Overview of the ReThink Health Dynamics Model

ReThinking Health Systems

More and more people are rethinking what it takes to achieve profoundly better results in health systems across the U.S. Such ambitious ventures, however, are hard to plan, unwieldy to manage, and slow to spread. ReThink Health and its allies are learning what it takes to spark and sustain system-wide improvements in different settings. We usually focus on three connected spheres of innovation:

- **Active Stewardship** helps leaders establish the conditions for diverse stakeholders to work together across boundaries to more successfully and creatively lead health system redesign, implement high impact improvements and innovations, and avoid sticking points along the way.
- **Sound Strategy** equips leaders with data and dynamic models to help them individually and collectively understand the complexity and interactions of their health system, play out plausible scenarios, identify opportunities, set priorities for action, and measure progress over time.
- **Sustainable Investment and Financing** advances new information, tools, and approaches to investment and financing that help create long term strategies, identify and leverage regional assets, shift how resources are used, and support efforts long enough to realize their promise for meaningful impact.

This document summarizes progress in creating the ReThink Health Dynamics simulation model.

EXPLORE FOR YOURSELF

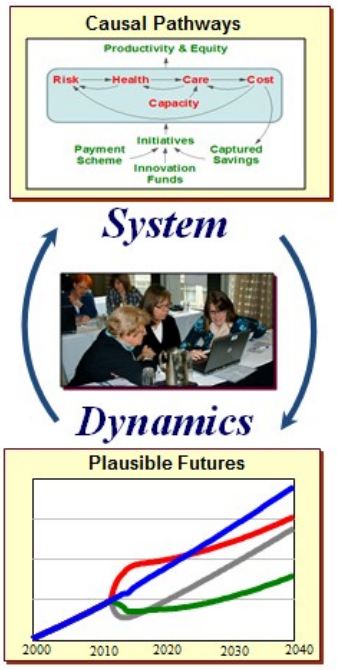
Read more about the model and explore online versions at:
http://www.rethinkhealth.org/dynamics

Guiding Questions

- How are local health systems structured?
- How and when do they change (or resist change)?
- Where is the greatest leverage to enhance performance?
- What trade-offs may be involved?
- What if non-experts could test scenarios for themselves?

These are among the main questions that guide our work with colleagues in different contexts.

Supporting Multi-Stakeholder Planning



Thinking through the complexities of the health system is fraught with difficulties. As a result, new initiatives tend to be short-sighted, fragmented, and unable to alter long-term trends. Formal modeling brings greater foresight, evidence, and creativity to groups who are working to establish a healthier, more equitable, and more sustainable health system.

The primary purpose of the ReThink Health model is to support multi-stakeholder planning and strategy design, not to forecast specific outcomes.

Planners may use this tool to examine uncertainties and explore opportunities for change—as well as the stakes of inaction. Simulating scenarios also encourages greater alignment and action as innovators see and feel what their efforts could accomplish.

Diverse teams are now using this tool across the country (see invited sessions below) and several have gathered local data to tailor it for their own region. Eight local configurations have been developed to date, representing the following regions.

Current Version

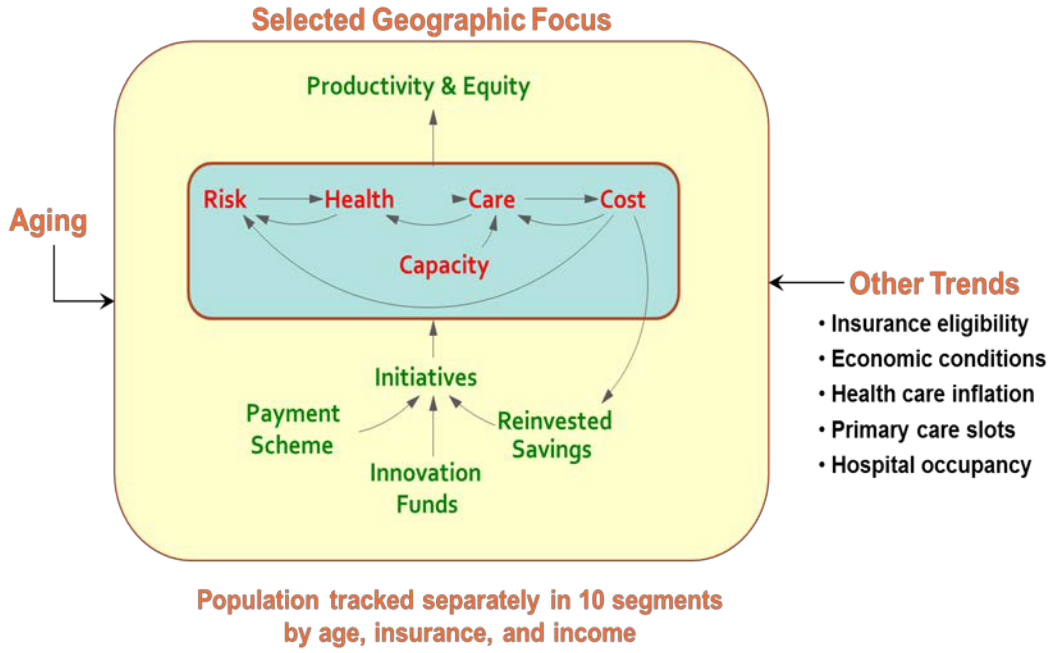
- Anytown, USA -- 300,000 & 50,000 versions (configurations based on national data, scaled to represent prototypical small- and mid-sized American cities)
- Atlanta, Georgia
- Cincinnati, Ohio
- Monadnock, New Hampshire
- Pueblo, Colorado

Prior Versions

- Alameda, California
- Contra Costa, California
- Manchester, New Hampshire
- Whatcom, Washington

Representing Local Health Systems

The ReThink Health model is a realistic, yet simplified, representation of a local health system. With a distinctive place-based and wide-angle view, it tracks changes in population health, health care delivery, health equity, workforce productivity, and health care costs under a variety of conditions - all within a single, testable framework tied to many sources of empirical data and open to sensitivity analysis. This diagram shows the general boundary and major sectors in the model.



Selecting a Geographical Focus

When representing a local health system, an immediate challenge is to find an appropriate geographical focus. After reviewing data and considering where policy insights might be most influential, users typically select a set of zip codes, a county, a Hospital Service Area, or a Hospital Referral Region. We have also configured Anytown models by scaling national data to represent smaller, prototypical regions.

Situating Decisions in Context

The model captures some of the most important physical processes that drive future trajectories across the health system (i.e., demographic, epidemiological, economic, operational, etc.) as well as key behavioral decisions of particular actors. In the model, as in real life, people may change their decisions as conditions change around them. A summary of behavioral logic in the model lists specific features that make it closely resemble real-world patterns of cause and effect.

Tracking Health System Dynamics

Through both cognitive and experiential learning, the model shows how well-crafted strategies can significantly improve health system performance. Behind the scenes lies an explicit mathematical model, with a transparent causal structure and several hundred interacting elements. It tracks changing levels of risk or vulnerability stemming from unhealthy behaviors, crime, and environmental hazards, as well as poverty and lack of insurance. Together, those drivers affect health status over time, including

physical illness (mild and severe), mental illness (controlled and uncontrolled) as well as acute episodes (urgent and non-urgent), and deaths.

Health status and illness prevalence, in turn, determine both the demand and cost for health care in different locations (i.e., routine and acute office visits, outpatient procedures and tests, hospital emergency room and inpatient stays, as well as post-acute/extended care in skilled nursing facilities, at home, and in hospice). The volume and nature of care delivered also feedback to affect health status, for example, by slowing the progression of chronic illness from mild to severe forms.

Finally, the model considers financial incentives from different payment schemes (such as fee-for-service vs. per capita) along with the program cost for each simulated initiative. If those interventions do save health care costs (relative to benchmarks for each population segment), then users may choose to capture and reinvest those savings in an effort to sustain the initiatives over time.

Offering a Menu of Intervention Options

The model represents several dozen distinct initiatives. Each may be simulated individually or in combinations to study the likely consequences over time on many metrics of health, care, cost, productivity, equity, spending, savings, and return-on-investment. Additional design options let planners sequence initiatives and/or direct certain efforts only to certain sub-groups, as a way of concentrating limited resources among those with the most to gain.

RISK	Healthier behaviors Environmental hazards	Crime	Pathways to advantage (family; student)
CARE	Preventive/chronic care Mental illness care	Self care	Hospital infections
CAPACITY	PCP efficiency	Recruit PCPs (general; FQHC)	Hospital efficiency
COST	Pre-visit consult Medical home	Coordinate care Malpractice	Post-discharge care Hospice
TRENDS	Uninsurance Local economy	Primary care slots Hospital occupancy	Inflation rate
FUNDING	Innovation fund	Reinvest savings	Contingent global payment

Distinguishing Population Subgroups

The model divides the population into 10 sub-groups, each with a distinct profile of health status and health care utilization. These groupings correspond closely to particular insurance categories.

Population Subgroup	Principal Insurance Type
Youth (ages 0-17)	
Advantaged, Insured	Commercial coverage
Advantaged, Uninsured	Mostly self-paid
Disadvantaged, Insured	Medicaid
Disadvantaged, Uninsured	Mostly uncompensated
Working Age (ages 18-64)	
Advantaged, Insured	Commercial coverage
Advantaged, Uninsured	Mostly self-paid
Disadvantaged, Insured	Medicaid
Disadvantaged, Uninsured	Mostly uncompensated
Senior (ages 65+)	
Advantaged	Medicare
Disadvantaged	Dual Medicare + Medicaid

Integrating Data Into a Single—Testable—Framework

Each local configuration draws together data from dozens of disparate sources to create a broad and balanced profile of the health and health care system in a particular region. The main data elements in each model address:

- ***Population composition***, divided by 10 subgroups according to age, insurance status, and income, and projections for aging and overall growth through 2040;
- ***Population health status***, including the prevalence of physical and mental illness (by subgroup);
- ***Health risks***, including high risk behaviors, environmental hazards, and high crime (by subgroup);
- ***Provider resources***, including office-based primary care providers (general and FQHC), specialists, and acute care hospital beds;

- ***Health care utilization***, including PCP visits and available slots for the indigent, ER visits urgent and non-urgent, inpatient stays and readmissions and discharge destinations, and people in nursing facilities or using home health care;
- ***Health care costs***, including nearly every category in the "personal healthcare expenditures" portion of the National Health Expenditures tracking system.

Wherever possible we use local data contrasted against national averages. If local data are unavailable or inadequate, we then develop small area estimates based on regional, state, or national sources. Some of the main databases that inform this model include:

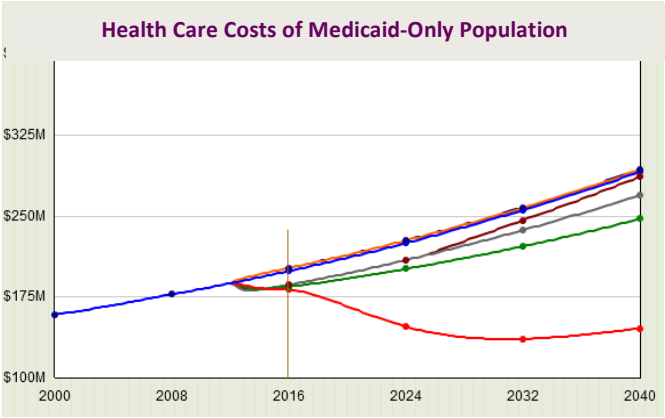
- U.S. Census 2010 (American Community Survey)
- CDC's Behavioral Risk Surveillance System (BRFSS)
- National Ambulatory Medical Care Survey (NAMCS)
- National Hospital Ambulatory Medical Care Survey (NHAMCS)
- National Survey of Children's Health (NSCH)
- National Nursing Home Survey (NNHS)
- National Home Health Care Survey (NHHCS)
- National Health Expenditure Accounts
- National Health Interview Survey (NHIS)
- National Health and Nutrition Examination Survey (NHANES)
- Medical Expenditure Panel Survey (MEPS)
- National Vital Statistics Reports from the CDC
- Kaiser Family Foundation State Health Facts
- National Hospital Discharge Survey (NHDS)
- Agency for Healthcare Research and Quality-Health Care Utilization Project (AHRQ-HCUP)
- Health Resources and Services Administration – Area Resource Files (ARF)
- Dartmouth Atlas of Health Care

Many parameters are also consistent with previously published analytical tools, including:

- CDC HealthBound policy model, selected by AcademyHealth as Public Health Systems Research Article of the Year for 2012; and
- CDC-NIH Prevention Impacts Simulation Model (PRISM), selected by the System Dynamics Society as Best Application of System Dynamics Modeling for 2011; and by the Society for Public Health Education as Best Article of the Year in Health Promotion Practice for 2013.

Initial Insights

Despite its uncertainties and limitations, users have discovered many valuable insights when using this tool. For example, local leaders have been consistently able to anticipate common pitfalls or "failure modes" that threaten to disappoint or derail regional change ventures. Some of the main failure modes stem from:



- Unsustainable program financing (i.e., attempting too much without adequate funding);
- Exacerbating bottlenecks (i.e., especially those affecting primary care);
- Supply push responses from providers that undercut health care cost savings (i.e., increasing the intensity of care per episode to compensate for drops in utilization and income);
- Comparing alternative strategies using only a short time horizon (i.e., biasing conclusions about the relative cost-effectiveness of different interventions); and
- Improving health, care, or cost while perpetuating or exacerbating inequities (i.e., failing to alter the structural conditions that drive health inequity).

All of these phenomena, and more, can be traced to the dynamically complex structure of a local health system. In addition, when equipped with model-based scenarios, planners are better able to address other shortcomings that may plague multi-stakeholder endeavors such as lack of a common vocabulary, inability to interpret performance metrics, the absence of a strategic perspective, disorganization, and dysfunctional teamwork.

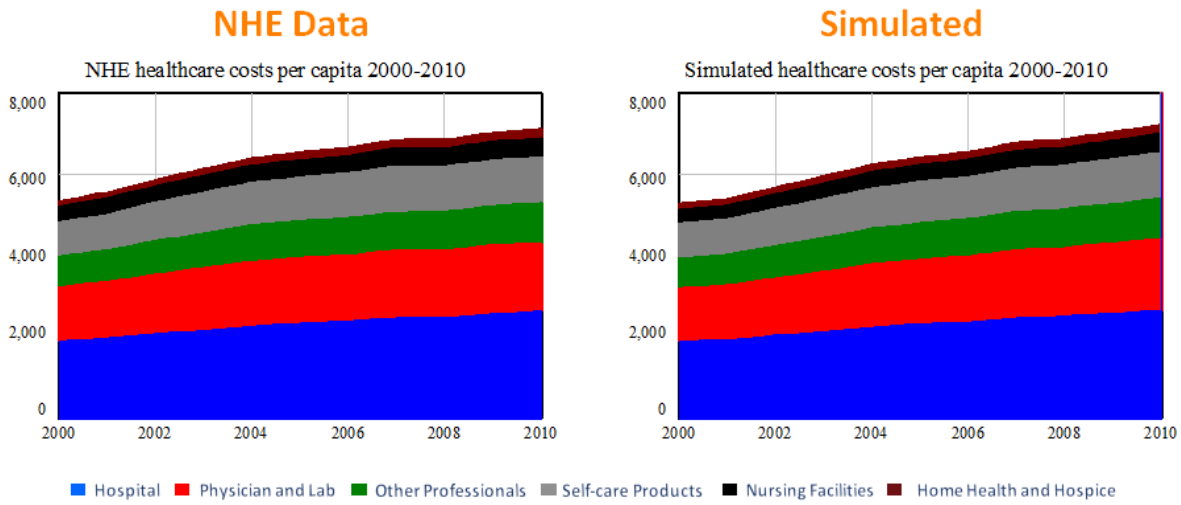
Building Confidence through Scientific Critique

Adhering to standard modeling practice, we use multiple approaches to critique the scientific integrity of this tool. Although the model is new and remains a work-in-progress, it builds on many prior analyses now extended to a local level. It remains open to evolve with user input and new research. Questions guiding our iterative development focus on:

- ***Policy Scope & Metrics***: How useful are the intervention inputs as well as the health and economic outputs? This involves a close consideration of the stakeholder perspectives, population sub-groups, health states, and causal structures represented in the model.
- ***Dynamic Behavior***: How well does the model capture real-world dynamics, particularly in its responses to intervention scenarios over time?
- ***Credibility for Strategy Planning***: How credible are the conclusions that users may draw from this tool, particularly regarding the relative direction, timing, and magnitude of intervention effects?

We are continually testing and refining the model to make certain that its historical outputs are accurate, its future outputs are plausible and internally consistent, and its boundary is wide enough to encompass the most significant drivers of change over time.

We have confirmed that the model closely matches 26 historical data time series (2000-2010), by population segment, including those from the Census, Vital Statistics, National Health Expenditure Accounts (NHE), and the American Hospital Association (AHA/ASH). For example, the following graphs show how well simulated output compares to observed data on per capita health care costs.



The first formal scientific review, chaired by Dr. Elliott Fisher, was held at the Dartmouth Center for Health Care Delivery Science just weeks after the model was first calibrated in 2011. Reviewers included a mix of health scholars, economists, engineers, policy analysts, organizational researchers, philanthropists, game designers, and more. Several subsequent reviews were conducted and we have received strong support from colleagues through scores of demonstrations and presentations. A detailed reference guide has been developed for experienced modelers and several peer-reviewed manuscripts are now being written to describe the model and its results for a wider audience.

Finally, we place great value on the reactions from local collaborators. Their close examination of this tool has helped to assure that it adequately represents current circumstances and is robust for thinking about plausible futures.

Recommended Uses

Individuals are welcome to use the model alone; however it is best used with a trained facilitator. Group workshops encourage stakeholders to interact with each other and with the model as they explore where the health system is headed and their own roles as change agents within it.

Interactive, Role-Play Gaming

Game-based learning offers yet another way to explore how the health system works from the perspective of its many players. We are therefore working with leading game designers at Dartmouth's Tiltfactor Laboratory and the Dartmouth Center for Healthcare Delivery Science to design an active, role-play game anchored in insights from the ReThink Health simulation model. Several prototype versions of the RePlay Health Games have been tested with diverse colleagues in which they experience empathy, understanding, and ultimately optimism about what they can accomplish together. Serious games like these offer an engaging way to spark interest and involvement among many stakeholders. We plan to design workshops where participants immerse themselves in the RePlay Health Game as a prelude to simulating formal scenarios using the ReThink Health model.

Workshops, Presentations, and Facilitated Strategy Labs

More than 60 invited sessions have featured the model in diverse venues. Selected examples include:

- AcademyHealth
- Alliance of Community Health Plans
- Altarum Symposium of Sustainable Health Spending
- American Academy of Health Behavior
- Association for Community Health Improvement
- Commonwealth Fund
- Communities Joined in Action
- Conn. Institute for Primary Care Innovation
- Dartmouth-Hitchcock Medical Center
- Grantmakers in Health
- Institute for Clinical Systems Improvement
- Institute for Healthcare Improvement
- Institute of Medicine
- International System Dynamics Society
- Kaiser Permanente
- Mayo Clinic
- National Center for Healthcare Leadership
- Northwest Health Foundation
- Robert Wood Johnson Foundation
- Rockefeller Foundation

Educational Users

In addition to its utility for practitioners in the field, the ReThink Health Dynamics Model provides a robust heuristic environment that is valuable to academic users for both research and teaching. Beyond schools that train healthcare professionals and administrators, the Model is of great interest to schools that prepare students to address large-scale public sector challenges across a range of disciples. In 2015, the National Association of Schools of Public Policy, Affairs, and Administration, and the 200 affiliate schools that provide MPP and MPA degrees, used the ReThink Health Dynamics Model to host its inaugural student competition across its member institutions.

In addition to use of the Model in academic workshops and events, educators in several academic institutions have incorporated the ReThink Health Dynamics Model into their curricula for undergraduate, graduate, and executive education programs. Selected examples include:

- Columbia University, School of Public Health
- Dartmouth Masters in Health Care Delivery Science
- MIT Sloan School of Management, Executive Education Program
- Medical University of South Carolina, Health Administration and Policy
- Penn State, Undergraduate Course in Health and Policy Administration
- SUNY-Albany Masters in Public Administration
- SUNY-Binghamton, School of Engineering
- University of Alabama, School of Nursing
- University of Virginia, Center for Large-Scale Computational Modeling
- Vanderbilt University, Health Care Council Fellows Program

Reports

- Homer J, Milstein B, Hirsch G, Fisher E. A Combination of Regional Initiatives Could Substantially Improve Health, Lower Cost, and Be Financially Self-Sustaining. Health Affairs. (*under review*).
- McFarland L, Reineke E, Milstein B, Niles R, Hirsch G, Cawvey E, et al. Systems Thinking and Simulations in the US Public Policy Community: NASPAA's Student Simulation Competition. 33rd International System Dynamics Conference; 2015 July 20; Boston, MA.
- Milstein B, Hirsch G, Minyard K. County officials embark on new, collective endeavors to rethink their local health systems. Journal of County Administration 2013(March/April):1-10.
- Milstein B, Homer J, Hirsch G. Sustainable Health Spending and the Untapped Potential of Reinvestment. Presentation at the Altarum Symposium on Sustainable Health Spending. July 15, 2014.
- Milstein B. How Modeling Can Inform Strategies to Improve Population Health. Presentation at the Institute of Medicine Roundtable on Population Health, April 9, 2015.
- Homer J. Introduction to the ReThink Health Dynamics Model: Simulating Local Health Reform in "Anytown USA". 2013 August. Note: This report describes features and scenarios from a prior version of the model.
- Homer J.. Does Place Matter for Policy? The Effect of Local Characteristics on Intervention Priorities in the ReThink Health Dynamics Model. 2013 August. Note: This report describes features and scenarios from a prior version of the model.
- Homer J. How Could We Do the Most Good Here? Using the ReThink Health Model to Evaluate Combined Intervention Strategies for Local Health Systems. 2013 August. Note: This report describes features and scenarios from a prior version of the model.
- Hirsch G. Pitfalls in Community Level Health Reform. 2013 August. Note: This report describes features and scenarios from a prior version of the model.
- Hirsch G, Homer J, Milstein B, et.al. ReThink Health Dynamics: Understanding and Influencing Local Health System Change. 30th International Conference of the System Dynamics Society; July 22-26,

2012; St. Gallen, Switzerland. Note: This report describes features and scenarios from a prior version of the model.

- Milstein B. Rethinking Health System Dynamics: Methods for Simulating Scenarios and Evaluating Policy Options. AcademyHealth Research Conference; June 26, 2012; Orlando, FL. Note: This report describes features and scenarios from a prior version of the model.

Case Examples

- Denzer S. *It Takes More Than A Village to Improve Community Health*. October, 14.2014. Available at http://thehealthcareblog.com/blog/2014/10/14/it-takes-more-than-a-village-to-improve-community-health/
- Milstein B, Hirsch G, Minyard K. County officials embark on new, collective endeavors to rethink their local health systems. Journal of County Administration 2013(March/April):1-10. Available at http://tinyurl.com/RTH-County-Officials
- ReThink Health. Case Study on Aligning Priorities. The Atlanta Regional Collaborative for Health Improvement. 2012. Available at: http://www.rethinkhealth.org/case-studies/aligning-priorities/
- ReThink Health. Case Study on Transforming Stewardship. Upper Connecticut River Valley, 2010-. Available at: http://www.rethinkhealth.org/case-studies/transforming-stewardship/
- ReThink Health. Case Study on Setting Strategy. Pueblo Triple Aim Corporation, 2010 -. Available at http://www.rethinkhealth.org/case-studies/setting-strategy/
- Milstein B. *ReThinking Health in Pueblo, Colorado: A Stewardship Strategy to Advance the Triple Aim.* Improving Population Health; 2012 August 21. Available at http://tinyurl.com/RTH-Pueblo-Story

Videos

- Overview of the Model: https://www.youtube.com/watch?v=YAmKs72wLK4
- Lessons from ReThinking Health: https://www.youtube.com/watch?v=ztmv75sghXc
- Interface mechanics and exercises: https://www.youtube.com/watch?v=YVj890-eOuk

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