Revision: April 12, 2008

"The Health Protection Game"
Prototype Design, Preliminary Insights, and Future Directions

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Learning to Succeed in a Simplified System

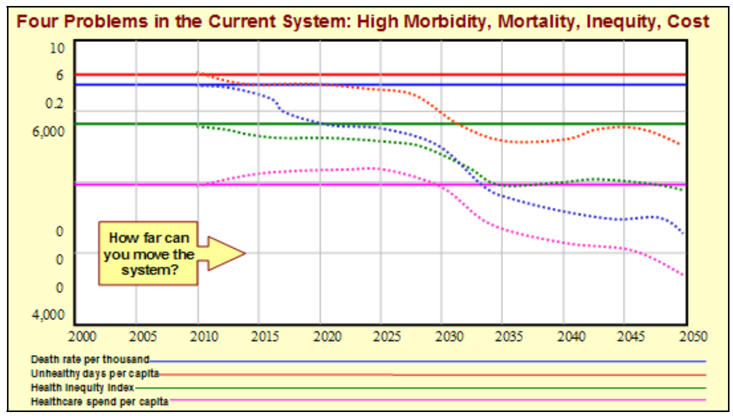
CDC developed the *Health Protection Game* for those wanting to experience, for themselves, the possibility of transforming our troubled health system. Players of the game are equipped with the power to navigate the U.S. health system toward greater levels of health, equity, and cost-effectiveness, if only they can discover how (Fig 1).

Solving a Systemic Problem

The players' goals are difficult to achieve, in part, because the game rests upon a computer simulation model that resembles the characteristic behaviors of the real-world health system. Time delays, resource constraints, feedback processes, sub-group differences, and other known features of the actual health system are represented within the model and must be understood by players in order to succeed.

The computer model allows tests of single interventions, as well as a high degree of creativity in mixing them for better effects. Also, the model has a transparent causal structure that allows players to identify the precise reasons for patterns observed in the game. Players learn by simulated experience and by tracing through the reasons for their successes or failures.

Figure 1 The Challenge: How Far Can You Move the System?



A Foundation for Wayfinding Summits

Those who aspire to lead change on a national scale may immerse themselves in this realistic, but simplified version of the U.S. health system. They may play out popular proposals, explore new ideas, rule out the most ineffective strategies, and gather support for more promising scenarios. The game teaches essential lessons and establishes a productive frame for finding a viable way forward. CDC plans to refine the game beyond its initial prototype and then use it as the basis for a series of *Wayfinding Summits* in which stakeholders across the country consider what they can do to help steer a course toward a healthier, more equitable, and more prosperous future.

Prototype Design

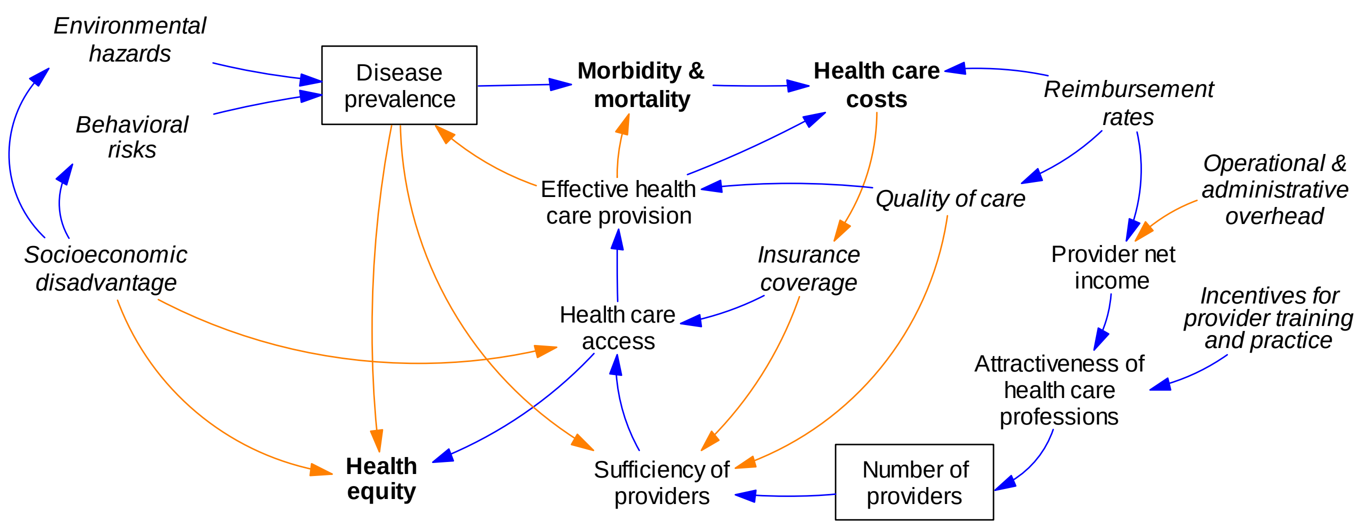
The prototype model combines major insights from earlier studies on factors that affect health system reform and population-based health protection.[1] Figure 2 shows the main features of the health system that are included in the game's underlying mathematical model. Two facts are immediately obvious: (1) all parts of the system, often considered separately in popular discourse and in analytic studies, are in fact causally connected; and (2) there are more processes at work, and more intervention options available, than one might infer from the dominant "cost, quality, and access" script.

[1] References available upon request.

An Integrated View of Health System Dynamics

The game's simulator tracks the entire U.S. population and its movement among states of health, risk behavior, environmental exposures, and socioeconomic advantage or disadvantage. Disadvantage makes it harder for people to choose healthier behaviors and exposes them to more hazardous environments, leaving them more vulnerable to an array of afflictions that increase aggregate disease prevalence. The disadvantaged also have worse access to health care than do the advantaged, due to less insurance coverage and less sufficiency of providers to meet patient demand. Greater disease prevalence combined with worse access to care means that the disadvantaged experience greater morbidity and mortality per capita than the advantaged do. Another factor affecting health outcomes is the quality of care delivered, reflecting the extent to which providers take the time to listen carefully to their patients and do a better job of diagnosis, counseling, and care. Figure 2 shows these relationships and stands as a broad summary of the model's causal structure, which actually contains several hundred interacting elements.

Figure 2 Major Causal Relationships in the Health Protection Game (Prototype)[2]



Scoring Criteria

Players attempt to achieve the best results across four criteria simultaneously (shown in bold in Fig 2). They must (1) save lives (i.e., reduce the mortality rate); (2) improve well-being (i.e., reduce morbidity due to unhealthy days); (3) achieve equity (i.e., reduce the excess morbidity and mortality attributable due to disadvantage); and (4) lower health care costs (i.e., reduce heath care spending per capita), all the while attempting to maintain appropriate implementation expenses (i.e., subsidies and program cost). The model tracks these and other variables over several decades (2000-2050) as players try different intervention strategies.

Policy Options

Players may employ nine types of interventions, alone or in combination, to achieve their goals (shown in italics in Fig 2). These include (1) expanding insurance coverage; (2) improving quality of care; (3) changing reimbursements; (4) improving operational efficiency; (5) simplifying administrative procedures; (6) offering provider incentives; (7) enabling healthier behaviors; (8) building safer environments; (9) creating pathways to advantage. Many of these general interventions can be further tailored by focusing on particular areas of the system (such as office-based versus hospital services, or the disadvantaged versus advantaged sub-group).

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[2] The main scoring criteria are highlighted in bold: morbidity, mortality, health equity, and health care costs. Italics indicate possible areas for policy intervention. Blue arrows indicate same-direction effects (e.g., lower reimbursement rates mean lower provider income), while orange arrows indicate opposite-direction effects (e.g., more operational and administrative overhead means lower provider income.) The boxes around "Disease prevalence" and "Number of providers" indicate that those variables have been modeled as stocks that change only gradually over time as the result of flows in (disease onset; newly-trained providers) and out (deaths; provider retirements).

Empirical Foundations

Because of the model's broad sweep, its variables are defined at a high level of aggregation. For example, the model does not consider individual types of disease or injury, but rather combines them all into a single measure of prevalence based on national surveys of self-rated health status. Such self-report metrics have been shown to be reliable predictors of health service utilization and health outcomes. In general, quantification of the prototype model is based on a variety of publicly available data from the Census, Vital Statistics, national health surveys, the National Health Expenditures database from CMS, and studies from the professional literature on health care utilization and programmatic impact.[3] We expect to refine some concepts and estimates as we gather more information from research studies and from subject matter experts, but simplifications will always be necessary to make the analysis tractable and consonant with available data.

Starting Conditions

The simulated system is placed initially in a dynamic equilibrium, with all outcome variables sitting close to where they were in real life around the year 2000. Absent interventions, the population size is unchanging, and none of the outcomes within the model are due to trends originating outside the health sector, such as aging, migration, economic cycles, and technological advances. In this way the game offers an opportunity to learn how to succeed within a simplified system before tackling something of greater complexity.

Preliminary Findings (Some settings in the prototype model may be refined and alter these results)

The game is still under development and has not yet been tested by a diverse audience. Although the best learning may be experiential, there is also value in understanding other's experiments. Thus, we present the following tentative findings as a preview of what participants may learn from the game. These illustrations generally involve simulating just one intervention at a time. Combinations or sequences are of course possible, offering a vast horizon for players to explore.

Cutting Reimbursement

Reducing reimbursements to office-based providers may initially lower costs. But it also has the tendency to diminish quality of care. The reduction in quality quickly leads to greater morbidity, particularly among those with chronic diseases; less effective preventive care also gradually increases the prevalence of disease. Our model suggests that these contrary effects can, in the space of only a few years, overwhelm the initial cost saving and yield a net cost increase. Also, the decline in quality most affects those who go to the doctor routinely, i.e. the advantaged. This produces a quick improvement in health equity, but for the worst reason: health status among the advantaged declined. Over time, however, the quality of care for the disadvantaged erodes faster than it does for the advantaged because a steady loss of providers impacts them more. As a result, health inequity gradually rises.

Achieving Universal Coverage

When we simulate universal coverage, we see a quick reduction in morbidity and mortality, as one would expect. But we also see an increase in health care costs, as more of the population is drawn into a health care system with only mediocre quality, doing relatively little to prevent disease in the first place. Expanded coverage can also worsen the inequity between the advantaged and the disadvantaged. Although it is true that the disadvantaged are more often uninsured, the model also takes into account that the disadvantaged more often face a shortage of local health care providers. When coverage is extended to all, the additional demand is fairly easily absorbed by providers to the advantaged, but not so for the disadvantaged. Indeed, for the disadvantaged, greater insurance coverage makes the shortage of providers that much worse. Thus, the major beneficiaries of the policy are the advantaged rather than the disadvantaged, and the inequity problem becomes worse, not better.

Improving Quality of Care

The model can simulate the effects of greater provider adherence to guidelines for effective chronic and preventive care. That improvement in quality results in a quick reduction in morbidity and mortality. In fact, the reduction in morbidity is greater than in the universal coverage scenario, because the quality improvement applies to a much larger segment of the population. Improved quality also leads initially to an increase in health care costs, but after

[3] References and model documentation are available upon request.

several years this turns to a reduction in costs below the baseline, as the benefits of preventive care accrue in the form of reduced disease prevalence. However, quality improvement worsens health inequity, much as in the universal coverage scenario. Quality improvement requires that providers spend more time with clients, and for providers to the disadvantaged, who start in a shortage situation, this means inevitably turning away even more patients. The simulation suggests that quality improvement also leads to some shortage of providers to the advantaged, but still many more of the advantaged benefit from the policy than do the disadvantaged.

Strategies for Improving Health Equity

If we want to improve health equity, the model points to two strategies that could work. First, we could alleviate the shortage of health care providers who serve the disadvantaged, by (a) boosting provider incomes through higher reimbursements or lower operational/administrative costs, or (b) offering more medical school scholarships and other incentives for students who commit to work with the disadvantaged after they graduate. A second approach is to reduce disease disparities that result from the greater vulnerability to affliction experienced by the disadvantaged. This approach entails either (a) creating safer environments and enabling healthier behaviors, both of which are disproportionately lacking among the disadvantaged, or (b) helping more people move out of their disadvantaged position, for example, through a mix of training/educational reforms and family income supports.

Upstream Health Protection: Reducing Environmental Hazards and Behavioral Risks

In line with the second approach described above, we simulated a general health protection scenario in which strong population-wide efforts, not dependent on clinical resources, are made to reduce environmental and behavioral risks for both the advantaged and the disadvantaged. This “upstream” strategy takes some time to see significant benefits, but after the first ten years or so the protection approach can potentially reduce morbidity and mortality more effectively than any of the “downstream” strategies described above. Also, unlike the downstream strategies, it ends up making a big dent in health care costs, and improves health equity, benefits that do not erode over time but actually keep getting better for 20 years or more before a new and much improved equilibrium is reached.

Games Help Us Understand How the System Behaves and Why

Simulating interventions and seeing their effects is only part of the game. The real insight comes from learning why and how our complicated health system behaves the way it does. For instance, why is the simulated health protection approach so effective, and particularly so for the disadvantaged? The answer can be found in the causal connections and feedback loops pictured in Figure 2. The disadvantaged inherently benefit somewhat more than the advantaged from reductions in environmental and behavioral risks, thereby helping to reduce disease disparities. But that is only the start. The reductions in disease prevalence then help further in two ways, especially for the disadvantaged. First, a reduction in disease prevalence eases the demand on scarce provider capacity allowing more patients to be seen for chronic care as well as preventive care. Thus, a virtuous cycle of prevention is created, and as a result, disease prevalence continues to decline further for a decade or more beyond the initial period of environmental and behavioral risk reduction. Second, a reduction in disease prevalence lowers health care costs, making insurance coverage more affordable, and leading employers to offer more coverage, thereby reversing the downward trend of recent decades. This increase in insurance coverage further improves health care access and leads to a greater improvement in health equity.

Next Steps: Refinement, Engagement, and Wayfinding

The findings described here are preliminary and subject to modification, or at least fine tuning. We plan to look more closely, for example, at assumptions about the sufficiency of providers for the advantaged and the disadvantaged, and whether recent trends (such as the expansion of retail health clinics) may indicate that something new is already happening. Also, by creating an engaging user interface along with an informative instructional design, we hope to extend the opportunity for potential champions of health system transformation to interact with and learn from the game—and more importantly, from each other. One of the biggest impediments to past reform initiatives has been that proponents of competing strategies have used different conceptual frameworks, each slanted to support their particular approach. CDC’s *Health Protection Game* offers a comprehensive and neutral framework in which advocates of different transformation strategies can come together, test their proposals, identify potential shortcomings, and work together to craft a package that cuts through the current clutter and inertia to reveal a practical way forward. Hence, a series of local *Wayfinding Summits* could spark a nationwide movement for change.