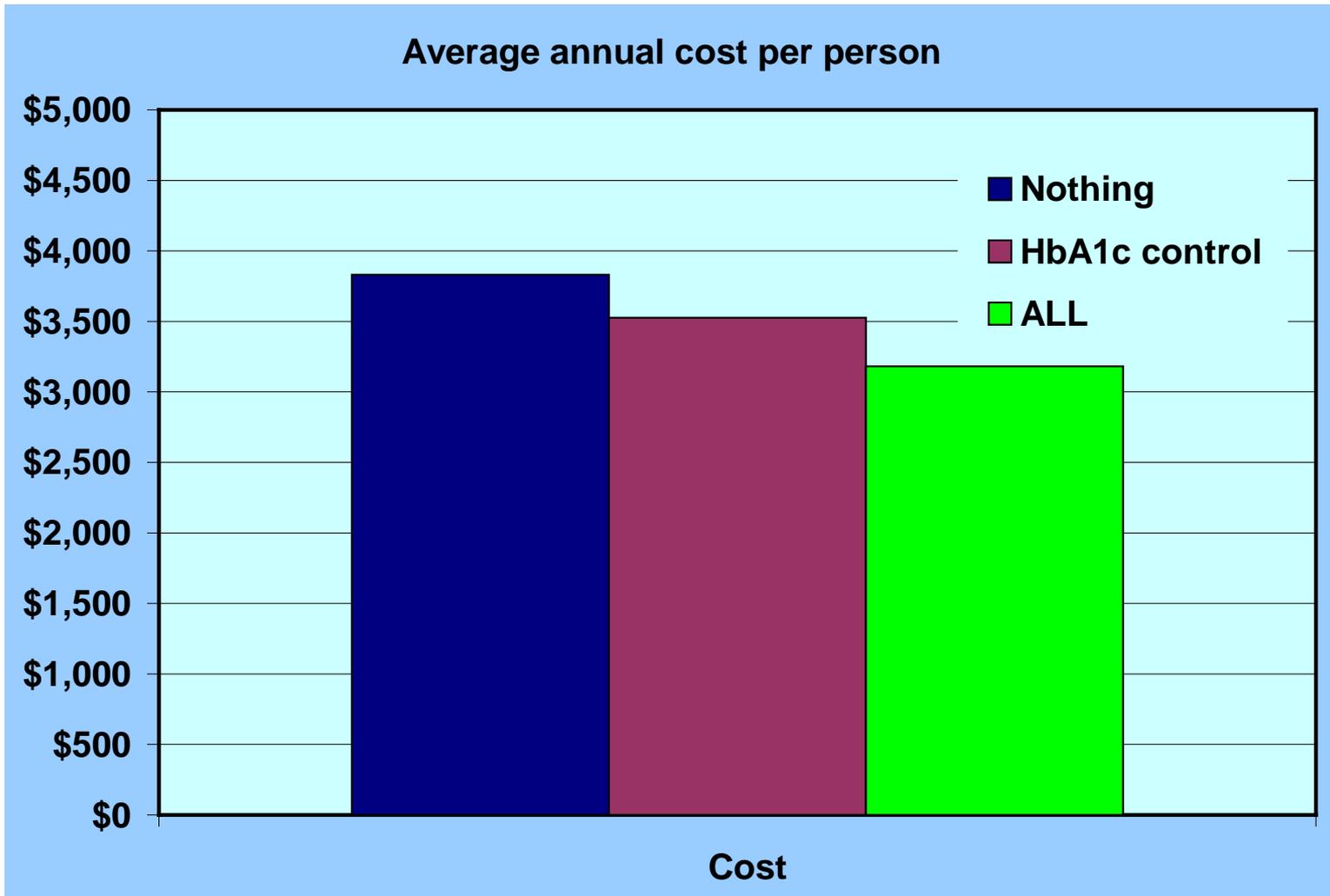
Setup

- For Patients with CAD and/or DM (for diabetics over 55 years of age)
 - Aspirin
 - Lovastatin
 - Lisinopril
- Keep it simple
 - As few visits and tests as possible
 - Don't strain to reach a goal
 - Just make sure they get it

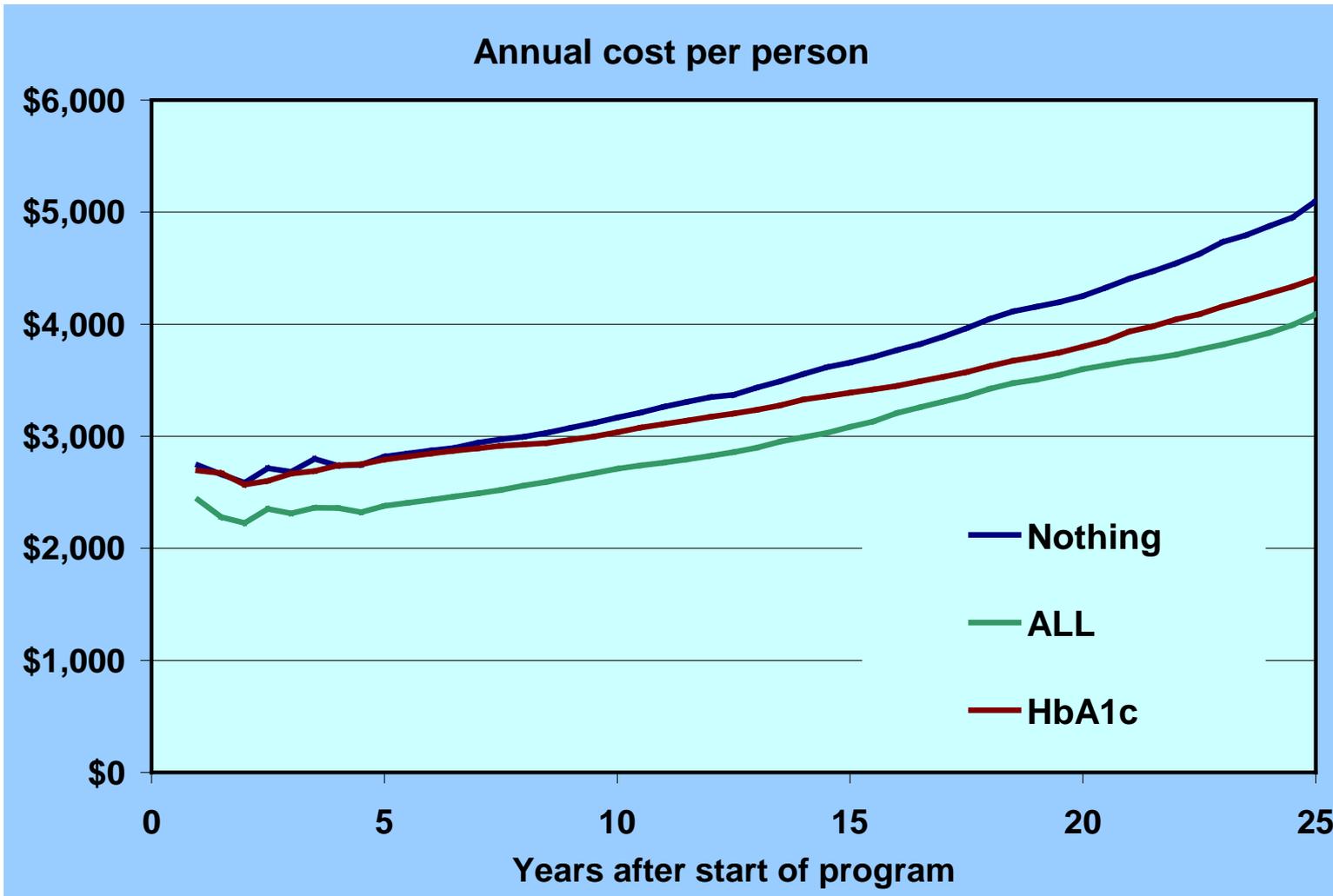
The Effect Begins Immediately



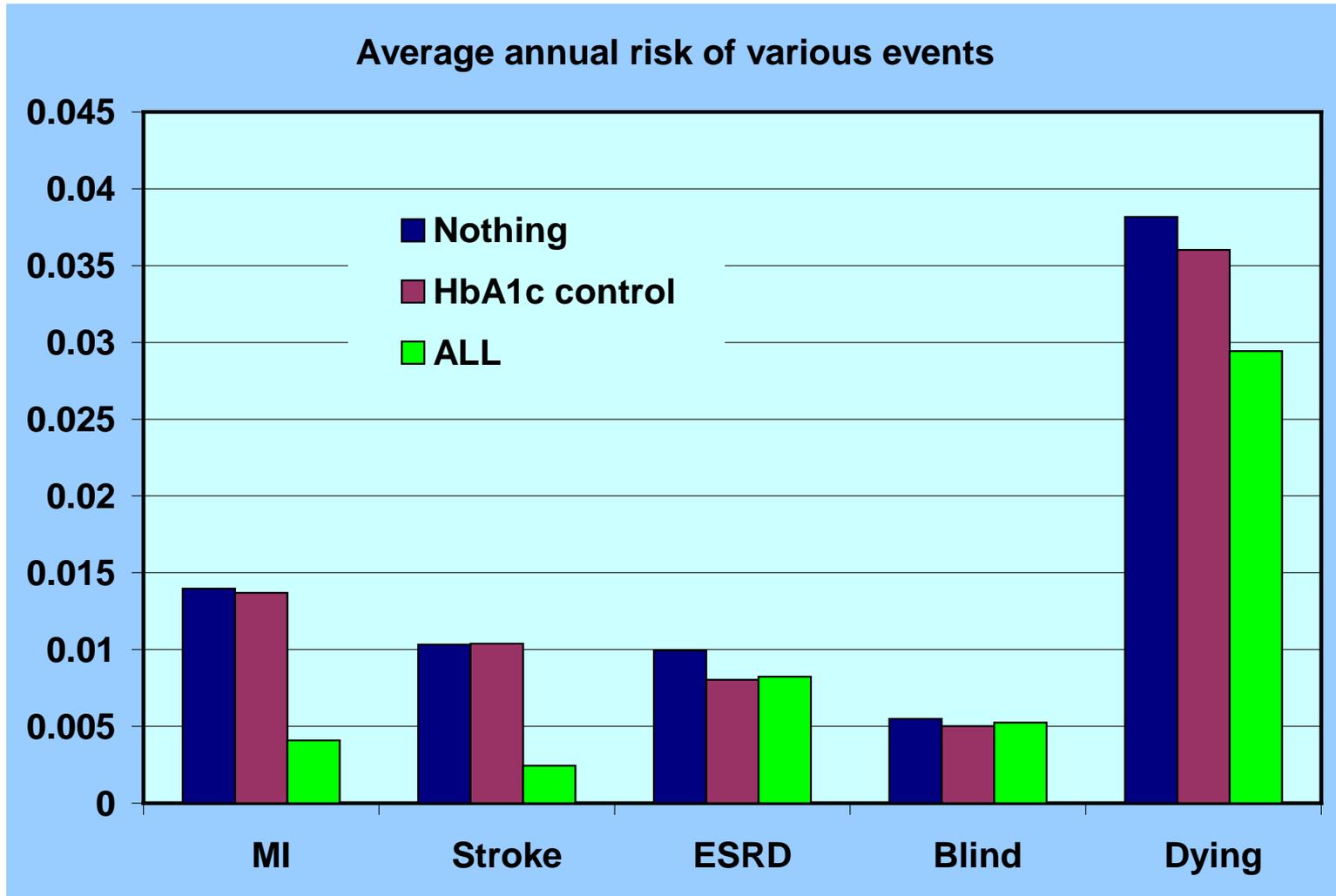
It Saves More Money



The Savings Begin Immediately



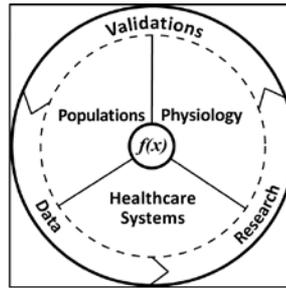
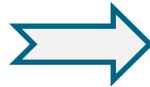
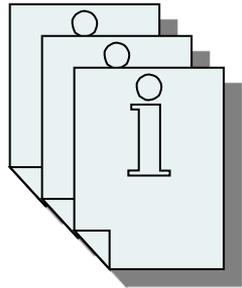
A-L-L has a Bigger Effect than 1% HbA1c Reduction



Independent Evaluation (2007)

- In 2004-2005, 28% of KP's eligible study population in Northern + Southern CA (n=170,024) had received A-L-L at low exposure, 13% at high exposure (59% no exposure)
- Modeled results consistent with actual findings by KP's Care Management Institute:
 - By 2006, heart attacks and strokes decreased by 15 per 1000 members for the low-exposure group ($p < 0.05$), and 26 per 1000 for the high-exposure group ($p < 0.05$)
 - 1,271 hospitalizations prevented in 2006
 - Net savings of \$38M/year among the study population
- Estimated net savings of \$120M per year if fully implemented among all of Kaiser's eligible patients
- If extended to 10% of U.S. diabetics, potential savings of \$1B/yr

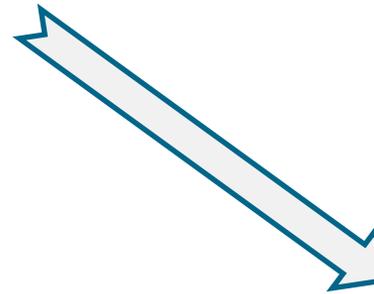
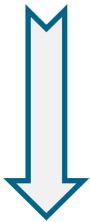
Archimedes Technology Concept



EMR and HRA Data

Public Databases,
Clinical Trials,
Observational Studies,
Epidemiological Data

Archimedes Model




Consulting Services


Archimedes Healthcare Simulator
INNOVATOR

 **IndiGO™**
Individualized Guidelines and Outcomes


Quantifying Healthcare

CMI Publication of Findings, 2009

- National publicity of Archimedes' modeling for Kaiser's A-L-L intervention
 - Dudl JR, Wang MC, Wong, M, Bellows, J. Preventing Myocardial Infarction and Stroke with a Simplified Bundle of Cardioprotective Medications. **The American Journal of Managed Care**, 2009 Oct 1;15(10):e88-94.

BusinessWeek

HEALTH CARE REFORM

October 1, 2009

A Kaiser Permanente study shows patients can ward off heart attacks and slash medical expenses with a simple generic drug regimen.

Archimedes Tools

- ARCHeS
 - Software as a Service application that enables simulation and analysis of interventions and programs for populations and subpopulations
 - Designed for healthcare administrators and policy makers
 - Case example: ALL project
- IndiGO
 - Point of care tool that suggests individualized treatment guidelines (combo of medications and behavioral changes) based on specific individual information and has been shown to improve compliance with physician recommendations
 - Covers cardiovascular disease, diabetes and its complications, and screening for breast and colon cancer
 - Has application for population management as well
 - Case example: Pilot in KP Hawaii

ARChES Innovator

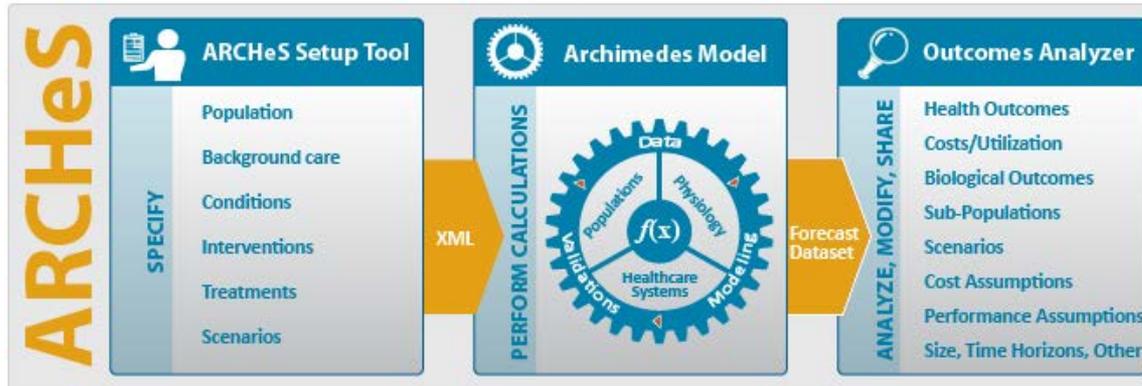
- Funded by Robert Wood Johnson Foundation
- Access to significant portion of Archimedes Model via Software as a Service (SaaS)
- Includes online interface to define simulation criteria and analyze outcomes
- Currently covers conditions, treatments, and outcomes related to cardio-metabolic risk (additional diseases added with each release)



www.archimedesmodel.com/arches-innovator



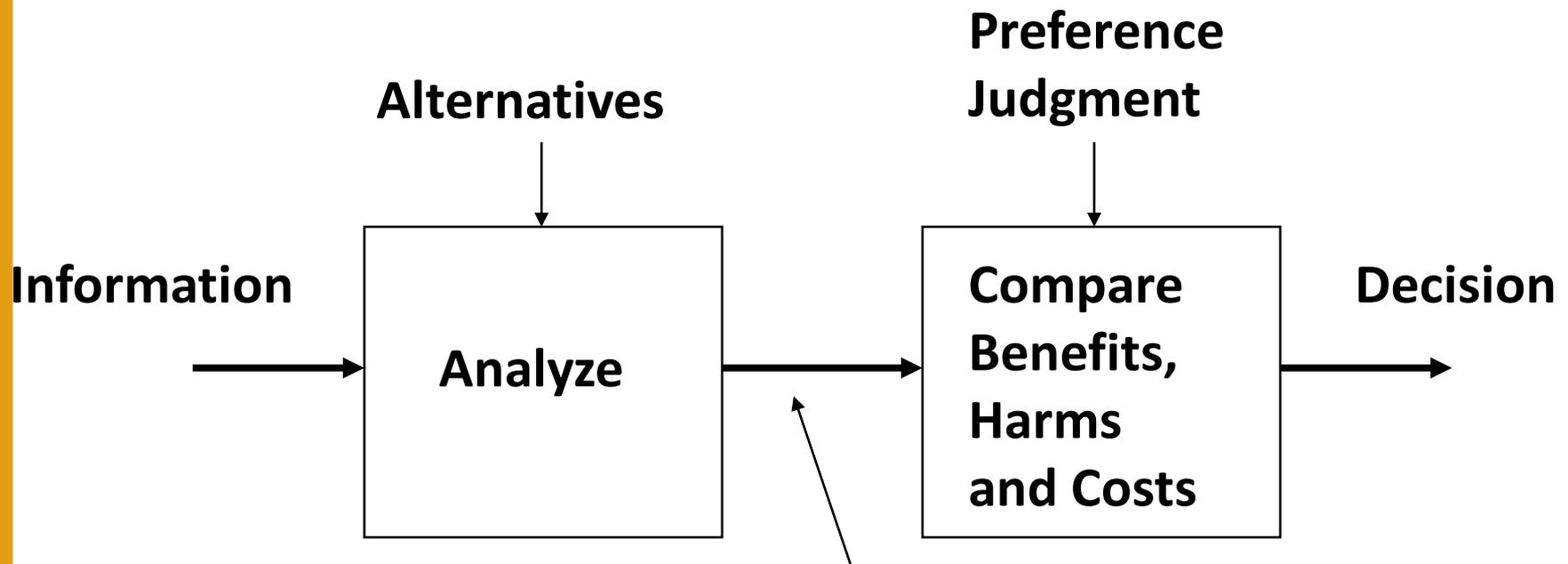
ARChES Innovator Architecture



- ARChES Setup Tool
 - User defines study for simulation on Archimedes Model
 - Population of interest
 - Background care
 - Standard or custom interventions
- Archimedes Model
 - Simulates study on Archimedes' grid computing facility
 - Generates health and economic outcomes over a twenty-year virtual time period
- Outcomes Analyzer
 - User can visualize and analyze resulting forecast dataset
 - User can modify assumptions such as compliance, disutility weights, costs, subpopulations, etc.

Formulating a Problem for Analysis

- Identify the decision(s) to be made
- Every decision has two steps



Outcomes of Each Alternative

Think of a trial or intervention to test: ARCHeS Setup Tool Does This

- Setting
 - Population: **US population**
 - Care processes: **levels of care currently seen in US**
 - Costs: **Medicare costs**
- Community population: **user defines**
- Care in the control group: **user specifies current care or no care**
- Interventions and their target populations: **user defines**
- Arms of the trial: **user defines interventions and adherence**
- Outcomes of interest: **> 30 outcomes pre-specified**

IndiGO

Point of care tool that suggests individualized treatment guidelines (combo of medications and behavioral changes) based on specific individual information

Improving the content of care

- Current guidelines have inherent limitations because they were designed for use without computers:
 - Focus on one variable at a time (e.g., BP)
 - Ignore other risk factors
 - Use sharp thresholds (e.g., SBP > 140)
 - Ignore the continuous nature of risk factor
 - Example: National guideline for hypertension
 - “Treat if SBP > 140, or if have diabetes, treat if SBP > 130
- It is now possible to design more effective guidelines that will simultaneously improve quality and lower costs

IndiGO: Pilot in KP Hawaii

Pilot Study

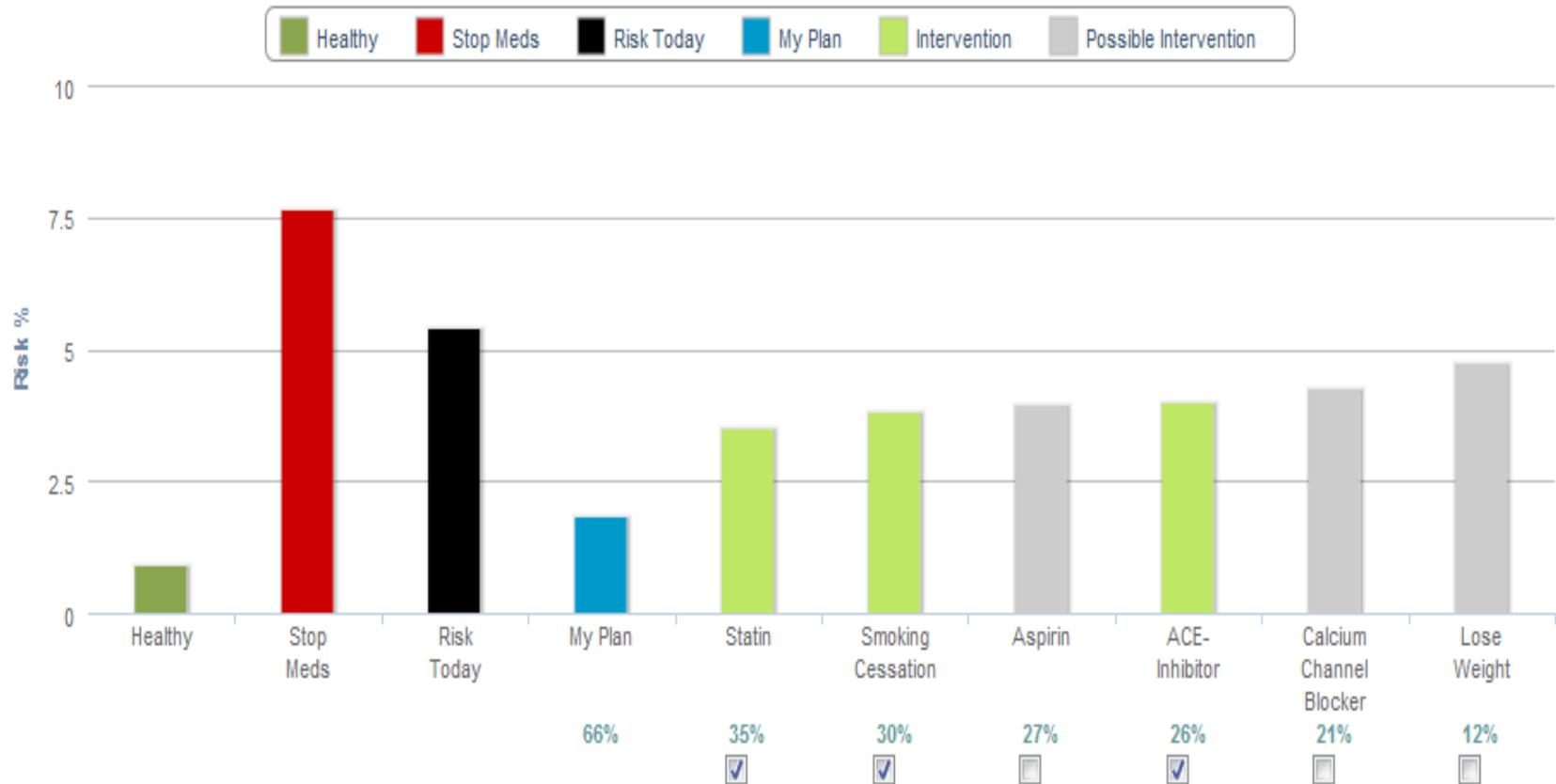
- IndiGO was implemented by KP Hawaii and independently evaluated by the KP Care Management Institute (CMI)
- All physicians were using EPIC and had access to a decision support tool that identified care gaps according to current guidelines (“standard care”)
- Primary care physicians at two clinics were provided access to IndiGO, in addition to EPIC and the care gap tool
- Results for patients exposed to IndiGO were compared to two different matched control groups

Findings

- Increased patient adherence
 - Candidates for statins showed 6-fold increase in use
- Improved outcomes
 - A 13% reduction in 5-year CVD risk, compared to EHR and panel support tool alone
 - For every 1 million members, 1400 heart attacks and strokes averted annually
- Reduced hospitalizations and costs
 - Estimated \$98 million saved annually

Heart Attack/Stroke | Risk of Diabetes | Diabetes Complications | Breast Cancer | Colon Cancer | Lung Cancer

Risk of Heart Attack or Stroke over the next 5 years



%... denotes Relative Risk Reduction

What are the effects of improving HEDIS Scores?

- Interventions
 - Simvastatin 40mg for diagnosed hypertensives if not meeting ATPIII targets
 - Simvastatin 40mg to anyone not meeting ATPIII targets
 - Single generic HTN med if systolic > 140
 - Glucose control to HbA1c <7.0
- Modeled improvement on each from average of CA plans to 75%

Assumptions

- Population modeled based on national data (NHANES)
- Event Costs
 - MI or stroke with 5-yr follow-up \$65,000 (from Medicare claims data)
- Intervention Costs
 - Lipids and Hypertension
 - \$150 (additional labs and visits)
 - Generic meds covered by pt copay
 - Glucose control: undetermined

Results of Improved Performance

Annual Impact of targeted improvement in HEDIS Score per Million adults in population						
Intervention	Increase (%)	Treated	Events Averted	Cost savings (\$M)	Net savings (\$M)	Savings Per patient (\$)
Statin w HTN	12	10231	59	3.8	2.3	225
Statin (ATPIII)	12	22321	117	7.6	4.2	188
Hypertension	9	24140	116	7.5	3.9	162

Conclusions

- Simple preventive measures using generic drugs can be cost effective
- ARChES can model the specific impacts of different targets in different subgroups of your population using your cost structure

Recognition

- IndiGO named “best care app” at Office of the National Coordinator Datapalooza in June 2012
- ONC currently sponsoring Million Hearts Mobile App challenge that features the IndiGO risk engine
- Archimedes awarded an indefinite duration, indefinite quantity (IDIQ) contract by Dept of Health and Human Services for both Arches and IndiGO
 - First and only modeling platform available to all agencies of HHS (e.g. CMMS, FDA, NIH, AHRQ, etc.)

Recent Peer-Reviewed Publications

- Health and economic outcomes for exenatide once weekly, insulin, and pioglitazone therapies in the treatment of type 2 diabetes: a simulation analysis [»[Vascular Health and Risk Management, Apr 2012](#)]
- Physicians' Actions And Influence, Such As Aggressive Blood Pressure Control, Greatly Improve The Health Of Diabetes Patients. [»[Health Affairs, Jan 2012](#)]
- An Estrogen Model: The Relationship between Body Mass Index, Menopausal Status, Estrogen Replacement Therapy, and Breast Cancer Risk. [»[Computational and Mathematical Methods in Medicine, Jan 2012](#)]
- Impact of Comorbidity on Colorectal Cancer Screening Cost-Effectiveness Study in Diabetic Populations [»[Journal of Internal General Medicine, Jan 2012](#)]
- Cardiovascular outcomes associated with a new once-weekly GLP-1 receptor agonist vs. traditional therapies for type 2 diabetes: a simulation analysis [»[Diabetes, Obesity, and Metabolism 9/6/2011](#)]
- Estimating Health and Economic Benefits from Using Prescription Omega-3 Fatty Acids in Patients with Severe Hypertriglyceridemia. [»[Am J Cardiol. 9/1/2011](#)]
- Individualized Guidelines: The Potential for Increasing Quality and Reducing Costs. [»[Annals of Internal Medicine, 5/2/2011](#)]
- Cost-effectiveness of chemoprevention of breast cancer using tamoxifen in a postmenopausal US population [»[CANCER, 3/14/2011](#)]
- Health Benefits and Cost-Effectiveness of Primary Genetic Screening for Lynch Syndrome in the General Population. [»[Cancer Prevention Research, 11/18/2010](#)]
- Modeling the effects of omalizumab over 5 years among patients with moderate-to-severe persistent allergic asthma. [»[Current Medical Research and Opinion, 11/04/2010](#)]
- Cost-effectiveness of adding information about common risk alleles to current decision models for breast cancer chemoprevention.[»[Journal of Clinical Oncology, 6/07/2010](#)]
- Age at Initiation and Frequency of Screening to Detect Type 2 Diabetes: A Cost-Effectiveness Analysis [»[The Lancet, 4/30/2010](#)] [»[View Technical Appendix](#)]
- Model-Based Benefit-Risk Assessment: Can Archimedes Help? [»[Clinical Pharmacology & Therapeutics, 12/15/2009](#)]
- Effect of Smoking Cessation Advice on Cardiovascular Disease. [»[American Journal of Medical Quality, 5/01/2009](#)]
- The Relationship between Insulin Resistance and Related Metabolic Variables to Coronary Artery Disease: A Mathematical Analysis [»[Diabetes Care Publish Ahead of Print, 11/18/2008](#)]
- A Physiology-Based Mathematical Model of Coronary Heart Disease Accurately Predicts CHD Event Rates in Real Populations. [»[Circulation, 11/08/2008](#)]
- Validation of Prediction of Diabetes by Archimedes and Comparison with Other Predicting Models. [»[Diabetes Care, 5/28/2008](#)]

More at: <http://www.archimedesmodel.com/publications>

Thank You

Modeling can make a difference

For more information

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