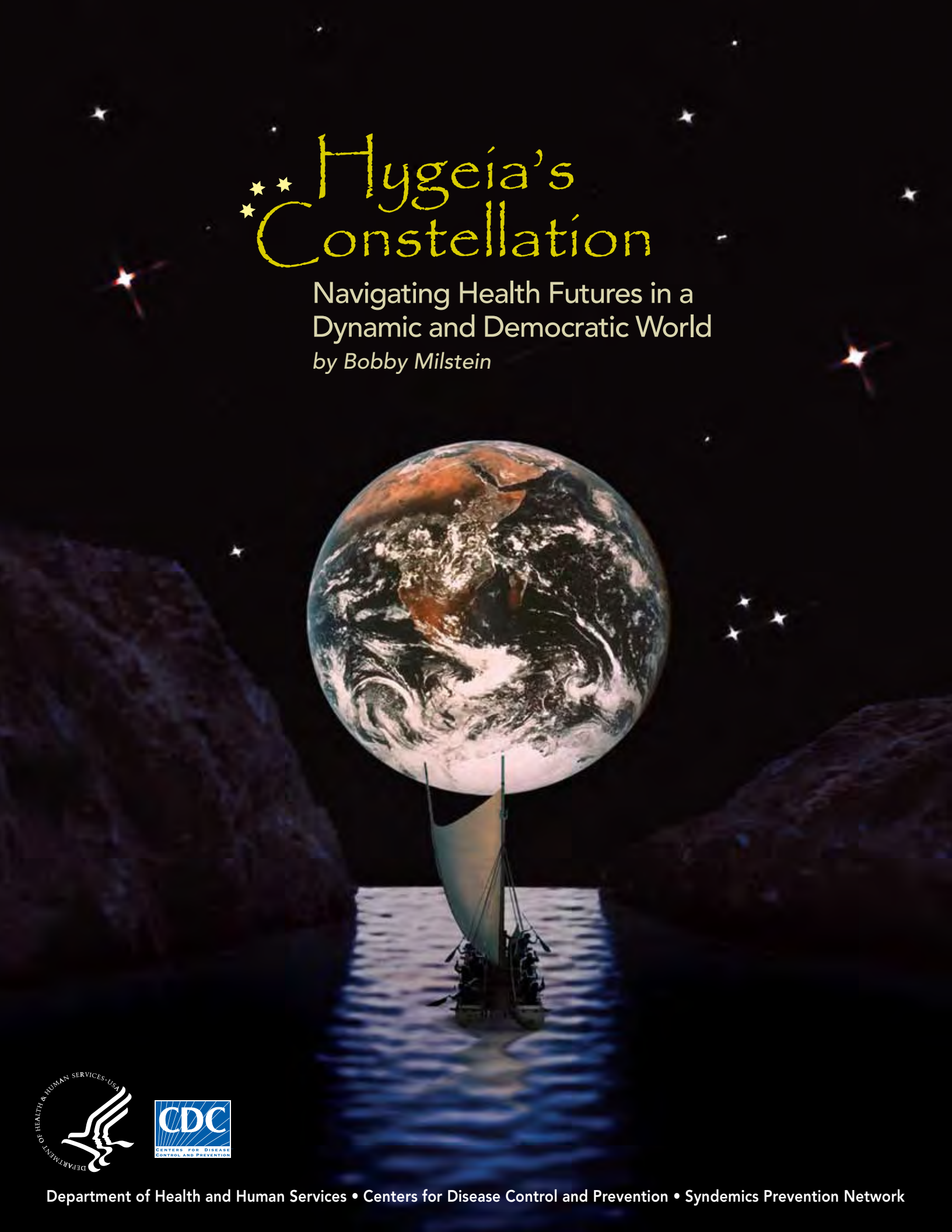
Hygeia's Constellation

Navigating Health Futures in a Dynamic and Democratic World

by Bobby Milstein



Department of Health and Human Services • Centers for Disease Control and Prevention • Syndemics Prevention Network

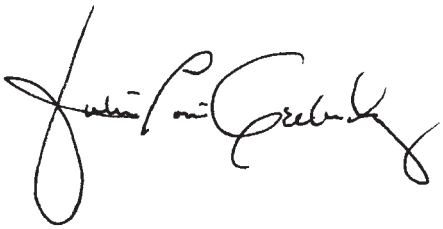
April 15, 2008

Hygeia's Constellation:
Navigating Health Futures in a Dynamic and Democratic World

Each life is a story. Some are long, rich epics filled with happiness, health, and rewarding work, while others—-far too numerous-—are punctuated by excessive adversity, affliction, and loss. Often, helping to define and ameliorate those extremes is another kind of story: the rapidly evolving drama of our collective effort to establish and maintain the conditions necessary for health. In Hygeia's Constellation, the focus is on both health protection, over time and across places, as well as health equity. It is a unique inquiry into the dynamic and democratic dimensions of health in the 21st Century.

Hygeia's Constellation points the way toward a promising new horizon for thinking and action at a time when health threats and the provision of healthcare are increasingly complicated, and health professionals of all types are challenged to respond. Building on past and current innovations, Bobby Milstein asks us to think differently: to consider more than one problem at a time; to see the health landscape in larger, more dynamic terms; and to question what exactly each of us can do, across our respective spheres of influence, to create the conditions for a healthier, more equitable future. Health systems in the United States and around the world are rapidly changing, and need to be guided by an orientation in which problems are confronted in a holistic manner that acknowledges both their contours and connections.

The grave dangers and abundant opportunities that characterize today's health protection enterprise require a broad outlook to navigate health futures-—the alternative trajectories that could unfold for the people's health over time. Hygeia's Constellation is an arresting resource that should be read by every health professional. Readers will be inspired and challenged to learn how their work, along with that of their fellow citizens, may indeed provide the leverage necessary to create a healthier, happier, and more prosperous future for all. Please join us in exploring this unique perspective and its power to transform our daily efforts to protect the public's health and achieve health equity.



Julie Louise Gerberding, M.D., M.P.H.
Director, Centers for Disease Control and Prevention
Administrator, Agency for Toxic Substances and Disease Registry

Acknowledgments

This report on the directed nature of public health work was created through interactions with scores of fellow travelers. Like all worthy voyages, its rewards lay in the unforeseen turns and surprising vistas found along the way. Several people, in particular, must be mentioned by name, for without their guidance this exploration might have stalled in one or more dead ends. Nainoa Thompson provided a compelling example of what it means to be both a student and teacher of navigation; Jack Homer masterfully managed to explain a simple way of learning about complexity; Dick Jackson was quick to go public with big ideas; Glenda Eoyang served as a consistently sensitive and astute sounding board; Nicole Lezin contributed her talents for listening, organizing, and writing; Joanna Davidson was a boundless source of inspiration; and Jasper Milstein opened new horizons just by arriving.

In addition, Union Institute & University committee members–Elizabeth Minnich, Michael Quinn Patton, Marshall Kreuter, Kate MacQueen, Harry Boyte, Ruth Ann Bramson, Don Klein, and Alan Barstow–helped with an unswerving combination of patient faith and pressing enthusiasm.

Finally, many friends and colleagues at the CDC not only saw value in this inquiry, but also provided the freedom to pursue it.

Hygeia's Constellation

Navigating Health Futures in a Dynamic and Democratic World

by Bobby Milstein

THE CENTERS FOR DISEASE CONTROL AND PREVENTION
Syndemics Prevention Network

April 15, 2008

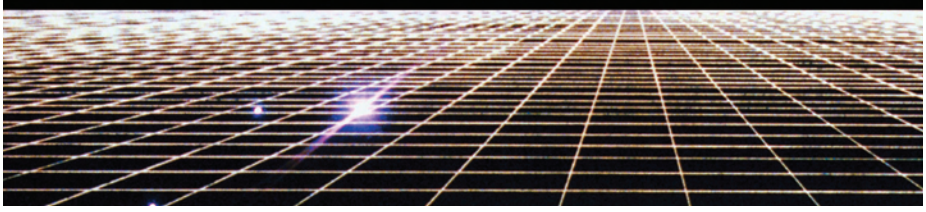
Contact Information
Bobby Milstein, PhD, MPH
Syndemics Prevention Network
Centers for Disease Control and Prevention

Tel: 770-488-5528
E-mail: bmilstein@cdc.gov
Web: http://www.cdc.gov/syndemics

Disclaimer: The findings and conclusions in this report are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention.

Imagining how to create a city in which life would be good is Hygeia's art, which is far more complex [than swallowing a pill]. For a city in which life would be good implies that there is none of that noise to which we adapt by losing our hearing, none of those fumes to which we adapt by developing chronic bronchitis, and none of those constructions that prevent the eye from venturing to the horizon. Yes, that's Hygeia's art, but it can also become a science, a science that tries to understand the basic requirements permitting human nature to express itself totally.

Dubos and Escande, 1979:87



Hygeia's Constellation

Navigating Health Futures in a Dynamic and Democratic World

ABSTRACT

Effective public health work is rooted in traditions of concerned, humane, directed science. However, the field has changed significantly since its formalization in the mid-19th century, and even today, innovators are reshaping its underlying orientations. This study examines the origins and implications of one such innovation, the recent introduction of the term *syndemic*, along with related shifts in thinking and action that occur when operating from a syndemic orientation. Distinguishing between a single epidemic and the phenomenon of syndemics expands, in very particular ways, the conceptual, methodological, and moral dimensions of public health work. This perspective is a reminder that epidemiologic principles have been applied largely to the first tier of a highly complicated health system. It also alerts us to the inevitability of boundary judgments, the need to actively critique those judgments, and the possibilities that exist for orienting the entire health protection enterprise in new directions.

Because public health workers aspire to assure safer, healthier conditions—which are politically contested and constantly in flux—the concepts, methods, and moral principles that shape health policy must themselves resemble the features of dynamic, democratic systems. Hence, a second purpose of this study is to explore what an explicitly dynamic and democratic view of public health work might entail. Examples provided here illustrate how innovators are learning to better acknowledge the interdependency of people in places; map the dynamics that govern patterns of health, vulnerability, and affliction; anticipate a range of plausible health futures; and work democratically with other citizens to build the public strength needed for navigating change and expanding people's freedoms. This inquiry joins conversations from three spheres of scholarship: public health, systems thinking and modeling, and social navigation. All of these inform our collective efforts to navigate health futures through the processes of setting direction, understanding change, and governing movement.

Table of Contents

Tables and Figures

PROLOGUE

Life expectancy in America was still lengthening between 1993 and 2006, as it had for most of the 20th century (Bell, 2005; National Center for Health Statistics, 2006). However, during that same period, adults in the United States reported a sharp decline in health-related quality of life, indicated by a 17% increase in the average number of unhealthy days per month (Figure 1) (Zack, Moriarty, Stroup, et.al., 2004). An important challenge for the modern health protection system[1] is to reconcile these apparent differences.

Part of the answer stems from the fact that health problems within populations almost never exist independently of one another. For instance, people experiencing one affliction (e.g., diabetes) tend to be affected by many (e.g., obesity, heart disease, cancer, asthma, depression), and those problems are often mutually reinforcing. Because of those interconnections, it is necessary to address the particular features of each disease while also crafting conditions that free people from becoming vulnerable to such massively entangled health threats in the first place. To sustain improvements in overall health and safety, public health work cannot stop with the delivery of effective disease prevention services; indeed, that is just the beginning.

Health planners have understood for decades that effective responses to the intertwined afflictions in populations require system-wide interventions. But the desire to achieve systemic change stands in opposition to what most health agencies—and the people who lead them—are prepared to do. Ingrained in financial structures, problem-solving frameworks, statistical models, and the criteria for professional prestige is the idea that each affliction can be prevented individually by understanding its unique causes and developing targeted interventions. Evaluations confirm that this single-issue approach can be effective in temporarily reducing the rate of a given disorder, but it cannot serve as a means for fulfilling society's ongoing interest in assuring the conditions in which all people can be healthy (Institute of Medicine, 1988, 2002a). Nevertheless, most health protection ventures operate with resources focused on one disease or risk factor, leaving other problems to be addressed by parallel efforts.

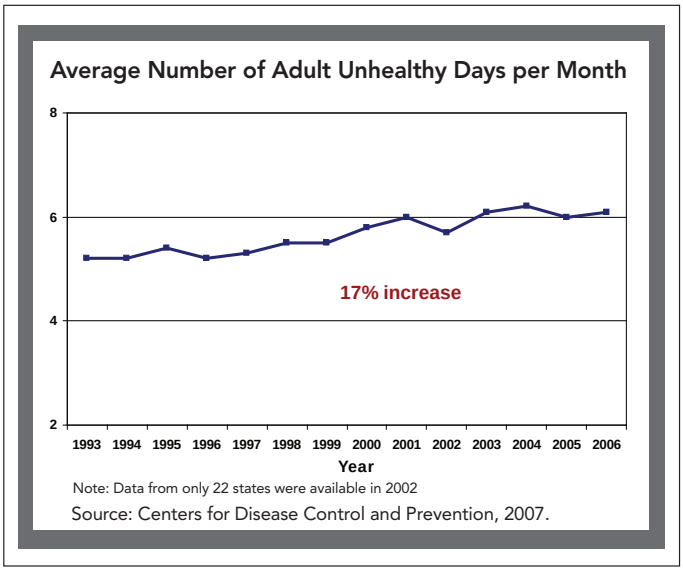


Figure 1: Worsening Trend in Adult Unhealthy Days, United States 1993-2006

This important but ultimately insufficient categorical approach is now so entrenched that the health protection system itself has been diagnosed with a disorder known as "hardening of the categories" (Wiesner, 1993:196).

In 1992, a new conversation became possible with the introduction of an unfamiliar word. Anthropologist Merrill Singer coined the term *syndemic* to describe the mutually reinforcing nature of health crises—such as substance abuse, violence, and AIDS—that take hold among people facing harsh and inequitable living conditions (Singer, 1994, 1996; Singer and Clair, 2003; Singer and Snipes, 1992). Observers throughout history have recognized that different disease processes interact in populations, much as they do within individuals, but Singer's innovation was to interpret those connections as evidence of a higher-order phenomenon, which he and his colleagues called a syndemic.

The science of epidemiology was developed in the 19th century to understand and control discrete, sporadically occurring, and widespread health problems—and it has proven to be an indispensable tool for guiding certain aspects of public health work. The notion of a syndemic, by contrast, challenges us to develop a complementary science of relationships, one that is capable of better understanding and

1 *Highlighted terms are discussed further in the glossary.*

more effectively governing the dynamic forces that surround multiple health problems, along with the intricate organizational systems that we as a society create to anticipate and respond to them.

This report explores how the seemingly subtle distinction between a single epidemic and the phenomenon of syndemics expands the conceptual, methodological, and moral dimensions of public health work. At a time when even the most highly trained and seasoned health professionals are beset—and frequently bewildered—by the sheer number of threats they are called upon to address, the prospect of thinking in syndemic terms has become a pragmatic imperative. It is a reminder that epidemiologic principles have been applied largely to the first tier of a highly complicated health system, as well as a call for orienting the entire health protection enterprise in new directions.

Striving to transform the conditions that give rise to syndemics, many health leaders are working harder than ever to reduce aggregate and inequitable burdens of illness in whole populations. Such comprehensive undertakings elevate public health work to new heights of ambition and complexity. Acting at this system-wide scale, however, requires thinking differently about public health work itself. As a result, innovators throughout the field are observing the health protection system in novel ways, exploring new frameworks for understanding the forces of change, adhering to new principles for directing the course of change, and devising new techniques for charting progress (Leischow and Milstein, 2006).

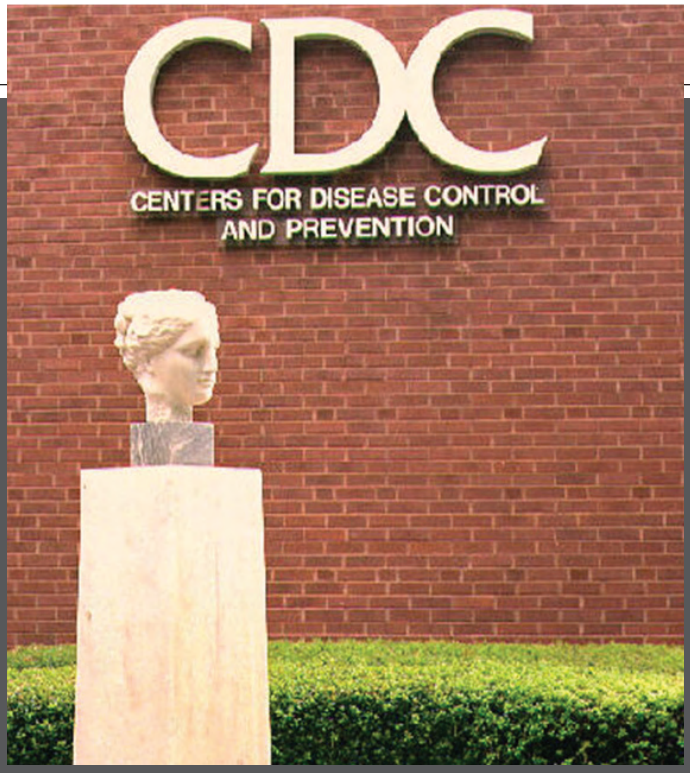
Intrigued by these innovations and intent on understanding more precisely what a syndemic orientation entails, the Centers for Disease Control and Prevention created the Syndemics Prevention Network. Launched in November 2001 (Milstein, 2002b), the group tracks particular instances in which syndemic principles are used, while at the same time pursuing broad, exploratory questions about the pressures and opportunities that move the field to rework its boundaries and practices—and even its language. In that regard, the project recognizes that public health work has changed significantly since its formalization in the mid-19th century and that even today it is poised for further transformation.

With this long view on the evolution of public health ideas, combined with a special emphasis on those innovations, trends, and priorities that have emerged in the modern era (1970—present), it is apparent how profoundly the field is changing. Three clearly discernable directions capture what is in fact a vast and highly nuanced set of shifts. Modern public health work is becoming more:

- ***Interconnected*** (i.e., ecological, multicausal, dynamic, systems-oriented). Efforts focus increasingly on exerting leverage within a large, evolving system rather than on controlling its discrete parts in their strictest sense (i.e., as parts unto themselves).
- ***Public*** (i.e., broad-based, partner-oriented, citizen-led, inter-sectoral, transparent, democratic). Actors are increasingly concerned with respecting many interests and assuring mutual-accountability as opposed to serving the needs and interests of any particular group or hierarchical authority.
- ***Questioning*** (i.e., evaluative, reflexive, critical, ethical, pragmatic). Standards for judgement tend to examine how simultaneous values like health, dignity, security, equity, satisfaction, justice, prosperity, and freedom are upheld in both means and ends.

This report goes beneath these emerging directions. By situating the recent dialogue about syndemics within the broader trajectory of ideas about public health practice, we examine what these movements imply, individually and collectively, about the changing character of modern public health work.

INTRODUCTION



On the lawn in front of the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia, stands a small stone sculpture. Every day, hundreds of people pass by as they enter the headquarters of one of the world's premiere public institutions.[2] Few notice the statue, and even fewer realize that it is a likeness of Hygeia—the Greek goddess of good health.

Although her face may be unknown to the average visitor, and even to most experts who profess to do her work, Hygeia's influence touches each of our lives, as it has for centuries in the still-unfolding story of our endeavor to become safer, healthier people.

2 *As an entity of the United States government, the CDC sits squarely in the public sphere. But that organizational placement is not all that qualifies it as a "public institution." Here, and throughout this report, the phrase public institution refers to those agencies or organizations, either governmental or nongovernmental, that adhere to democratic norms and actively advance policies and practices that support a strong public sensibility.*

The first public institutions ever to focus formally on protecting population health were organized in England in the mid-19th century, spreading quickly thereafter throughout Europe, North America, the Pacific, and beyond (Rosen, 1993). By many measures, the ensuing years proved to be the healthiest in human history, due in large part to the deliberate work of these new organizations and the social movements they helped direct (Krieger and Birn, 1998; Szreter, 2002). Former CDC Director Jeffrey Koplan recently summarized this remarkable period of discovery and action by observing that "public health achievements in the 20th century dwarfed those that had accumulated in the previous 19" (Koplan, 1999:4). And Richard Rhodes, winner of the Pulitzer prize for his inquiry into the scientific drive behind nuclear warfare, declared that "public health is probably the most successful system of science and technology combined, as well as social policy, that has ever been devised. . . .It is, I think, a paradigmatic model for how you do concerned, humane, directed science" (Rhodes, 2002).

It is these qualifiers—concerned, humane, directed—that distinguish public health work from other forms of intellectual pursuit and public action, which tend to be narrowly focused, inhumane, or disorienting. These qualifiers point to the distinctive democratic commitments, moral considerations, and navigational sensibilities that animate effective health leaders and align them with the deep, transformative tradition of pragmatism (Addams, 2002; Dewey, Hickman, Alexander, 1998; West, 1989). Moreover, this pragmatic character of the field still remains strong, despite the rise of powerful undercurrents during the 19th and 20th centuries to position positivism as the main philosophical orientation for studying health policy.

Despite all of their promise for achieving greater health gains (Ezzati, Hoorn, Rodgers, et.al., 2003), and despite all the current enthusiasm about finally confronting entrenched inequities (Evans, 2001; Gwatkin, 2000; Institute of Medicine, 2002b; Leon and Walt, 2001; Northridge, Stover, Rosenthal, et.al., 2003; Wilkinson, 1996), our efforts to protect the public's health in the modern world are transforming and destabilizing in ways that have only begun to be acknowledged (Beaglehole and Bonita, 2004; Fielding, 1999; Institute of Medicine, 2002a, 2002c). An ever-expanding body of knowledge about opportunities for protecting health and preventing disease—which are now known to exist everywhere from the genetic to the ecological—is offset by the fact that much of this knowledge is never used (Green, 2006; Green and Johnson, 1996; Institute of Medicine, 1997); and it is further undermined as great achievements of the past either erode or become dangerously fragile in their modern context.

Since the mid-20th century, for example, there have been sharp declines in the effectiveness of several formerly powerful health protection measures. This was the case for two of our most significant advances: drug therapy for controlling tuberculosis and the use of DDT for preventing malaria (Rosenberg, 2004). Microbial resistance, in the case of TB, and concerns over harmful environmental effects, in the case of DDT, eroded the effectiveness of these once-treasured interventions. These examples are, of course, just two chapters in a much longer and more subtle story. Numerous other instances of health protection measures that have lost their effectiveness can be traced to an array of complicated physical and social trends, including such phenomena as demographic and epidemiologic transitions, the emergence of new pathogens, increasingly pervasive forms of violence, and the spread of transformational new ideas and new technologies across virtually all spheres of human existence. In the past few decades alone, these and other forces of change have introduced grave new threats, as well as unprecedented opportunities for precisely the kind of concerned, humane, directed action that is the hallmark of public health work.

In this precarious position, with our existing health protection infrastructure in flux (Baker and Koplan, 2002; Baker, Potter, Jones, et.al., 2005; Centers for Disease Control and Prevention, 2000b) and with all of our lives—indeed with life itself—in the balance, what exactly is Hygeia's work? Who does it? How strong must it be? Where is it leading?

PURPOSES OF THIS DOCUMENT

This report examines how public health work is transforming and reorienting in the context of contemporary challenges. It concentrates on several linked innovations in thinking and action, set against historical examples and current trends. With those directions in mind, the report then considers the pragmatic work that we must now do, as citizens of a pluralistic and increasingly fast-moving world, to assure safer, healthier conditions for ourselves and for generations to come.

The first section, Navigating Health Futures, delves deeper into what Richard Rhodes identified as the "directed" character of public health work. It regards the essential challenge facing those who value health, individually and collectively, as one of navigating among a variety of plausible futures: some that are fraught with excessive and unjust suffering, and others that are demonstrably safer and healthier. By considering the qualities that would-be navigators must possess, we counter the myth that effective navigation depends only on the efforts of those with special abilities or advanced credentials and instead locate the power for change within each citizen who finds the courage to become personally involved.

Acting in this way, in pursuit of one's values, makes a person visible to the point where a story could be told about him or her as an individual. Extending this idea to the circumstance in which society is filled with many possible actors, all of whom react to one another, raises the question of whether it is, in fact, feasible to align or organize our efforts so that they create a demonstrably healthier future. The health of ourselves, our families, and our world seems to depend on this fragile dynamic: on the configuration of more than six billion individual stories, contributing as they must to the larger story of how well we navigate for health. Within that broad story also lies an important inner tale about the changing roles that trained health professionals have in the modern health protection system.

The section entitled, Valuing Conditions, asks us to think hard—as some Hawaiian children already have done—about what is most important to us and what we are willing to do to protect the things we value. Then, in a section on Crafting Conditions, we revisit a 150-year-old piece of public health lore: John Snow's interruption of the 1854 cholera epidemic in London by removing the Broad Street pump handle (Frerichs, 2004). While acknowledging the importance of Snow's pioneering action, we question what lessons are drawn today from his contribution and juxtapose those against insights from another form of public health work performed at a different time and place. Together, these examples set the backdrop for a section on Perceiving Dynamic Conditions, which examines the mismatch that occurs when actions borne of incremental, step-by-step thinking become the main avenues for directing system-wide change. That dilemma is then reexamined in a section on Reorienting Public Health Work, which presents the main facets of a syndemic orientation and explores the conceptual, methodological, and moral innovations that it entails (Milstein, 2002b).

The penultimate section on Transforming Conditions illustrates four of these innovations in action. First we revisit North Karelia, Finland, in the 1970s: epicenter of one of the most successful health improvement ventures on record (Puska, 1995). Looking anew at what the Finns accomplished, with their bifocal vision of people-in-places and their remarkably democratic approach to the work, we find clues indicating how the citizens of Finland successfully transformed the conditions that left them vulnerable to heart disease, stroke, cancer, and other related diseases in ways that their American counterparts still have not.

Moving beyond North Karelia, we examine how two complementary analytic methods—system dynamics mapping and simulation modeling—help to expand the questions that health planners may ask, as well as the tools that we use for learning in and about dynamically complex systems (Sterman, 2000, 2006). These methods, and others like them, open new horizons for better understanding some of our toughest, most counterintuitive dilemmas (Forrester, 1971). Two such problems, highlighted as examples here, are how to prevent and control diabetes in an era of rising obesity and how to craft an effective grantmaking strategy in situations where the pressures of multiple interacting epidemics are outstripping people's power to respond.

Shifting from the virtual world of dynamic models to the real world of directed action, we conclude this section with the confession of a noted epidemiologist who sees an insidious problem in the way that he (and others like him) are trained to become health professionals in the first place. His perspective reveals several pitfalls of professionalism, while underscoring both the difficulty and the tremendous value of keeping our civic identities in the foreground as we work to protect the public's health. In an era when science and professional expertise hold such high esteem, these insights illustrate how public-minded professionals can reframe their practice and create institutional cultures that allow serious public health work to flourish.

A final section draws these various themes together to reflect on the renewed meanings of each word in the otherwise wobbly and too-casually used phrase, *public health work*.

Ancient Greece, the mixed mythical and real-world backdrop for Hygeia and her family of gods and goddesses, was also the setting for one of the greatest voyages in literature—Homer's *Odyssey*. It was also the birthplace of an imperfect but still-promising experiment in social governance called democracy. Stories illustrating these three themes—of Hygeia's active stewardship of the public's health, navigation through uncharted terrain, and governance through democratic organizing—are braided in this document. The ideas beneath these stories, and the many innovators who bring them to life around the world, are the stars in Hygeia's constellation, inspiring and guiding us as we journey together into an evolving future, continually crafting and protecting what we truly value: the conditions in which all people can be healthy.

JOINING SCHOLARLY CONVERSATIONS

When Merrill Singer coined the term *syndemic* in the early 1990s, he crystallized into a single word an important but often-neglected strand of thinking about how people actually experience health problems, particularly those who have been excluded from society's full respect and protection. The following passage explains why he introduced the term.[3]

Commonly, violence, substance abuse, and AIDS have been described as concurrent epidemics among inner city populations. However, the term epidemic fails to adequately describe the true nature of the contemporary inner city health crisis, which is characterized by a set of closely interrelated, endemic and epidemic conditions, all of which are strongly influenced by a broader array of political-economic and social factors, including high rates of unemployment, poverty, homelessness and residential overcrowding, substandard nutrition, infrastructural deterioration and loss of quality housing stock, forced geographic mobility, family breakup and disruption of social support networks, youth gang formation, and health care inequality.

We have introduced the term "syndemic" to refer to the set of synergistic or intertwined and mutual enhancing health and social problems facing the urban poor. Violence, substance abuse, and AIDS, in this sense, are not concurrent in that they are not completely separable phenomena. Rather, they emerge in the lives of participants in our study as closely intertwined threads in the often tattered fabric of their daily lives. (Singer and Romero-Daza, 1997:1)

In the early phase of the HIV/AIDS epidemic, applied anthropologists like Singer teamed up with public health investigators in an urgent, though unfamiliar, effort to examine the local and cultural dimensions of vulnerability, risk, and prevention. In those nascent exchanges between anthropology and epidemiology (Hahn, 1995; Janes, Stall, Gifford, 1986; MacQueen, 2002; Trostle and Sommerfeld, 1996), Singer made explicit what had long been held as a basic principle by residents and observers of poor and minority neighborhoods: different types of health problems are frequently connected in ways that must not be overlooked.

---

3 *In the first decade after the word syndemic appeared in print, diffusion of the concept had not proceeded much further than its originator. In October 2001, the science citation index counted exactly 30 references to Singer's most widely read article (Singer, 1994) but no publications with the term syndemic in its title, abstract, or keywords. The one article to have featured the word in its title prior to 2001 was Singer's 1996 report on connections among substance abuse, violence, and AIDS was published in the journal Free Inquiry in Creative Sociology, which is not included in the science citation index and so it is impossible to track references to it. An expanded search encompassing publications not included in the index revealed several additional publications in which the concept was mentioned, all of which were authored by Singer himself (Singer, 1996, 1999, 2001; Singer and Romero-Daza, 1997). At least one other team of researchers did cite the 1996 paper, but they did not use the term syndemic in the text of their report (Valdez, Kaplan, Curtis, et.al., 1995). Moving beyond academic databases, Internet searches using a variety of search engines returned between 0 and 11 hits, all of which were links to Singer's 1994 or 1996 article. This lack of an online presence provides a relatively clear starting point for tracking further diffusion in the years ahead.*

Ideas about ecological and systems approaches had been circulating in the field, but there was no coordinated scholarship on the subject of syndemics per se. In November 2001, the CDC launched the Syndemics Prevention Network, which sparked widespread interest throughout the public health workforce and beyond (Centers for Disease Control and Prevention, 2001; Milstein, 2002b, 2005). Since then, recognition of the term has been growing, and a widening conversation is now under way.

In November 2001, seven reports had explicitly used the word syndemic (Singer, 1994, 1996, 1998, 1999, 2001; Singer and Romero-Daza, 1997; Singer and Snipes, 1992). Just over six years later, in January 2008, approximately 200 such reports exist, with about 85% of them by authors other than Singer. Also, during that same time period, the number of Internet hits using the Google search engine grew from 0 to 2,820.

As of January 2008, approximately 625 colleagues representing over 400 organizations in 20 countries had joined the network, which continues to grow about 8% per month.

With the Greek prefix *syn*, meaning together, the term syndemic strips away the ancient idea that illnesses originate from extraordinary or supernatural forces and places the responsibility for human suffering squarely within the public arena, where people come together to confront and craft a common world. Singer's neologism points to the power of all relationships, raising questions about how different kinds of health problems affect each other. At the same time, it calls attention to the ways in which people and institutions relate to one another and to the physical places in which they exist. In its fullest sense, the word syndemic portrays health as a fragile, dynamic state that is imperiled when social and physical forces come together in harmful or dysfunctional ways. The word asks that all observers pay closer attention to the connections that have always existed but are often overlooked, unquestioned, or neglected in the conventional approach of epidemiology.

The notion of a syndemic does not challenge the legitimacy of epidemiology, which was invented to understand discrete, sporadically occurring problems and has proven itself to be an indispensable tool for guiding public health work. Instead, the idea invites us to develop a complementary science of relationships (Bammer, 2003; Emirbayer, 1997) that is capable of understanding and more effectively governing the dynamic forces that surround multiple health problems, along with the intricate organizational systems that we as a society create to anticipate and respond to them.

By advancing the notion that epidemics can and often do come together as syndemics, Singer resisted the tendency to divide different sorts of health threats into analytically or bureaucratically convenient categories. Instead, he deliberately expanded the boundary that most of us—especially health scientists—instinctively use when framing our thinking and action. He also used his neologism to question what sorts of facts and values ought to shape our work in protecting the public's health. What Singer did not write about, however, was the degree to which his approach, grounded in critical medical anthropology (Singer, 2004), was connected to the process of "boundary critique" that had emerged almost a decade before as the methodological core of critical systems thinking (Ulrich, 1983, 2000, 2002).

To better appreciate the implications of Singer's linguistic intervention, or of similar innovations that strive to transform our perceptions and performance of public health work, we must consider the conceptual orientation from which it springs. However, the quest to situate such innovations within a larger intellectual landscape draws us into a vast set of scholarly conversations about the conditions for health and the most productive ways of thinking and acting to assure them. One particular interpretation of Singer's innovation recognizes its position and heritage within three broad but distinct spheres of scholarship (Figure 2).

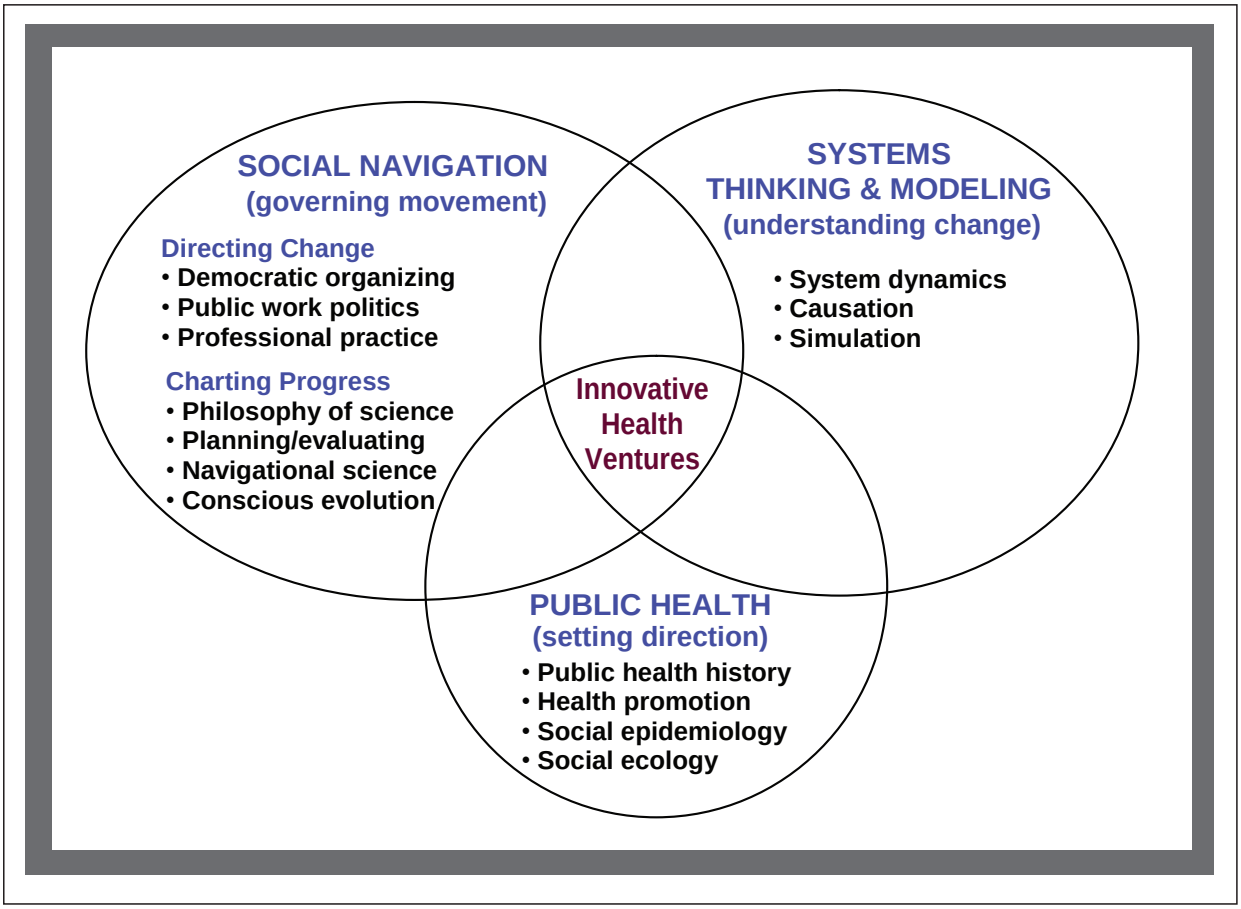


Figure 2 Selected Fields and Subfields Shaping Innovative Health Ventures

The *public health* sphere is the domain where society's health-related goals are set. This sphere provides the context for learning what health leaders have set out to accomplish at different times, in different cultures, and from different points of view. Writings on public health history, health promotion, social epidemiology, and social ecology are among the most relevant strands of scholarship here.

The sphere of *systems thinking and modeling* aims to improve understanding in a world marked by dynamic complexity and animated by various forms of causal relationships (e.g., reinforcing and balancing feedback structures). This sphere provides a focus for questioning what processes cause health problems to emerge, how different health problems are related, what kinds of responses they evoke, and what it takes for health systems to change. Roles for analytic methods that focus explicitly on understanding causal relationships—like system dynamics mapping and simulation modeling—come to the forefront, as do philosophical considerations about the nature of causal reasoning itself.

Finally, the sphere of *social navigation* encompasses those aspects of thinking and action that address goal-directed movement, specifically the organization and governance of healthrelated conditions. This area deals with questions about who does the work to effect healthrelated change, by what means, against what forms of resistance, and in pursuit of which values. It also includes a reflexive dimension for discerning how health-related conditions are changing, for whom, and in what directions.

The subfield on *Directing Change* draws insights from broad-based democratic organizing ventures, with an emphasis on roles for citizen actors and critiques of public institutions, corporations, and professional practices. Likewise, the subfield on *Charting Progress* takes an expansive look at how we plan and evaluate public health work. By bringing the temporal dimension of population health dynamics to the forefront, it frames health improvement efforts in both a navigational and an evolutionary context. This sphere of inquiry also considers the epistemological prerequisites for recognizing and recording change within dynamic and democratic systems.

Taken together, these fields of inquiry highlight the dynamic and democratic character of health-related conditions and of our own health protection endeavors. These dimensions, in turn, sketch the outlines of a distinct conceptual reorientation that occurs when shifting from a problem-solving approach with a single, fixed problem at its center to the fluid, public craft of navigating health futures in an unstable and openly contested landscape.

For the purposes of this study, we drew boundaries around these particular fields of inquiry and labeled them in such a way as to highlight their relevance and interconnections. All of them share an essential navigational character in the processes of setting direction, understanding change, and governing movement. Each field is positioned to complement the others and their synthesis yields a transdisciplinary orientation for both studying and generating innovative public health ventures.

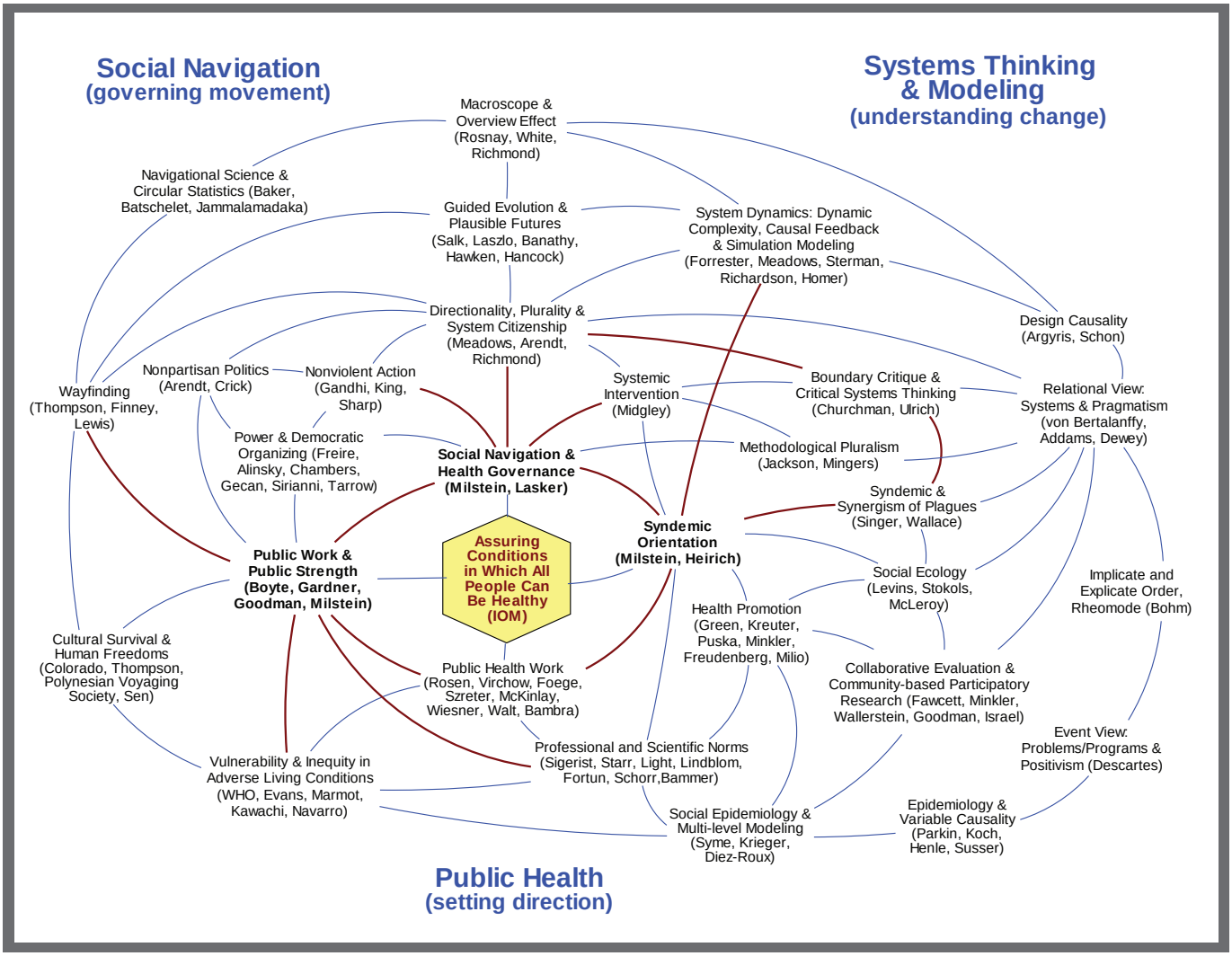


Figure 3 Assuring the Conditions for Health: Selected Ideas Shaping Scholarly Conversations

Figure 3 delineates several of the most prominent ideas that are hallmarks of each domain, based on a review of nearly 7,000 published references. This is not a causal diagram. It is a map of selected ideas and the scholarly conversations that emerge from them. The links indicate connections or possible connections that exist among the ideas, in some cases even where the relevant writers themselves have not noticed an association. The relationships depicted take several forms. One idea may follow from another, support it, or contradict it. The diagram's intent is to examine pathways and consider how conversations change complexion based on the constellation of ideas that shape them. The authors listed within the parentheses and cited in the accompanying narrative convey salient perspectives, which may differ from one another. Red (bold) links are the most crucial ones for drawing together the three broad fields of inquiry.

Located on the far right of the diagram is the provocative idea, from physicist David Bohm, that in addition to the *explicate* order we perceive with our senses and measure with instruments, there is also an *implicate* order that explains the connectivity and wholeness exhibited throughout nature (Bohm, 1981). In many respects, our tendency to concentrate on either the explicate or the implicate order maps onto one of the primary distinctions affecting all public health thinking: the choice of an *event-oriented view* versus a *relational view* (Emirbayer, 1997). An event-oriented view is characterized by efforts to define specific problems and thereby devise narrowly targeted responses. It lends itself to the strict application of Cartesian positivist logic.

By contrast, a relational view resists focusing on any particular entities unto themselves and instead examines patterns of connection across layers of organization, searching for insight into the ties between a system's structure and its observed behavior, often set within the context of a vast network of human relationships. This *systems approach* (von Bertalanffy, 1951; von Bertalanffy and LaViolette, 1981), with its willingness to engage the perplexity of daily life, resonates with the premises and practices of *pragmatism* (Addams, 2002; Dewey and Sidorsky, 1977; West, 1989), even though their vocabularies have remained largely distinct.

A notable exception can be found in the work of Werner Ulrich, who has written explicitly about the need to "pragmatize" critical systems thinking for professionals and citizens (Ulrich, 1998, 2000, 2003). Working in that populist vein, he has extended the ideas of pioneer systems thinkers like Churchman (Churchman, 1970) to stress the need for diverse stakeholders to engage in active *boundary critique* as they examine the various facts and values that are and are not included in a given intervention or inquiry (Ulrich, 1983, 2002).

The most complete synthesis of these approaches in contemporary systems practice appears in Midgley's notion of *systemic intervention* (Midgley, 2000, 2006), which achieves a remarkable synergy by combining boundary critique with the power of *methodological pluralism* (Flood and Jackson, 1991; Mingers and Gill, 1997).

Moving further from right to left across Figure 3, the event-oriented and relational views each lead to correspondingly different notions of causality, with attendant differences in analytic methodologies. Despite modern critiques, epidemiology adheres largely to ideas of *variable causality*, in which one or more factors are assigned the role of a proximal or distal cause (Evans, 1976, 1993; Parkin, 1873; Susser, 1973, 1991, 2001). Alternatively, systems thinkers concentrate on the particular organization or configuration of variables at work in a problematic situation, pursuing the idea of *design causality* as their guide (Argyris, 1996; Dent, 2003; Richardson, 1991; Schon, 1983). These contrasting views of causal structure have also been translated into distinct mathematical forms, such as *multi-level models* (Diez-Roux, 2000) or *system dynamics simulation models* (Forrester, 1961; Homer and Oliva, 2001; Sterman, 2000), as just two of many possible examples.

A set of hybrid concepts, located in the middle right of the diagram, bridges the spheres of public health and systems thinking and modeling. These concepts include ideas about *social ecology*, which examines the reciprocal influence of individuals and their environments (Levins

and Lopez, 1999; McLeroy, Bibeau, Steckler, et.al., 1988; Stokols, 1992, 1996; Stokols, Allen, Bellingham, 1996; Stokols, Grzywacz, McMahan, et.al., 2003), *collaborative evaluation and community-based participatory research*, which attempts to diversify participation and equalize power relationships in the conduct of program/ policy evaluation or action research (Fawcett, Francisco, Hyra, et.al., 2000; Fawcett, 2002; Fawcett, Paine-Andrews, Francisco, et.al., 2001; Goodman, 1998, 2001a; Goodman, 2001b; Israel, Schulz, Parker, et.al., 1998; Minkler, 2000; Minkler and Wallerstein, 2003; Wallerstein, 1992; Wallerstein and Bernstein, 1994), *social epidemiology*, which strives to incorporate information on social determinants of health into theories of disease distribution (Berkman and Kawachi, 2000; Krieger, 2001a, 2001b; Syme, 1994; Syme, 1996; Syme, 2005), and *health promotion*, which attends to those conditions that sustain population health (Freudenberg, 1978, 1982; Freudenberg, Eng, Flay, et.al., 1995; Green, 1999; Green and Kreuter, 2004; Green, Richard, Potvin, 1996; Kreuter, 1992; Kreuter, 2003; Milio, 1981, 2001; Minkler, 1989, 1994; Puska, 1995). Although there are important differences among these traditions, they all proceed from an essentially relational view of the world and are devoted to exploring the interfaces between society and population health. For the most part, however, these orientations do not incorporate the sort of analytic formalisms that have become so prominent in the system sciences over the last 50 years (Midgley, 2003). In general, their commitment to a relational view tends to break down in the selection of formal analytic methods that are more consistent with conventional biomedicine and public health research (e.g., event-oriented, correlational methods like regression modeling).

One exception to this trend of mismatching concepts and methods can be found in the intricate mathematical models used by Rodrick and Deborah Wallace to track a *synergism of plagues* affecting New York City neighborhoods and suburbs since the 1970s (Wallace and Wallace, 1998; Wallace, 1988; Wallace and Wallace, 1997). Not coincidently, Singer drew heavily on the Wallaces' research as a primary justification for his writing on *syndemics* (Baer Singer, Susser, 2003; Singer, 1994, 1996; Singer and Clair, 2003; Singer and Romero-Daza, 1997; Singer and Snipes, 1992).

The cluster of relational approaches to public health work in the middle right of the diagram is also linked in important ways to the ideas of social navigation located on the left, but in this two-dimensional picture those connections are omitted.

Efforts to assure equitable conditions for health are widely understood to require an element of social action or planned intervention (Freudenberg, 1978; McKinlay, 1993), sometimes orchestrated to expose and challenge the practices of those perceived to be "disease promoters" (Freudenberg, 2005) or the "manufacturers of illness" (McKinlay, 1979). For that reason, leading practitioners and theorists have sought to incorporate concepts of power, politics, community organizing, and social movement in their analyses of public health work (Farmer, 2003; Fawcett, Paine-Andrews, Francisco, et.al., 1995; Israel, Checkoway, Schulz, et.al., 1994; Light, 1997; McKnight, 1978; Muntaner, 2002). In most cases, these ideas are shaped by a deeply-held desire to empower disenfranchised or oppressed groups and thereby approach a higher state of social justice (Rissel, 1994; Wallerstein, 1992; Wallerstein and Bernstein, 1994). The concern for achieving social justice is, in fact, so prominent that it has been argued to be a defining element of the field and of the public's health itself (Beauchamp, 1976; Hofrichter, 2003; Krieger and Birn, 1998; Raphael, 2002; Ruger, 2004).

However, to appreciate the essential navigational character of the field one need not accept, a priori, that the struggle for social justice is the guiding ideal of public health politics. The mere facts of our plurality and agency in a constantly changing world make *power and democratic organizing* important dimensions of the work. According to the political scholar Joan Bondurant, "social and political theory have neglected the central question of means, and, therefore, the problem of inevitable conflict" (Bondurant, 1988:v.). Apart from pursuing abstract ends, like empowerment or social justice, we may properly consider and critique public health innovations within the larger sphere of efforts to build and exercise the power that we already possess.

Some democratic theorists (Alinsky, 1946, 1971; Chambers and Cowan, 2003; Freire, 2000; Gecan, 2002; Sirianni and Friedland, 2001a; Tarrow, 1998) carry this orientation still further by explaining that the work of governing social change goes beyond processes of collaboration to include an acknowledgment of our unique and sometimes conflicting interests, combined with a dedication to work across those differences as we negotiate and shape a common world.

Certain commentators have bristled at the notion of tying public health work so closely to the political sphere, fearing that it may undercut our claims of scientific credibility (Rothman, Adami, Trichopoulos, 1998). However, such criticisms generally confuse partisan politics, based on dogma and ideology (which are antithetical to scientific inquiry), with the robust DRAFT Hygeia's Constellation — Page 29 traditions of nonpartisan politics (which often are the impetus for serious scientific practice and responsible evidence-based policy making) (Arendt, 1958; Crick, 1993; Fortun and Bernstein, 1998).

Also commonly overlooked is the nature of political action itself and its consistency (or inconsistency) with the aims of health protection. With that as a further consideration, we see that the inevitable conflicts over social direction among those with differing interests and aspirations must be conducted through the use of *nonviolent action* (Bondurant and Fisher, 1973; Gandhi and Fischer, 1983; King, 2002; Sharp, 1962, 1973a, 1990, 2005). The alternative is flatly inconsistent with the work of assuring equitable conditions for health.

Stepping back from the gritty details of how we wield power and govern change amidst our differences, we see that the entire process is aptly captured by the Polynesian concept of wayfinding (Evenari, Aginsky, Dorsky, et.al., 1999; Finney, 1976; Lewis, 1994; Polynesian Voyaging Society, 2002; Thompson, 2000a, 2005). The idea, as originally conceived, involves more than the physical task of navigating long-distance deep-sea voyages. It also encompasses the cultural values and practices that infuse decision-making at home (Thompson, 2000b). The idea combines the notion of navigating from place to place with the concepts of moving forward through time while transferring a continually evolving culture from one generation to the next.

Just as each crew member on a canoe is ultimately responsible for its safe passage from port to port, so too are all members of society endowed with the opportunity—and the responsibility—to help govern the course of public affairs. As the biologist Garrett Hardin observed,

> We cannot predict history but we can make it; and we can make evolution. More: we cannot avoid making evolution. Every reform deliberately instituted in the structure of society changes both history and the selective forces that affect evolution—though evolutionary change may be the farthest thing from our minds as reformers. We are not free to avoid producing evolution: we are only free to close our eyes to what we are doing" (quoted in Corning, 2000).

These ideas are not merely metaphorical; they also offer a precise nomenclature for describing the directed nature of change and our role as agents or navigators within it. Recent works on the concept of *guided evolution and plausible futures* echo many of these same sentiments (Banathy, 2000; Hancock and Bezold, 1994; Hawken, Ogilvy, Schwartz, 1982; Laszlo, 2001; Salk, 1973). However, much of that literature lacks the precision and sophistication that is possible using formal *navigational science* (Baker, 1981; Batschelet, 1981; Jammalamadaka and Sengupta, 2001) and intentional *macroscopic orientations* (Richmond, 1993; Rosnay, 1979; White, 1998).

There are also many practical benefits of seeing health-related social change as the product of our collective wayfinding. Specifically, it

- adds *directionality* to the other essential human conditions of natality, mortality, and plurality (Arendt, 1958); DRAFT Hygeia's Constellation — Page 31
- recognizes that each member of society, regardless of his or her nationality or legal status, is a *system citizen* in the literal sense of being an active participant in the systems of which he or she is a part (Meadows, 1991; Richmond, 2002; Richmond, 2003);

- elevates the stature and necessity for effective *public work*, which is defined as "sustained, visible, serious effort by a diverse mix of ordinary people that creates things of lasting civic or public signifi cance" (Boyte, 2004b, 2005; Boyte and Kari,1996a; Center for Democracy and Citizenship, 2001; Gardner, Csikszentmihalyi,Damon, 2001);
- underscores the value of *cultural survival* as the repository of time-tested wisdom (Colorado, 1992; Malama Hawaii, 2003; Polynesian Voyaging Society, 2002; Thompson, 2000b); and
- serves as a reminder of a basic but often neglected dimension of *human freedoms* (Sen,1999; United Nations Development Programme, 2004): the freedom to move in directions other than those that our predecessors or contemporaries have established.

The phrase *social navigation* is my own invention (Milstein, 2002b, 2004b, 2004c; Milstein and Homer, 2004; Milstein and Seville, 2005), designed to combine the pragmatic, evolutionary perspective of wayfinding with the vast store of theory and experience about social movements (Etzioni, 1991a; Freeman and Johnson, 1999; Goodwin and Jasper, 2004; Morris and Mueller, 1992; Moyer, 2001; Sheller, 2001), the dynamics of conflict and nonviolent action (McAdam, Tarrow, Tilly, 2001; Powers, Vogele, Kruegler, et.al., 1997; Sharp, 1973a, 1990, 2005; Tarrow, 1998; York Zimmerman Inc. and WETA-TV, 2000), social entrepreneurship (Ashoka, 2004; Bornstein, 2004; Duhl, 2000); and broad-based democratic organizing (Chambers and Cowan, 2003; Cortes, 1993; Gecan, 2002; Industrial Areas Foundation, 1990; Osterman, 2002; Rogers, 1990; Warren, 2001; Wood, 2002). It also addresses the reflective and epistemiological aspects of these efforts to direct change under the complementary notion of charting progress.

In the context of public health literature, social navigation is closely aligned with the concept of community health governance (Lasker and Weiss, 2003), which grew out of the system change orientation of the Turning Point Initiative (Hassmiller, 2002; Turning Point National Program Office, Turning Point Performance Management Collaborative, Public Health Foundation (U.S.), 2003). However, that particular model lacks some of the political texture and intergenerational features, as well as the potential mathematical formalism, of an explicit navigational framing.

The prospect of navigating toward healthier futures raises questions about our individual and collective capacities to counter those forces that might move society in dangerous or risky directions (Freudenberg, Eng, Flay, et.al., 1995). Building on the recent wellspring of ideas about community capacity and collective efficacy (Bowen, Martin, Mancini, et.al., 2000; Chaskin, 1999, 2001; Eng and Parker, 1994; Goodman, Speers, McLeroy, et.al., 1998; McKnight and Kretzmann, 1990; Norton, McLeroy, Burdine, et.al., 2002; Sampson, Raudenbush, Earls, 1997), I have sought to recast this notion in more outwardly democratic terms as public strength (Homer and Milstein, 2004; Milstein, 2003a).

This phrase permits two simultaneous strands of interpretation: one having to do with the power of citizens to direct the course of change toward a negotiated set of valued conditions, and the other emphasizing the vitality of the polis itself. It is precisely this latter aspect of preserving an open and active political sphere, where the potential for effective public work resides, that leads to our concern for vulnerability and inequity in adverse living conditions (Aday, 2001; Evans, Barer, Marmot, 1994; Kawachi, Subramanian, Almeida-Filho, 2002; Lamprecht and Sack, 2003; Marmot, 2004; Navarro, 1993, 2002; World Health Organization, 1986, 2005a)—not under the instrumental logic of social risk factors for disease, but rather as serious impairments of public health unto themselves (Buchanan, 2000).

Earlier, we observed that a new conversation about public health work had opened when Merrill Singer introduced the term syndemic. In light of the interconnected themes in Figure 3, it appears that we may already have articulated many useful principles and procedures to support and extend this direction in thinking. The conceptual move that allows us to see syndemics links the fields of public

health, systems science, and social navigation. For that reason alone, it is worthy of our enthusiasm as well as our scrutiny. Seeing syndemics reveals novel lines of inquiry while reviving and reconnecting us to some of the most profound and long-standing conversations in the field.

For simplicity, we may refer to the entire conceptual outlook that approaches public health work in these dynamic and democratic terms as a *syndemic orientation* (Milstein, 2002b, 2002c, 2002d, 2004a, 2004b, 2004c).[4] A closely aligned perspective was developed by sociologist Max Heirich in his book Rethinking Health Care to describe the conceptual, methodological, and ethical innovations that reworked the health landscape in America in the 20th century (Heirich, 1999).

The real significance of a syndemic orientation, however, lies in the transformations that it might engender for our *professional and scientific norms* (Bammer, 2003; Fortun and Bernstein 1998; Light, 1991, 1997; Lindblom, 1959; Schorr, 1997; Sigerist, 1943; Starr, 1982) and even more forcefully, in the meaning of *public health work* itself (Aday, 2005; Bambra, Fox, Scott- Samuel, 2005; Foege, 1987; McKinlay, 1979; McKinlay and Marceau, 2000a; Rosen, 1993; Szreter, 2002; Virchow and Rather, 1985; Walt, 1994; Wiesner, 1993). Both of these issues represent rich areas of scholarship and debate, to which this study contributes. The remainder of this report examines particular instances that illuminate and enrich our understanding of what a syndemic approach to public health work might entail.

Being less concerned with the idea of a syndemic when used as a noun (i.e., to name clusters of linked afflictions), we will concentrate instead on the nature of people's thinking and action when they operate from a syndemic orientation.

The study's specific guiding questions are

- What kind of science lies beyond the boundaries of epidemiology, which focuses in name and in practice on the singular phenomenon of an epidemic?
- What concepts characterize a syndemic orientation?
- What methodologies support this perspective (scientifically, politically, morally)?
- What effects do these ways of thinking and acting have on individuals and in the world at large?

A SYNDEMIC ORIENTATION IS...

A way of thinking about public health work that focuses on connections among health-related problems, considers those connections when developing health policies, and aligns with other avenues of social change to assure the conditions in which all people can be healthy.

4 *Strictly speaking, it might be more accurate to label the overall approach a "navigational orientation" or a "relational orientation." But those descriptors tend to be less effective in capturing people's initial imagination and in releasing their hold on outdated mental models (Doyle and Ford, 1998; Sterman, 2002). What is most important about the term syndemic is not the word itself, but the type of thinking that it engenders (Richmond, 2000), as well as the unique constellation of concepts and methods that it joins (Milstein, 2002a).*

NAVIGATING HEALTH FUTURES

Looking ahead there is little doubt that safer, healthier futures for ourselves, our families, and our world are plausible, as are ones fraught with excessive and unjust suffering.[5] Which of these paths will come to pass depends in part—some say in large part—on our powers to resist those forces that threaten our well-being and navigate for health. With an array of familiar and unfamiliar threats to health accumulating amidst intense changes in local and global living conditions, it is worth asking, how prepared are we to find and follow a healthier course? Is it even meaningful to think in such terms? And if so, what does that imply about the work to be done, and about ourselves as navigators? What powers are needed to direct the course of change? Who possesses them? Where exactly are we headed…and why? These are among the many questions running beneath, and increasingly on the surface, of a widening dialogue about how public health work is reorienting to the challenge of navigating health futures in a dynamic and democratic world.[6]

Even in the most violent, turbulent, or tyrannical times, there always exists the potential to move in a new direction (Loeb, 2004).[7] For many, the experience of undeserved or avoidable suffering (sometimes even the hint of it) can incite a constructive anger that in turn confers the courage necessary to speak and act for change. Such anger is constructive when, unlike rage or apathy, it springs from a respect for people's dignity (Horton, 2004) and is directed towards transforming adverse conditions for the better.[8]

Contrary to popular myth, those who choose to act in this way—as navigators to safer, healthier conditions—need no heroic qualities. Originally, the word "hero," as Hannah Arendt reminds us,

> *Was no more than a name given each free man who participated in the Trojan enterprise and about whom a story could be told.[9] The connotation of courage, which we now feel to be an indispensable quality of the hero, is in fact already present in a willingness to act and speak at all, to insert one's self into the world and begin a story of one's own. And this courage is not necessarily or even primarily related to a willingness to suffer the consequences; courage and even boldness are already present in leaving one's private hiding place and showing who one is, in disclosing and exposing one's self. The extent of this original courage, without which action and speech and therefore, according to the Greeks, freedom, would not be possible at all, is not less great and may even be greater if the 'hero' happens to be a coward. (Arendt, 1958, p.186-187).*

None of us can escape the constraints of history, nor the limitations of our present circumstances; yet by the sheer force of acting, an inevitable (possibly endless) sequence of reactions begins. The most pressing question for those who value health, therefore, is whether that perpetual flow of actions and reactions can somehow be directed or at least channeled toward a demonstrably healthier future.

---

5 *The emphasis on choosing among plausible futures stems from the rationale presented in Hancock and Bezold, 1994.*

6 *The two phenomena—dynamism and democracy—directly affect the task of navigating health futures. Living conditions change and those changes are open in part to the influence of any person or group. The term* ***democratic*** *is not used to suggest that democracy is or ought to be the sole form of global government, but rather to acknowledge the openness—or potential openness—of global affairs to the governance of all people (i.e., global citizens). The closest synonym to this use of the term democratic is* ***pluralistic****. Just as the pressures of evolution and adaptation tie public health work to the study of dynamic systems, so too does the fact of human plurality link public health work inexorably to questions of governance, power, and democratic citizenship.*

7 *The infinite directionality of the human condition arises primarily from two sources: (1) the freedom that each person has when choosing how to think and act (note the emphasis on "how to" rather than "what to"); and (2) the condition of natality, wherein new people continually come into the world, bringing with them the potentia for new thinking and further action (Arendt, 1958:186-187).*

8 *Additional insight into why constructive (or relational) anger is so often the precursor to public action can be found in Chambers and Cowan, 2003; Rogers, 1990; Thompson, 2000a.*

9 *Following this same construction, this report illustrates how we may better meet contemporary health challenges by expanding the definition of a public health hero to encompass all free people who participate in efforts to assure healthful conditions and about whom a story can be told. This requirement that "a story can be told" is crucial, for it calls upon each of us to reject the idea that other people can make us healthy. It asks us to safeguard healthful conditions, for ourselves and others, by mustering the courage to become personally—and identifiably—involved in the work. Real heroism springs from actually doing whatever is within our capability to do to be healthy, operating over whatever scales of influence we may have, even if only over ourselves.*

VALUING CONDITIONS

Protecting What You Consider Special: ***The Star Path of Ke Ala Hoku***

If it is a healthier course that we seek, and the pragmatic talents of navigators that we need, then perhaps some of the voyagers in our midst may guide us toward more useful ways of understanding and organizing public health ventures. Humans, as a species, have evolved a remarkable prowess for wayfinding, which confers to us a distinct survival advantage (Finney, 1992). It is an advantage that goes beyond having developed unique modes of locomotion, encompassing a vast, synergistic constellation of sensory, cognitive, emotional, organizational, and cultural traits (Corning, 2003). In earlier phases of human history, physical navigation or the ability to direct movement over land, water, and air was paramount. But in the last two millennia, when patterns of cultural evolution have moved to the forefront (Doncaster, 2001), our well-being and survival grew to depend more on social navigation, or the ability to direct the course of social change toward a negotiated set of valued conditions. In our time, one of the most notable wayfinders—in both the physical and the social arena—is Nainoa Thompson, lead navigator of the Polynesian Voyaging Society (Evenari, Aginsky, Dorsky, et.al., 1999; Kyselka, 1987).

In 1976, after successfully navigating the voyaging canoe *Hokule`a* from Tahiti to Hawaii without instruments, in the nearly-extinct tradition of his Polynesian ancestors (Finney, 1994; Kyselka, 1987; Polynesian Voyaging Society, 2004; Thomas, 1997), Thompson became an icon at the vanguard of the Polynesian Renaissance—itself a conscious endeavor to revive ancestral traditions that had been eroded by centuries of colonialism and redirect the future of Hawaii's social and ecological development (Dudley and Agard, 1993; Harden and Brinkman, 1999; Kanahele, 1982; Malama Hawaii, 2003).

Beyond his work as a sailor and an educator, Thompson brings a powerful navigational sensibility to the many problems facing his island home and the people who live there.[10] He understands well the importance of remaining alert in the midst of a journey. He also knows that what is true on a sailing canoe in the Pacific applies equally to our evolutionary journey into the future: with sight and other

10 *Demographic analyses indicate that population health in Hawaii, which had been remarkably high for centuries, declined precipitously after Western contact in 1778 (Kunitz, 1994; Nordyke, 1989; Stannard, 1989). By 1820, the Native Hawaiian population fell from approximately 795,000 to 150,000. Further declines continued throughout the 19th century, with a pronounced shift in morbidity and quality of life occurring in 1897, when the United States forcibly overthrew the Hawaiian Kingdom (Dudley and Agard, 1990; Seward, 2001; United States. National Archives and Records Administration and Schamel, 1999). Like other indigenous people who endure the effects of colonialism, racism, and social marginalization (Haas, 1992; Kunitz, 1994; Memmi, 1970; People's Health Movement, 2004; Trask and NetLibrary Inc., 1999), who have been denied sovereignty, dispossessed of their land other material resources, and denied self-determination (United Nations, 1997), Native Hawaiians bear a far greater burden of disease than other sub-groups living in Hawaii (Blaisdell, 1993, 2002; Hawaii Health Information Corporation, 2001; Papa Ola Lokahi, 1998; The Native Hawaiian Health Research Consortium, 1985). Similar inequities are evident in educational achievement, incarceration, and an array of other social indicators. In addition, the combined forces of economic development, immigration, climate change, oceanic change, and importation of invasive plant species have put Hawaii's fragile island ecosystem in serious jeopardy.*

senses closed to signals of location and direction, it does not take long to become disoriented, wandering in a sea of change without a map, risking life and squandering a more prosperous future. Worse than other navigational obstacles like dwindling energy, mechanical problems, or turbulent conditions, disorientation is an agonizing, wasteful, and potentially protracted state. Lacking the necessary frame for pragmatic thinking, disorientation is no mere barrier: it is the antithesis of conscious navigation and the chief impediment to effective wayfinding (Polynesian Voyaging Society, 2002).

In 1995, Thompson used his distinctive world view to help the children of Hawaii articulate their vision for a healthier future, a vision so compelling and so pragmatic that it quickly became formalized scientifically and enacted legislatively as the Ke Ala Hoku Critical Indicators (Hawaii Community Services Council., 1999; Hawaii State Legislature, 2000).[11] He even remembers the exact moment during that project in which he and a group of school children came to appreciate the profound significance of the unfinished work that they must do to safeguard the conditions that make life in Hawaii worth living.

> *In February of 1995 a good friend of mine, Holly Henderson, came to me and said, "We have eighteen school children and we want to put together a visioning process so they can define their future." It was the same visioning process that we use to plan a voyage—where do we want to go, how do we prepare to get there.*
>
> *So the kids came down to where Hawai'iloa {a deep-sea voyaging canoe} was being built and we went into this shed. We sat down. The kids were very standoffish: they didn't want to talk. But we started to talk about a vision for Hawaii's future. I didn't have any answers but I had questions so I asked the kids: "How many of you are born and raised in Hawaii?" Seventeen out of the eighteen were born and raised in Hawaii. I said, "How many of you are going to stay and live here in Hawaii?" They kind of slowly raised their hands They were shy. Seventeen of the kids raised their hands; they were going to stay in Hawaii. I asked the one girl who didn't raise her hand where she was going to live. "No. no," she said, "I am going to live in Hawaii but I am going to travel and see the world first." In the end, there was consensus-all eighteen were going to live here.*
>
> *So then I asked, "Why? Why would you pick this small little place—this small speck of land-when you have all these other choices? What makes this place so special?" And they answered—"the culture"—"family"—"it's a beautiful place"—and they had a whole laundry list of things that they all agreed on. Then I asked, "How many of you want to have children?" Now they were all participating. They all raised their hands. Then I asked, "Where do you want your children to live?" Without hesitation they all told me that they wanted their children to live in Hawaii. Then I asked, "Why?". And they told me they wanted all those things that were special about Hawaii for their future children. "How do you know," I asked, "that in twenty years those things that you consider special are stil going to be here?" At first they all raised their hands but when they really digested the question every single one of them put their hands down. In the end, there was not a single hand up. No one could answer that question. It was the most uncomfortable moment of silence that I can remember. We all sat there, looking at each other, without an answer to a fundamental question that seemed so powerfully important to the future of our children. That was the defining moment for me. I recognized that I have to participate in answering that question otherwise I am not taking responsibility for the place I love and the people I love (Thompson, 2000b).*

11 *Ke ala hoku* is the Hawaiian phrase for "star course", a constellation of celestial signals like the ones that ancestral Polynesian navigators learned to follow so they could sail safely over the vast, foreboding ocean. In the modern context, the idea of a star course conjures the notion of a set of indicators by which we could navigate social change and fulfill public values. The effort to articulate indicators for guiding contemporary policy making in Hawaii began by asking 6,000 youth statewide about the kind of conditions they wanted for themselves and their children. Eventually, the group selected 58 indicators in the following six categories: Healthy Natural Environment; Safe, Nurturing Social Environment; Thriving, Diverse, Sustainable Economy; Educated Citizens; Civic Vitality; and Aloha Spirit. The International Institute for Sustainable Development describes the entire venture, which started by having adults listen carefully to children at the grassroots, as being "thoroughly intergenerational, with youth and adults working together at every level of planning and action. In addition, citizens from government, business, and nonprofit organizations have been involved in the process" (International Institute for Sustainable Development, 2004). Thus, as a public organizing venture, the Ke Ala Hoku project is remarkable not only in the degree to which it elicited input from so many whose voices tend to be excluded from policy making, but also in its deliberate resonance with Polynesian culture and its productive engagement among ordinary citizens, social scientists, program administrators, and elected officials. In other respects, however, the project is but one instance in a class of similar visioning/bench marking ventures across the United States and beyond. For additional background on the broader "community indicators movement" see: (Gibbs and Brown, 2000; Hayes and Willms, 1990; Opdycke, 2001).

Thompson's story speaks to the remarkable power that he and those 18 children possess and of the daring spirit they bring to public life. It is a tale about being moved, personally, to protect and sustain the things we love. This work—the work of directed citizenship—springs from a passion for securing and celebrating that which is precious and might easily be lost, including life itself and the freedoms that make living worthwhile.

The history of public health work is marked by examples of profound changes brought about by those with this same passion for creating and protecting what is precious to them (World Health Organization, 2000). In almost every case, such changes depended on actors entering public life in precisely the way that Arendt speaks of them, with the courage of their convictions but not necessarily credentials (Fee and Acheson, 1991). It depended on people who saw themselves as participants in public life, not onlookers. Pick your group: mothers suffering the aftermath of drunk driving (Lord, 2000), gay men first confronting HIV/AIDS (Shilts, 1987), workers exposed to hazardous conditions (Centers for Disease Control and Prevention, 1999), injection drug users lacking access to clean needles (University of California Berkeley. School of Public Health., University of California San Francisco. Institute for Health Policy Studies., Centers for Disease Control and Prevention, 1993), teens rejecting manipulative tobacco marketing (Social Marketing Institute, 2004), alcoholics and drug addicts on the road to recovery (Alcoholics Anonymous, 2004); or others; in one example after another, we see those whose health is most threatened by adverse conditions stepping up, speaking out, sparking change.

Prompted by Thompson's poignant questions, the Hawaiian children readily identified "things that they consider special," and even if the items on their individual lists were not widely shared, any one of them may be valued enough to inspire concerted action. Thus, the very act of defining and working to create or protect valued conditions sets in motion a new and powerful story. Therein lies the genesis—and the remarkable openness—of our endeavor to protect the public's health. It is the same now as it was in the 1800s, when public health work first became a distinct area of scientific study, professional practice, and public concern. Historian Gil Elliot recounts the critical shift in thinking that opened the way to formal public health work.

> *Public death was first recognized as a matter of civilized concern in the nineteenth century, when some public health workers decided that untimely death was a question between men and society, not between men and God. Infant mortality and endemic disease became matters of social responsibility. Since then, and for that reason, millions of lives have been saved. They are not saved by accident or goodwill. Human life is daily deliberately protected from nature by accepted practices of hygiene and medical care, by the control of living conditions and the guidance of human relationships. Mortality statistics are constantly examined to see if the causes of death reveal any areas needing special attention...*
>
> *When politicians, in tones of grave wonder, characterize our age as one of vast effort in saving human life, and enormous vigor in destroying it, they seem to feel they are indicating some mysterious paradox of the human spirit. There is no paradox and no mystery. The difference is that one area of public death has been tackled and secured by the forces of reason; the other has not. The pioneers of public health did not change nature, or men, but adjusted the active relationship of men to certain aspects of nature so that the relationship became one of watchful and healthy respect. In doing so they had to contend with and struggle against the suspicious opposition of those who believed that to interfere with nature was sinful, and even that disease and plague were the result of something sinful in the nature of man himself (Elliot, 1972).*

What inspires such vigilance and the courageous actions that flow from it? Thompson and the Ke Ala Hoku participants began by looking to the future and acknowledging that the things they consider special are vulnerable, requiring stewardship and protection amidst inevitable—even unknowable—forces of change. Instead of being paralyzed by fear or uncertainty, instead of looking for someone to blame, or some expert to step in, or some

government official to hold accountable, they adopted a constructive stance. In their "uncomfortable moment of silence," a moral and conceptual shift could take hold. For Thompson himself, and perhaps for others in the room, it was a step into the public sphere. Flooded with newfound feelings of consciousness and conscience, he and the others came to a deciding moment: looking forward and wondering what exactly it means to be responsible not just for oneself but for generations to come.

While the role of science in guiding public health action is widely acknowledged, the related roles for consciousness and conscience are only beginning to receive equal attention. All three shape the character of public health work, just as all three share the same Latin root (i.e., *scire*, meaning to know). Science refers to the means of acquiring knowledge of any kind through explicit procedures such as "experience, observation, identification, description, experimental investigation, and theoretical explanation of phenomena" (American Heritage Dictionary, 2000). Consciousness situates that knowledge in a larger context that includes self-awareness of the endeavor to acquire knowledge itself. Conscious science, therefore, expands the scope of knowledge to include information about "one's environment and one's own existence, sensations, and thoughts." Finally, the idea of conscience places scientific inquiry—and the actions that flow from it—within a framework of evaluative judgment. That framework, importantly, is not only self-referential (i.e., applying scientific criteria to judge scientific merit) but also concerned with the role of science in resolving public dilemmas and advancing human development. When enacted with conscience, public health work includes "a moral or ethical aspect to one's conduct together with the urge to prefer right over wrong" (American Heritage Dictionary, 2000). It is this conscience (sometimes referred to as a "moral compass") that places public health science in service of common sense and imposes boundaries on the kinds of procedures that may be used legitimately to acquire knowledge or pursue human values (Yankelovich, 1991).

Public health scholars will recognize the Hawaiian children's predicament as similar to the primary purpose of public health work: "to assure the conditions in which people can be healthy" (Institute of Medicine, 1988, 2002a). Since 1988, when the U.S. Institute of Medicine (IOM) famously introduced this idea of *assuring conditions* as the animating purpose for all public health work, it has remained a foggy notion for most professionals in the field as well as the public at large. It is beyond our scope at the moment to look for a definitive explanation, but the *Ke Ala Hoku* story conveys the practical meaning of what such work entails: a continuous endeavor undertaken by each us, working alone and with others, to create or protect the conditions that make it possible to be healthy in a changing world where others are doing the same. This is not easy work, for there may be stark inadequacies and inequities of power, as well as varying degrees of convergence, disagreement, or uncertainty about exactly what to do (Huxley, 1937). Also, what is valued by some may be quickly—even forcefully—contested by others. Despite these challenges—indeed because of them—our work to assure safer, healthier conditions is a vital dimension of public life. The challenges posed by uncertainty and plurality, in fact, add a distinctive *public* dimension to health work, making it a remarkably poignant and pressing form of human endeavor.

Temporarily silenced by Nainoa Thompson's question about the future and wondering whether their children would be able to enjoy the same island in similar ways, the *Ke Ala Hoku* participants came to appreciate the serious implications of their own actions (or inactions) in directing the course of change. Their perplexity turned into something definite: a realization that each of their lives, even as youngsters, was not merely to live, but to live in a way that lets others live as well. This particular ethic encapsulates the unique relational idea that how we act today affects others, now and in the future, in ways that familiar ethical slogans like "Do no harm," "Do unto others as you would have them do unto you," and "Live and let live" do not quite capture (Laszlo, 2001). To live in a way that allows others to live as *well* acknowledges the inherent trade-offs within the choices we make in daily life. It proceeds from the premise that one person's life and health might come at the expense of another's, or that undue freedoms by some may entail, at least in part, greater inequity and deprivation elsewhere. Above all, it raises pragmatic questions about what we value and how we behave, without losing sight of the fact that there are differing degrees of freedom surrounding and constraining those choices in our plural world.

CHARACTERIZING PUBLIC HEALTH WORK

Whereas patients need a doctor's care only occasionally to treat sickness and regain health, people must work all the time, occasionally with help from professionals, to guard against affliction and enhance their well-being (sometimes understood as health-related quality of life) (Centers for Disease Control and Prevention, 2000a). Such work requires individual effort as well as collective organizing and action to reduce threats to health in whatever form they come. Although particular ventures to address particular health problems may be temporary (e.g., quarantine to slow the spread of an infectious disease, or emergency aid and psychological counseling after a disaster), the overall enterprise to assure healthier conditions must be sustained over time in a concerted, vigilant, and pragmatic way. This is part of the reason why thinkers who are concerned with the health of whole populations emphasize the importance of institutionalization and sustainability: themes that are comparatively absent in writings that focus on the care of individuals (see, for instance, Annie E. Casey Foundation, 2002; Goodman, McLeroy, Steckler, et.al., 1993; Hancock, 2000; Hodge, 1996; McMichael, Smith, Corvalan, 2000).

If we could predict the future, this task of assuring healthful conditions would be far easier. But anyone who has accidentally taken a wrong turn knows what Arthur C. Clarke meant when he asserts that the "future is not to be predicted, but created" (quoted in Laszlo, 2001:ix) Often, it is our own perceptions and decisions about how to move in the world, rather than the influence of truly exogenous forces, that shape our experience. Even without perfect knowledge or absolute power we can, in most cases, learn enough through observation and research to help us chart the roads ahead.

> *By 2020 there will be approximately 21 mega cities that will each approach populations of 10 million inhabitants. This trend will exacerbate and expand two new health problems—'built' environmental conditions and syndemics.*
> *— Lonnie King*

Investigations on the long-term effects of smoking (Office of the Surgeon General., 2004) or of adverse childhood experiences (Felitti, Anda, Nordenberg, et.al., 1998), for example, demonstrate just how much we can in fact discover about the future consequences of particular behaviors or exposures. Such inquiry also prompts us to explore and create new alternatives in the present. It helps open options and expand navigational choices, for we cannot pursue healthier directions if we cannot see them.

Another thing we know about the future—particularly the next three to five decades—is that it will bring significant transitions: demographically, environmentally, economically, culturally, geopolitically, and otherwise (McNeill, 2000; Meadows, Meadows, Randers, 1992; United Nations, 2002; Woodward, Hales, Litidamu, et.al., 2000; World Commission on Environment and Development, 1992). Our experience of past transitions of similar scope (such as the shift from a primarily agrarian to a primarily industrial mode of production) reminds us that they carry both grave threats and remarkable opportunities for the public's health. However, in truth, several trends with great significance for the public's health are unfolding in the 21st century that have no good historical analogues whatsoever (e.g., environmental change, population growth, increasing speed of communication and transportation, exhaustion of petroleum reserves, spread of genetic and biological technology, and others).

Some of these changes will take us by surprise (perhaps because we have not paid enough attention to warning signs), while others can be more easily anticipated. For instance, the health consequences of phenomena like an aging population (Centers for Disease Control and Prevention and Merck Institute of Aging and Health, 2004; National Research Council, 2001), global environmental change (McMichael, 2001), and increasing urbanization (Galea, Freudenberg, Vlahov, 2005; McMichael, 2000; United Nations, 2002) are examples of issues that are already being studied closely. And even the most welcome transformations—like regime changes from dictatorship to democracy—will nevertheless cause dislocations and disruptions that may destabilize or undermine the conditions for health. Regardless of the specific nature of the changes in store, the stance that health leaders must maintain is one of keeping pace with changing times, preparing for surprise, and being clear about the conditions we are working to create as well as the legacy that we will leave behind (Bazerman and Watkins, 2004; Foege, 1987; Levins, 1995).

SEEING CONDITIONS AS FREEDOMS

Even though public health work is ultimately about assuring the conditions in which all people can be healthy, the practical tasks of identifying, creating, and safeguarding those conditions in a dynamic and democratic world have only begun to be defined and justified (Gostin, Boufford, Martinez, 2004). By contrast, the IOM's three core public health functions—assessment, policy development, and assurance—have been more fully translated into practical forms like essential services (Public Health Functions Steering Committee, 1999), performance standards (Centers for Disease Control and Prevention, 2004e; Corso, Wiesner, Halverson, et.al., 2000), and training competencies (Public Health Functions Steering Committee, 1997; Tilson and Gebbie, 2004). In the 19 years since the initial call to reorient public health work around the challenge of assuring conditions, there is still no clear, operational statement about precisely what those conditions are. This is equivalent to not having identified our most basic values, not having answered for ourselves the essential navigational questions that Thompson posed to those 18 school children. Where do we want health-related conditions to go? How shall we prepare to get there? Who among us will do that work? What forms of resistance must be overcome?

The *Ke Ala Hoku* project, and thousands of other visioning efforts like it, have attempted to address similar questions, with varying degrees of seriousness and completeness. For instance, the first international conference on health promotion in Ottawa, Canada articulated a set of "prerequisites for health" in the widely-cited *Ottawa Charter* (World Health Organization, 1986). These included: peace, shelter, education, food, income, a stable eco-system, sustainable resources, and social justice and equity. But, as profound as that list of prerequisites is, its articulation 20 years ago has yet to significantly shape the main thrustof policy dialogues today, which continue to focus on how to manage each item on a long listof risks and diseases without necessarily joining those questions with ones about creating andassuring the related conditions for health (McKinlay and Marceau, 2000b; Milio, 1981). Evenworse, the absence of a robust and complementary focus on policies for improving adverse conditions, out of which all diseases and risks emerge, is itself not widely acknowledged to be a problem.

In the United States, for instance, the Healthy People 2010 national objectives are not organized around a clear set of conditions to be assured, but rather into 20+ separate chapters, each focused on a different disease or risk behavior. A few additional chapters are devoted to conditional objectives (i.e., access to health services, educational and community based programs, food safety, the environment, and public health infrastructure), but there is practically no explanation for how those particular conditions were selected nor the extent to which they cover the full spectrum of conditions that must be assured (United States Public Health Service, 2000).

What does it really mean to have—or not have—adequate conditions for health? Despite all that we have learned through public health research, there remains little agreement around this central question. Consequently, many thinkers and writers tend to become caught in tiresome, unproductive debates over a false dichotomy between individual and social responsibility for health.[12]

One way of fostering a better dialogue is to consider the degree of choice (or lack thereof) that people have over the conditions that affect their health. Levins and Lopez frame the matter this way:

> *Choices are always made from among alternatives presented by the social environment, or by circumstances that were themselves not chosen… When we recognize the elements of non-choice in choice, we can escape the contradiction between social causation and individual responsibility and understand the interactiveness of the two (Levins and Lopez, 1999).*

12 Common sense suggests that there is nothing mutually exclusive about the two, and indeed many people admit that both individual and social forces affect the public's health (Mann, 1999). Still, the professional literature remains filled with extreme arguments framed around an assumed dichotomy. For more details see: Gori, 2001; Koopman and Lynch, 1999; Lukes, 1973; Raphael, 2002.

In a similar vein, the World Health Organization (WHO) summarized the views of many observers by defining living conditions as "the everyday environment of people, where they live, play and work. These living conditions are a product of social and economic circumstances and the physical environment—all of which can impact upon health—and are largely outside of the immediate control of the individual" (World Health Organization, 1998:16). Note that these conditions were not seen as uncontrollable, but rather outside the *immediate* control of *individuals*. This framing leaves open the possibility that groups of people, organized in ways that harness the synergy of their relationships and resources, could develop sufficient power to govern the course of change (Chambers and Cowan, 2003; Lasker, Weiss, Miller, 2001).

Based on this understanding, adverse living conditions might be defined as circumstances that inhibit people's freedom to live and to develop their full potential. They may include, at a minimum, any deviation from the conditions necessary for life and human dignity, including phenomena like hunger, homelessness, joblessness, illiteracy, war, environmental decay, and various forms of injustice or oppression, including racism. These, in turn, are among the conditions that sustain entrenched vulnerability, both within nations and internationally. They must therefore become objects of concern not just by those most directly affected, but of broad-based public concern as well, including that of health professionals who are trained to do public health work.[13]

If choice and control enter the mix in both individual and social ways, then it may be useful to follow the lead of Nobel laureate Amartya Sen and think of the conditions for health as an array of freedoms (Sen, 1999). Physical security, for example, entails freedom from hazardous physical exposures like excessive heat, cold, radiation, or toxic chemicals—freedoms that are not at all randomly distributed among sub-groups in society (Clifton, 2004; Jackson, Locke, Pirkle, et.al., 2002; Klinenberg, 2002). Likewise, the condition of peace entails freedom from violence in all forms (Krug, 2002). Having a minimal standard of living demands freedom from deprivation in a material sense as well as from undue dependency in a social context (Moynihan, 1973). Social engagement depends on countering the disconnection that comes from inequality, injustice, and various forms of social mariginalization (Berkman, Glass, Brissette, et.al., 2000).[14] The maintenance of stable organic processes and mental/emotional balance all rely on maximizing people's freedom from the array of biological, psychological, emotional, and spiritual impairments that can disrupt these essential conditions for healthy living. Another important feature of these conditions/freedoms is that they operate together, through synergy, rather than separately, through partial accumulation. As Peter

> *We are still called upon to give aid to the beggar who finds himself in misery and agony on life's highway. But one day, we must ask the question of whether an edifice which produces beggars must not be restructured and refurbished.*
>
> *— Martin Luther King, Jr*

13 Because of their role as providers of highly specialized services, health professionals often do not recognize and respond to vulnerability and social disparity for its own sake, in the same way that citizens without professional health training often do. For more on this aspect of professionalism see: Farmer, 2003; Illich, 1982; Light, 1997; Starr, 1982.

14 One stark example is the recent trend toward large-scale incarceration as way of dealing with public problems (The Sentencing Project., 2004)

Corning, the biologist best known for revealing the causal role of synergy in evolution (Corning, 1998, 2003), correctly points out,

> *Each of us has an array of basic needs that must, by and large, be satisfied continuously. We cannot, for instance, do for very long without fresh water, or waste elimination, or sleep. Accordingly, each of us—individually and collectively—requires a synergistic "package" of resources and suitable environmental conditions. A society that can reliably provide this package will thrive and possibly grow larger. But if even one of these needs is not satisfied—if any part of the package is deficient—the entire enterprise is likely to be threatened (Corning, 2000).*

If our health depends on the continuity and combination of such a vast array of conditions/freedoms, then that opens the whole health protection enterprise in a very particular way to the influence of each person's work. It also raises immediate questions about our power as citizens, how that power is used, and whose efforts ultimately shape the prospects for a healthy life (Walt, 1994).

History shows that people acting to protect what they value have a profound ability to direct the course change, with corresponding effects (both positive and negative) on their own health and that of others near and far. Acting in this way, organized citizens have navigated significant social movements such as those to abolish slavery, dismantle legal segregation, outlaw child labor, and clean up the environment, to name just a few with the most obvious health benefits. Such endeavors often must be sustained over decades or centuries, but when they take hold, they can change the course of history. For those involved and for the generations that follow, they literally move the world in a safer, healthier direction.

That said, it is also possible to move simultaneously in very dangerous directions, away from relatively healthful conditions. In the 20th century, for example, the proliferation of destructive weapons (Cirincione, Wolfsthal, Rajkumar, 2002; Potter, 1982; Rhodes, 1986), large-scale environmental degradation (McNeill, 2000; Meadows, Randers, Meadows, 2004), profit-driven "disease promotion" (Freudenberg, 2005); and repeated attempts at genocide and ethnic cleansing (Hinton, 2002; Weitz, 2003) stand out as some of our most troubling trajectories. That both healthful and unhealthful movements can proceed simultaneously, and interact with one another, is a testament to the sheer enormity—and perpetual need for — the "*concerned, humane, directed science*" that guides public health work.

CRAFTING CONDITIONS

Revisiting Broad Street: A Cautionary Tale

Although the notion of assuring healthful conditions was only recently articulated as the driving purpose of public health action, it is fair to ask, what have we learned about this sort of work since it was formalized in the mid-1800s? One recent commemoration of that history marked the 150-year anniversary of John Snow's famous removal of the Broad Street pump handle (Centers for Disease Control and Prevention, 2004a).

In 1854, the residents of London were contending with the third in a series of cholera epidemics, following previous outbreaks in 1831 and 1848. Each of the two earlier epidemics had killed tens of thousands in a frightening and horrific way. As Sharon Guynup described it, "one could be healthy at dawn and buried by dusk" after a rapid and lethal progression of diarrhea, vomiting, and spasms (Guynup, 2004).

Mid-19th century London was also the center of the industrial revolution. Drawn by the promise of higher-paying work, rural families moved *en masse* to working class neighborhoods like the one surrounding Broad Street. Hedging their bets, many brought with them the animals that had sustained them on small farms, creating a crowded neighborhood that interspersed cowsheds and slaughterhouses with eight-to-a-room urban slums. London was experiencing rapid modernization, but much of this left the residents of Broad Street behind.

Their aging and overcrowded structures were situated over fetid cesspits. The sewers underneath and the structures above were pressed to the breaking point, and the break occurred in 1854 when the infectious agent of cholera was introduced into these adverse conditions (Frerichs, 2004; Summers, 1989).

Discovery of the cholera vibrio was still two decades away. In the absence of definitive scientific evidence of cholera's cause, a fearful populace experienced the literal meaning of an epidemic: an unknown and mysterious affliction put upon (*epi*) the people (*demos*). Selfstyled experts weighed in with different theories about whether bad air, bad water, or divine intervention was the real culprit. Snow believed that something in the water was to blame, mainly because he thought an airborne cause would manifest itself in people's lungs (which cholera did not). Still, he had trouble persuading anyone else since the "poison" in the water could not be seen. Moreover, the stench from raw sewage was extreme, literally blurring the boundary between water and air.

Today, Snow is rightly hailed as a hero of modern epidemiology for his pioneering collection and analysis of death records, household interviews, and geographic maps, noting from these data that cholera cases were highly concentrated among households drawing water from the Broad Street pump. He further demonstrated that the pump was supplied by the water of two companies, one drawing water upstream from the Thames River, and the other downstream where contamination with raw sewage had occurred. With this evidence in hand, he persuaded the Board of Guardians (a city council-like body responsible for public health, welfare, and sanitation) to remove the pump handle. The incidence of new cases dropped immediately, and a public health legend was born.

Snow's action prevented many thousands of deaths in the short term. Yet this version of the story, while powerful, is incomplete. The dramatic decline in cholera deaths was, in fact, a fragile gain. Closing the pump temporarily never addressed the adverse conditions that feature so prominently in a fuller portrait of the Broad Street neighborhood and so many other similarly stressed areas of the city. The people in those neighborhoods were still vulnerable—both to cholera and to an array of other afflictions. Investigators writing for a magazine called *The Builder* returned to the Soho neighborhood around Broad Street one year later, in 1855, to examine how conditions had changed: they found that no improvements at all had been made.

> *Even in Broad Street it would appear that little has since been done...In St Anne's-Place and St Anne's-Court, the open cesspools are still to be seen; in the court, so far as we could learn, no change has been made; so that here, in spite of the late numerous deaths, we have all the materials for a fresh epidemic...In some {houses}*

the water-butts were in deep cellars, close to the undrained cesspool...The overcrowding appears to increase (Summers, 1989).

The epidemic had ended, but inaction in the face of these adverse conditions continued. Four years after Snow's intervention, the stench from the Thames had grown so overwhelming that the British Parliament was closed for one of the few times in its history, DRAFT Hygeia's Constellation — Page 61 after unsuccessful attempts to deal with the odor by draping curtains soaked in chloride of lime across the windows. It was not until the 1870s, after a fourth cholera outbreak in 1866—which killed nearly 4,500 people—that an innovative sewage system designed by engineer Joseph Bazalgette matched the above-ground modernization with improvements down below (Guynup, 2004).

Why isn't Joseph Bazalgette's contribution commemorated by the CDC, along with those of John Snow and the other actors who played a role in this larger civic venture? The story of the pump handle and its veneration today reveals many of the attributes traditionally emphasized by health professionals: a sharp focus on a specific, technical intervention; a concentration on immediate reductions in morbidity and mortality from just one cause; and a declaration of victory based on those criteria.

Highlighting these particular plot points both distorts and discounts the populist nature of public health work. It portrays health action as decisive, scientific, and heroic in the sense of having a single actor at the center, while obscuring a broader view of this work as a kind of *public craft*, one that is open to the contributions of many while being iterative, improvisational, cumulative, inspired, and technical all at once (Boyte, 2000, 2004b; Fortun and Bernstein, 1998; Lindblom, 1959; Scott, 1999).

To see the actions of Snow, Bazalgette, and others as part of a larger public craft acknowledges the reality that efforts to protect people's health evolve over time, involving more issues than health alone and a more varied cast of characters than experts in medicine, statistics, or human biology. Storylines that portray public health work as a craft are therefore not strictly about solving singular problems, but rather about *solving for pattern* (Berry, 1981).

SOLVING FOR PATTERN

A bad solution is bad because it acts destructively upon the larger patterns in which it is contained...because it is formed in ignorance or disregard of them. A bad solution solves for a single purpose or goal, such as increased production. And it is typical of such solutions that they achieve stupendous increase in production at exorbitant biological and social costs…Good solutions recognize that they are part of a larger whole. They solve more than one problem and don't create new problems. A good solution should not enrich one person by the distress or impoverishment of another.

— Wendell Berry

When crafting healthful conditions—and seeing those conditions as affecting peoples' freedoms—the pump handle story presses toward a different ending. It may, in fact, have no end at all. For we can readily observe how the actions of Londoners in the 19th century are still unfolding today, triggering further actions as we confront different versions of the same essential challenge to design living conditions that support our prosperity and well-being (Jackson, 2003).[15] Joseph Riley, former Mayor of Charleston, South Carolina and founder of the Mayors' Institute on City Design identifies this long arc connecting past, present, and future as the most important dimension of public leadership.

15 The current obesity epidemic in the US, for example, is widely thought to stem from a similar dysfunctional interaction between the built environment and human health (Frumkin, Frank, Jackson, 2004).

When a Mayor makes a decision about a physical development, a hundred years later the citizens of your city are going to be shaped by that. So the quality and the beauty and the order and the excellence and the profoundess of it and the degree to which it contributes to the public realm I think ends up being the most important responsibility and the most lasting action that a Mayor has (Mayors' Institute on City Design, 2002).

Looking back at how our predecessors tried to address the 1854 cholera epidemic, one is struck by the portfolio of the Board of Guardians: public health, welfare, *and* sanitation. In modern society, these functions have become separated from one another by elaborate administrative and professional boundaries (Weber, 1946). The fine-grained specialization of these and other health-related functions has created a sizable gulf between different groups of professionals, each with different institutional affiliations and a different slice of technical knowledge. It also separates professionals of all stripes from the citizens they profess to protect and serve (Benveniste, 1977; Boyte and Kari, 1996b; Illich, 1977; Jennings and Hanson, 1995a).

If the modern-day guardians of population health see their work as a craft-like endeavor to assure healthful conditions, then that work becomes something different than an endeavor to *make* people healthier, although that is a main motivation.[16] Neither is the primary purpose to control disease, prevent premature death, nor enhance quality of life, all of which are also valued outcomes. On its surface, the emphasis on assuring conditions does not match any of the familiar ways that health professionals routinely use to justify their actions and careers. It expands the circle of those responsible for the public's health far beyond a cadre of trained professionals, resting control within a dynamically complex system that is animated by the actions (and inactions) of every citizen, institution, and the public as a whole (Sigerist, 1996). Most intriguing of all, this idea of assuring healthful conditions steps beyond the confines of over 150 years of formal public health science.

Actions to intervene in people's lives can be guided by a science that thinks about individuals—as does medicine—or even collections of individuals—as does epidemiology (Pearce, 1999). But it is an entirely different proposition to use either of those sciences as a principal guide for assuring the healthfulness of constantly changing and politically contested *conditions*. That prospect warps many people's idea about what public health scientists can do. It even challenges strongly-held values about what science itself is meant to do (Chalmers, 1999). Still, if public health work aspires to assure certain conditions that are publically crafted and constantly in flux, then the concepts and methods that shape health policy must themselves resemble the features of dynamic, democratic systems.

A strong consensus has formed among health scholars around the need to render public health science and policy at an ecological level, consistent with the craft of assuring healthful conditions (Green, 2006; Green and Kreuter, 2004; Susser and Susser, 1996). But few of the frameworks put forward to date have transcended the conceptual problems that arise by seeing improvements in people's lives as the mostly highly valued end (Buchanan, 2000). What it means to organize science and society around the goal of continually and equitably assuring conditions for health is still a puzzle.

16 Hannah Arendt offers a detailed exegesis on the dangerous categorical error underlying all endeavors to "make people" into a particular form (Arendt, 1958). As Margaret Canovan explains in the introduction to Arendt's writing, "to understand political action as making something is in Arendt's view a dangerous mistake. Making—the activity she calls work—is something a craftsman does by forcing raw material to conform to his model. The raw material has no say in the process, and neither do human beings cast as raw material for an attempt to create a new society or make history. Talk of 'Man' making his own history is misleading, for (as Arendt continually reminds us) there is no such person: 'men, not Man, live on the earth and inhabit this world.' To conceive of politics as making is to ignore human plurality in theory and to coerce individuals in practice" (Canovan, 1998:xvii).

One clue is to think differently about the role of science in guiding health action. In the Broad Street story, actions designed to prove or disprove the competing theories of cholera's causes (even the one that turned out to be correct) could not safeguard the health of area residents as thoroughly as the pragmatic combination of separate innovations made by doctors, engineers, public officials and others that, together, rendered cholera less mysterious and permanently reworked the flow of sewage in the changing London landscape.

Likewise, the tendency in hindsight to represent the John Snow story as an unqualified victory reveals a narrow parsing of health itself. It distorts the full scope of the challenge that we face as a people to limit our collective vulnerability to many health threats at once and over time. In the midst of the London cholera epidemic, removing the pump handle reduced the accelerating incidence of cholera quickly and effectively, but it did not alter people's vulnerability to other infectious threats of the day (e.g., syphilis, tuberculosis, smallpox), nor to those environmental and occupational threats that remained—and accumulated—in their homes and workplaces. Furthermore, Snow's conviction that polluted water was to blame for all infectious diseases also led, ironically, to his defense of industrial manufacturing processes that we now know to have been extremely dangerous to the public's health (Lilienfeld, 2000). These facts are difficult to reconcile with the heroic, scientific storyline, so they tend to be overlooked.

It is not surprising that Snow and the people whose lives he saved viewed his intervention as a success. However it is surprising that today, more than a century and half later, we still commemorate it as a flatly successful event, knowing full well that it did relatively little to assure safer, healthier conditions over the long-term for Broad Street residents.[17] If modern public health workers had truly taken to heart our present mandate to assure healthful conditions for all, we would draw different lessons. We would do better to recognize the tremendous value— as well as the painful insufficiency—of halting the spread of cholera temporarily, while leaving people vulnerable to the same problem later.[18] And we would notice more readily that the received storyline overlooks the contributions made by so many other actors whose work before and after Snow also helped to free us from the scourge of cholera.

17 There have been several attempts to critique the valorized rendition of John Snow's work. For the most part, however, these commentaries challenge the myth of Snow as a neutral scientific observer by emphasizing the political values that he exhibited and the particular philosophy of science that he employed. For example see the following exchange from the American Journal of Epidemiology: Brunskill, 1992; Dunn, 1992; Krieger, 1992; Vandenbroucke, Eelkman Rooda, Beukers, 1991.

18 For an example of the opposite strategy, wherein the solution to an immediate problem is crafted in such a way as to assure that it would not recur again, consider Nainoa Thompson's approach to the problem of natural resource depletion in Hawaii. In 1990, the Polynesian Voyaging Society embarked on a project to build a traditional Hawaiian canoe using only native materials, as their ancestors had done. An instant problem arose when no one could locate a tree of sufficient size and strength out of which to fashion the hull. Their venture was thwarted by the almost total deforestation of Hawaii's koa forests. Whereas historical records indicate that early Hawaiians built several thousand canoes per year, it was impossible for modern Hawaiians to build even one. The project eventually continued by accepting the gift of a Sitka spruce from Native Alaskans, but not before Thompson and his colleagues initiated a massive reforestation of their own koa stand (Evenari and Thompson, 1992; Thompson, 1995).

FROM BROAD STREET TO EAST BROOKLYN:

Choosing a Future

The story of East Brooklyn Congregations (EBC) stands in contrast to that of John Snow and our reading of his contribution. First, it has no single public health hero. Instead, it has multiple heroes in the Arendtian sense: people whose "courage and even boldness are already present in leaving one's private hiding place and showing who one is" (Arendt, 1958:186). It is a story of people with a strong sense of place--East Brooklyn, New York--and of time--not a single moment, but rather a long time horizon. Their view extended backward, tying the present to the past, as well as forward, envisioning a healthier future toward which multiple EBC actors consciously navigated. Intent on transforming adverse living conditions for all, their plight was shared, and so was their power. Their journey, as described below, was not an easy one nor will it ever be truly complete. Instead of persuading a city council to remove one pump handle temporarily, EBC's is a prolonged and arduous endeavor, with high stakes and long odds.

The John Snow story is a public health classic. If we take to heart the idea that health action is about improving adverse conditions and expanding the freedoms that make it possible for all people to be healthy, then the EBC story could become a classic as well—even though the word "health" does not appear in the narrative. The word public, however, is front and center: the public and its abundant power.

Michael Gecan, a veteran organizer and longtime ally of East Brooklyn residents, offers a unique vantage point on this intricate case history. The following extended quotation does more than recount the facts, in sequence, of the events that unfolded. It also conveys—through first person narrative—the remarkable passion and insider's perspective that make this story worthy of our attention.[19]

> *In the spring of 1978, East Brooklyn was the South Bronx minus the presidential motorcades. It was a place of stunning devastation, glaring needs. Gunfire crackled every night. There was fire, abandonment, and rubble. In the words of one visitor, Boston's Mayor White, it looked like "the beginning of the end of civilization." The leaders that met with Ed Chambers {current director of the Industrial Areas Foundation} that day were eager, even desperate, to do something, anything, now.*
>
> *Chambers heard the leaders out. Then he told them precisely what they did not want to hear. Forget the issues. Don't pick a galvanizing cause. Avoid charismatic leadership. Instead, he urged them to take the time to recruit more local congregations and associations in the area, so that they would begin to reflect the racial and religious diversity in a community of nearly a quarter of a million people. He preached financial independence that began with each and every member institution, no matter how poor and pressed, shelling out significant yearly dues to the fledgling organization. Only after the local leaders and institutions committed their money—dues money, hard money—should they pursue softer foundation funding. He set a high target: $250,000 in money raised and money pledged. And he insisted that they never seek government funding for their core budget. Finally, he challenged them to take the time to learn about power and how it really works and to focus more on the growth and development of local leaders.*
>
> *Chambers hammered away: recruit institutions; find allies; pay dues; train leaders; don't do for others what they can do for themselves. Some in the group grumbled. How could they ask their followers to pay dues to an organization that wasn't ready to address issues? Chambers answered their questions with another question: how could they ask people for tithes and offerings to support their local congregations? Because they believed in what they were preaching and teaching. Because people, no matter how poor, always found ways to pay for what they truly valued. And when they paid for it with their own hard-earned money, not the government's, not some foundation's, they owned it. And*

19 This extended quotation is used with permission from Beacon Press.

ownership—of a home, a congregation, an organization, a nation—encouraged participation and responsibility, accountability and commitment.

The activists squirmed, fumed, and rebelled. Without an issue or cause or crisis, no one would act, no one would move, and no one would work. You have to "prove" to people that success is possible before asking them to join, pay dues, or attend training. Chambers conceded that that was the conventional wisdom in the progressive and radical worlds. But in this case the conventional wisdom was dead wrong. Loose groupings of interested individuals didn't have a prayer of addressing major crises—housing, crime, schools, jobs, and others. Each crisis was, at bottom, a power crisis. The power of the mob, the power of drug lords, the power of corrupt borough machines, and the inertia of the police bureaucracy could only be challenged by another, deeper institutional power.

Unconvinced, unsatisfied, a few people stalked out or didn't return. But the majority of the leaders reluctantly went along. As one leader later said, "Well, we'd tried just about everything else—model cities, poverty programs, causes for this, causes for that. None of it worked. So we didn't have much to lose." Except time. Ed Chambers spent 18 months working long distance with the mature and intelligent leaders of what would become East Brooklyn Congregations. They recruited twenty local institutions. They raised, to their complete surprise, nearly $250,000 in dues and grants. They sent hundreds of leaders through local training sessions and fifty through the IAF (Industrial Areas Foundation) ten-day training. They ran meetings that started on time and ended on time and lasted one hour. They did all of this work themselves, without a paid staff person, in one of the nation's poorest communities, at the very worst of times, while buildings continued to burn and bullets continued to fly.

This period devoted to building a powerful and durable base—what we in the IAF called the sponsoring committee phase—is what most other organizations, parties, agencies, movements, unions, and civic associations tend to forget, skip, or give short shrift. But it's precisely during these months and years that a community can begin to develop new depth and new breadth, can sort out the majority of hard and persistent workers from the small minority of loudmouths, can tap into talent already present but usually overlooked, and can engage allies and supporters waiting in the wings but not knowing how best to contribute. It's right here, in this gestation phase, that a new culture of public life and public action and clear accountability can begin to form and spread.

In the nearly twenty-three years since, some of the same leaders who sat in a church basement and skeptically eyed the six-foot-five, 250-pound IAF director when he first preached the fundamentals of power organizing have used that power to transform their community. They pressed the city to replace three thousand missing street signs, stop signs, and one-way signs—to put the area, quite literally, back on the map. They negotiated with the Parks Department to upgrade every park and playground. They leaned on the Transit Authority to renovate the subway and el stations. They made sure that lots were cleaned, streets swept, and drug locations raided. They identified the need for two new primary health centers—and had them built. They pressured the Board of Education to build two new high schools—smaller, safer, more responsive to parent and student needs—and co-sponsored them. They increased the registration and turnout of voters, in spite of a series of dreadful and uncompetitive elections. They rekindled a spirit of the possible in a place that had grown dark with cynicism and despair. And—most visibly-they designed and built nearly three thousand new, affordable single-family homes.

An organization with a core budget of $300,000 dollars a year, a staff of four, and a modest headquarters in a local apartment complex halted two decades of burning, deterioration, and abandonment by building a critical mass of owner occupied town houses and generating a chain reaction of other

neighborhood improvements. EBC built on every large parcel and abandoned block in the area—140 vacant acres. The market value of the housing built now exceeds $400 million.

The group succeeded in large part because its leaders creatively applied the lessons absorbed during the sponsoring committee phase to the challenge of rebuilding a wasteland with homes affordable to working families making as little as twenty thousand dollars a year. Instead of beginning by asking governments for funding, the leaders of EBC first raised $8 million of no-interest revolving construction financing from their own church bodies—The Roman Catholic Diocese of Brooklyn, the Episcopal Diocese of Long Island, and the Lutheran Church Missouri Synod. They would never have the chutzpah to approach their bishops for million-dollar loans if they hadn't decided to pay their own dues and generate their own core budget and discipline themselves to avoid government largesse.

They pushed this principle further. Instead of asking for the most public subsidy available from the City of New York, they asked for the least amount of subsidy that any group requested—a no interest, ten-thousand-dollar-per-home second mortgage with lien. In fact, when the EBC leaders, primarily African-American and Hispanic, poor and working poor, approached the city's housing commissioner with their request, he said that he would provide more than they asked for—twenty-five thousand dollars per house to each buyer. A truly bizarre negotiation then ensued, with the EBC leaders demanding less, in the form of loan, and the city offering more, in the form of a grant. The city officials began to whine, "Why, we give the Rockefeller Partnership housing program twenty-five thousand dollars. How would it look if we gave you less?" This logjam dissolved when the EBC leaders threatened to tell the New York Times about this silliness.

Then they pushed it further still. When Ed Chambers and I recommended a down payment of thirty-five hundred dollars on a home then costing fifty thousand dollars, the leader said no. They voted for a higher down payment of five thousand dollars so that they didn't experience a repeat of the dreadful FHA scandal, in which homes were nearly given to families who felt little or no sense of ownership and often treated their properties as if they still belong to the government, not to them. As a friend of mine said when I told him the story, "They're smart. They're avoiding mental rental."

From the start, these leaders never made the mistake of thinking that the housing program is more important than the power organization. The effort was not viewed as an opportunity to build a large bureaucracy. It wasn't a patronage program. It wasn't an avenue into the profitable world of housing management and consulting contracts. The two general managers hired to do this work—first the incomparable I. D. Robins, then the astonishingly effective Ron Waters—worked for EBC, not the other way around. They were expected to build homes with a minimum of staff, with modest overhead, and the lowest possible cost. The EBC Nehemiah effort was seen as an action of the organization, a measure of its power, and a test of its ability to pressure, push, and leverage its vision and will against sluggish housing agencies and bankrupt housing theories.

All of this flew in the face of those who fancy themselves experts in housing, urban development, and civic activism, then and now. One political leader said, "You'll never do this. Your eyes are bigger than your stomach." Another said, "Forget it. If you build them, no one will buy them. If they buy them, they won't maintain them. Many housing and foundation executives wondered, aloud, "But who's going to manage these people?" Our answer was that they were going to do what all other American home buyers do—manage themselves. We weren't about to do for others with they could do for themselves. (Gecan, 2002:10-15)

If the EBC members had listened to the experts, they would never have developed power or the intent to use it. As "ordinary" citizens, they used practical knowledge (which includes but goes beyond expert, technical knowledge) to navigate the process of neighborhood transformation. They constructively channeled anger and dissatisfaction with the status quo into a vision of meaningful and extraordinary change. Not coincidentally, this was change that the experts had dismissed as impossible precisely because they themselves were unable to achieve it.

EBC's members, with some prodding from Chambers, made a decision to step forward, to move into public life and begin a story of their own. In doing so, they moved from being spectators to participants—people willing to be held accountable instead of simply holding others accountable (Gecan, 2002; National Commission on Civic Renewal, 1998). In Arendt's view, stepping forward, speaking out, and taking on this type of responsibility are the stuff of real courage. Boldness, however, is not all that matters. Arendt also recognized the inherent unpredictability of action, which for her, meant that it must be accompanied by the habits of *promising* and *forgiving*: two additional processes that open and enrich the public sphere (Arendt, 1958).

Another way of describing EBC's venture is to recognize it as public work: "sustained, visible, serious effort by a diverse mix of ordinary people that creates things of lasting civic or public significance" (Center for Democracy and Citizenship, 2001). When guided by a clearly articulated constellation of values (i.e., a moral compass), this type of work builds public strength—the power of citizens to direct the course of change toward a negotiated set of conditions. And strength, Ed Chambers would agree, is the point. Not satisfied with a quick win that fades away, the people and organizations that do the public work of an EBC are engaged in something quite different: "digging very deep roots for something to be planted so that when the wind blows and the rain falls, the organization won't be swept away" (Gecan, personal communication, 2003).

Like the Hawaiian schoolchildren, the EBC leaders are naming and protecting what they value, choosing a different future, steeling themselves for the work that is required to get there, and taking a long, broad view of their commonwealth. By their processes and by their achievements they are crafting more healthful conditions—which now include their own enhanced power to act. They are not just crossing problems off a long and ever-changing checklist.

This approach to public health work can be both exhilarating and exhausting, in part because it is constantly evolving. It entails apprenticeship, artistry, practice, technical mastery, continued vigilance, and progressive evolution. To excel at such a craft involves more than taking on tasks or doing piecework with the assumption that others, working in parallel, will do the same. It requires a commitment to the creative process, tolerance for ambiguity, willingness to act under uncertainty, awareness of human limitations, a refusal to scapegoat others, and a passion for serious learning (Schon and Rein, 1994). It demands that we continually strive to see the greater whole, without losing sight of the many particular part-whole relationships that often preoccupy our attention (Eoyang, 2001). It also implies acceptance of imperfect prototypes, knowing that they can be refined with the input of others. These prototypes, and the larger works that they inspire, in turn, must survive practical tests of sustainability and worth. Do others value them? Will they meet the tests of time? Can they withstand the forces of wind and weather?

To see the task of assuring healthful conditions as a public craft is to take a different view of public health work—one more aligned with the creative, iterative, public work of EBC, but also encompassing the more solitary and temporary interventions that Snow and other better-known "heroes" have devised. The following sections seek to explore and illuminate precisely that sort orientation.

PERCEIVING DYNAMIC CONDITIONS

The Era of Relative Clarity

It is easy to imagine the intense, well-deserved optimism that John Snow must have felt as the incidence of cholera cases dropped so sharply in the wake of his action. In the century that followed, many physicians, epidemiologists, and biomedical researchers shared that same satisfying feeling. An array of discoveries and technological advances fueled the belief that each item on the long list of human diseases would succumb, one after the other, to the relentless progress of science. Progress, however, was never exactly uniform and there were many misguided notions and frustrated aspirations. But overall, the public and professional ethos from the late-19th to the mid-20th century was one of steady progress and relative clarity (Hudson, 1983; Mullan, 1989; Winslow, 1943).

Much of that clarity sprang from a deep-seated faith in the power of medical specialization (Rosenberg, 1989). The advent of bacteriology, back in the late 19th century, changed both medicine and public health, leading to an understanding of germs as vectors of infectious disease and solidifying the study of tightly controlled experiments as the *sine qua non* of health science (Brandt and Gardner, 2000). These developments helped shape the essential character of the field, with its operational emphasis on beginning with a clear case definition its obsession with understanding the causal mechanisms of both disease and of program/policy interventions, and its organizational tendency to proliferate new areas of specialization as necessary. These emphases led to many well-documented successes (e.g., the development of vaccines, water filtration systems, and milk pasteurization) which, in turn, justifiably reinforced the idea that a single-minded focus was tremendously useful and productive. The turn of the 20th century, notes historian Paul Starr, "now seems to have been a golden age for public health, when its achievements followed one another in dizzying succession and its future possibilities seemed limitless" (Starr, 1982:197).

That optimism prevailed well into the 1960s, when the promise of penicillin and other "miracle" drugs led the U.S. Surgeon General, among others, to predict an imminent triumph over all infectious diseases. "The time has come to close the book on infectious diseases. We have basically wiped out the infection in the United States," said Dr. William Stewart in 1967 (Surowiecki, 2001:46).[20]

As we know, however, headlines in the subsequent decades brought news of drug-resistant tuberculosis, escalating rates of chronic disease, troubling displays of violence and environmental damage, and the appearance of HIV/AIDS along with dozens of other baffling threats to the public's health. The original model of disease specialization that seemed so successful earlier in the century was not shown to be wrong, only too limited a concept for organizing and sustaining initial gains, especially amidst profound shifts in the physical and social environment. An era of creative thinking then ensued out of which came the broader concept of health promotion (O'Donnell, 1986a, 1986b, 1989).

20 This quotation, widely attributed to Surgeon General Stewart, is in fact a matter of some historical controversy. John Parascandola, official historian for the U.S. Public Health Service, has been unable to determine the exact circumstances in which the remark was made. Even Dr. Stewart himself does not recall having said it. But neither does he refute the possibility, saying only that he may have said something to that effect. Nevertheless, the continual reappearance of this statement suggests that the sentiment behind the supposed quote was (and is) widely accepted. Or, at least it is widely thought to be a plausible thing for the Surgeon General to have said. So plausible, in fact, that Stewart himself accepts the premise. The popular acceptance of this notion is perhaps the more relevant point anyway. According to Parascandola, "there is no question that in the period of the late 1960s, and beyond, there was a great optimism about our success against infectious disease" (personal communication, November 11, 2001).

After its initial articulation, which most scholars assign to Canada's Lalonde Report in 1974 (Canada Department of National Health and Welfare and Lalonde, 1974), the full scope of what health promotion entailed took shape only incrementally. The basic philosophy evolved inexorably from a diagnostic, to an environmental, to what is now an ecological or systems approach (Green, 1980; Green and Kreuter, 1991, 1999, 2004).

Many saw health promotion as a positively framed inversion of disease prevention. Instead of concentrating on deficits and disease, now the focus was on assets, empowerment, and health (Antonovsky, 1984; Brown, 1985; Kretzmann and McKnight, 1993; Wallerstein, 1992). Others conceded that there was more to it, but could only see health promotion's lofty goals like safe schools, healthy children, racial justice, sense of community, and the end of poverty. Several writers observed profound political and ethical implications differentiating health promotion from disease prevention, implying the need to complement a focus on behavioral change with an emphasis on social change and principles of an open society (Freudenberg, 1978; Minkler, 1978, 1989). But despite the intuitive sensibility of health promotion, it lacked a clear formalism to match the perceived pragmatism and quantifiable credibility held by epidemiology and clinical preventive medicine.

Epidemiologic methods continued to enjoy institutional favor. They proved invaluable in identifying and illuminating many narrowly bounded problems of disease, such as toxic shock syndrome (Centers for Disease Control and Prevention, 1997) and Legionnarie's disease (Fields, Benson, Besser, 2002). At the same time, health promotion showed that health was not only an end, but also a means to achieving greater quality of life (World Health Organization, 1998). But neither approach offered an organizing framework for the field capable of supporting the increasingly diverse health protection enterprise. Rather, when pursued in parallel, these separate problem solving strategies were generating problems of their own and further fragmenting the field.

The Era of Growing Confusion

In contrast to the era of relative clarity and optimism, the latter half of the 20th century was a time of growing confusion and complexity. Within living memory, chronic diseases and mental health problems became the leading causes of death and disability. Infectious pathogens evolved vexing capacities of drug resistance. Environmental and occupational exposures took on new proportions in our technologically-dependent, rapidly globalizing economy. And all forms of injury—encompassing things like motor vehicle crashes, suicide, rape, terrorism, warfare, and more—switched from being seen as mere accidents or flaws of human nature into preventable, if still largely perplexing, phenomena (Krug, 2002; Spivak, Prothrow-Stith, Hausman, 1988).

The organizational confusion that now pervades the field shows little sign of stopping. It challenges our thinking and action with at least three significant forms of general complexity (Kahane, 2004; Senge, 2003). First there is dynamic complexity, where the distance between cause and effect is delayed, making causal relationships murkier and more difficult to perceive using conventional analytic methods (Richmond and Peterson, 1997; Sterman, 2000, 2006).[21] There is also social complexity in the form of plural stakeholders with differing and often conflicting interests (Lasker and Weiss, 2003). This is an important source of variation and challenge that regrettably tends to be obscured by rhetoric emphasizing only the collaborative aspects of public health ventures.[22] And a third class of complications stems from the process of adaptation itself, where previously effective solutions have trouble keeping pace with the problems they once solved so well. As Abraham Lincoln put it, "the dogmas of the quiet past are inadequate for the stormy present. Our present is piled high with difficulties, and we must rise with the occasion. As our case is new, so we must think anew and act anew"(Lincoln, 1862).

Beyond these general forms of organizational complexity, which are not confined to the health system, additional challenges arise from the epidemiologic transitions that have literally redrawn the contours of population health throughout the world (Olshansky and Ault, 1986; Omran, 1971; Rogers and Hackenberg, 1987). Over the centuries, and most rapidly during the last 100 years, many nations moved from contending primarily with the pestilence and famines of antiquity to being beset by new forms of population-wide health threats. Researchers have parsed these epidemiologic transitions into four relatively welldocumented stages: the age of pestilence and famine; the age of receding pandemics; the age of degenerative and man-made disease; and the age of delayed degenerative disease (Olshansky and Ault, 1986). Each of these epochs is named for the particular type of health problem afflicting the most people and creating the greatest burden within a given nation or region. If we were to look instead at the entire constellation of health threats and how they interact, however, we would likely recognize another, more enduring pattern: the persistence of entrenched syndemics.

The technological and social changes associated with modernity—including the sophisticated actions of public health workers themselves—dramatically altered the types of risks that populations face, shifting the major causes of death and disease from communicable diseases (such as gastroenteric and respiratory infections) to non-communicable diseases, mental health ailments, and various forms of intentional and unintentional injury (Murray, Lopez, Harvard School of Public Health., et.al., 1996). But despite these shifts in absolute burden, all forms of affliction—with the possible exception of smallpox—continue to take their toll even at low levels of incidence. The practical implication for

21 The speed of physical and cultural evolution in modern times has yielded a world that is significantly different from the one in which our early ancestors faced, and in which most experimental methods were developed to understand. We have therefore inherited several framing assumptions which prove problematic in under contemporary conditions. "In place of the assumptions of independence, one-way causality, and impacts that are instantaneous and linear, we need assumptions that celebrate interdependence, closed-loop causality, delays, and non-linearities. Only when the representations in our mental models commonly bear these characteristics, will we increase the likelihood that the initiatives we design will create the outcomes we intend" (Richmond and Peterson, 1997:11).

22 The emphasis on collaboration stems, in part, from the situation observed by Joan Bondurant (discussed above on page 12) that social and political theory, including public health science, have "neglected the central question of means, and, therefore, the problem of inevitable conflict" (Bondurant, 1988:v.).

society is clear: we need health protection strategies that address unique problems uniquely, as well as complementary strategies that focus on assuring safer, healthier living conditions for all. Either without the other is likely to fall short of the challenges that we must now confront.

There is also a complicated interplay between disease-causing pathogens and the interventions that we rely upon to prevent and control them. Although still poorly understood, it is now clear that this dynamic sometimes results in the evolution of greater microbial resistance and/or virulence (Ewald, 1993, 1998) . Moreover, age-old afflictions newly understood to be disease-driven (such as alcoholism, substance abuse, depression, and suicide), as well as newly discovered ones (like AIDS, SARS, West Nile virus, and dozens of others in the last 30 years alone) combine to create a broader, more intricate constellation of health threats than was the case in earlier eras. Even the powerful "agent-host-environment" analytic orientation begins to break down in circumstances where so many threats are operating simultaneously.

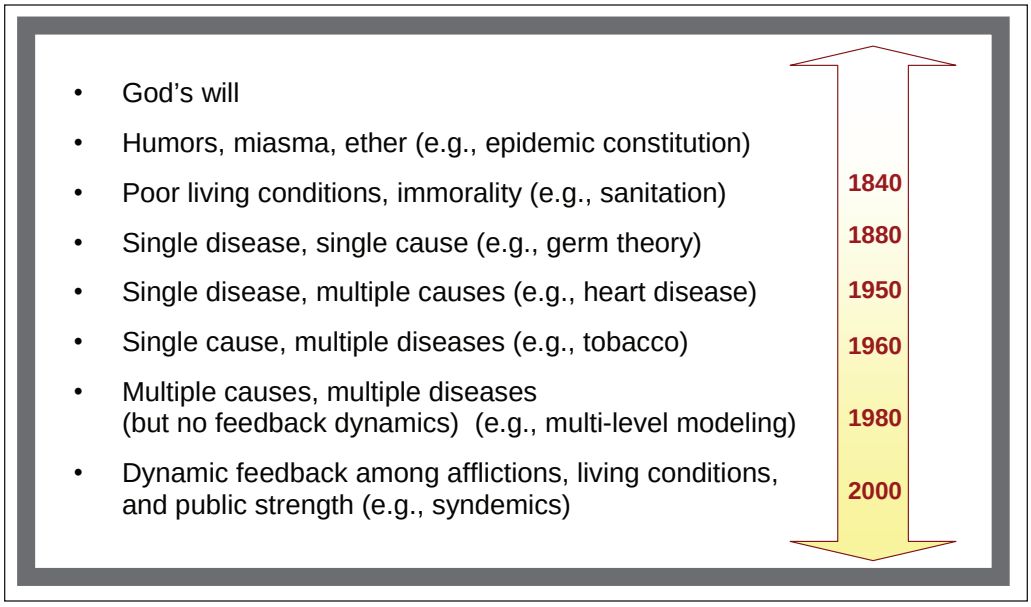


Figure 4 Changing and Accumulating Ideas about the Causes of Population Health Problems

Responding to wave after wave of these vexing challenges, public health leaders sought innovation by turning to other academic perspectives. Scholars making important contributions came from fields such as anthropology, communications, economics, ecology, ethics, evaluation, history, organizational development, law, philosophy, political science, public policy, psychology, urban planning, sociology, and others. These rich traditions complemented conventional epidemiology in crucial ways, but their incorporation tended to be piecemeal and multidisciplinary rather than integrated and transdisciplinary (Higginbotham, Albrecht, Connor, 2001; Kline, 1995; Rosenfield, 1992). The consequence has been even greater specialization—this time by academic discipline. The boundary of thought and analysis expanded, adding greater texture to the overall health protection enterprise, while exacerbating its underlying problem of fragmentation.

Shifts in causal thinking also moved the field in even more profound ways (Susser, 1973, 1991, 2001). To the ancient and still-popular idea that sickness is a sign of God's will came new propositions and new evidence about what causes population health problems (Figure 4).[23] Long before the first public health agencies were formed, people saw illness emanating from imbalances in humors, miasma, ether, and other environmental conditions (Ackerknecht, 1948). For instance, an early precursor — though not identical— to our modern notion of a syndemic was Thomas Sydenham's 17th century idea of an "epidemic constitution," in which the temporal pattern of co-occurring epidemics was thought to come from a particular configuration of atmospheric conditions.[24]

Major parts of Sydenham's theory were erroneous, but his concepts were "destined to play an important part in the advancement of public health in the nineteenth century" (Rosen, 1993:81). For it was then that

23 This brief history of causal theory was developed with the help of Joel Nitzkin.

Edwin Chadwick and others, believing that unsanitary conditions led to a host of interrelated diseases, would lead Western society in reforming the physical and social conditions of industrial workers as well as the urban poor (Duffy, 1990; Sedgwick, 1902).

Then, toward the turn of the 20th century, researchers like Henle, Koch, and Pasteur ushered in the germ theory of disease (Evans, 1993; Henle, 1938). Their achievements apparently ended a centuries-long debate about the causal role of specific contagions leading to specific diseases, and it pointed the way toward effective interventions that brought about the first major epidemiologic transition in history. With chronic illnesses like heart disease and cancer on the rise, scholars soon realized that the germ theory's notion of a single disease tied to a single cause was merely one way of framing causal relationships. They began to recognize that a single disease could have multiple causes (Centers for Disease Control and Prevention, 2003b; Farquhar, 1999); and it was not long before epidemiologists studying risk factors like tobacco reversed this perspective, tying single causes to multiple diseases (Office of the Surgeon General., 2004; Olson, 2004).

Nowadays social epidemiology, with its theory of multicausality linking many causes to many diseases is in vogue (Berkman and Kawachi, 2000; Krieger, 1994, 2001b; Syme and Frohlich, 2002). Its reliance on multi-level modeling (Diez-Roux, 2000), however, represents a very different form of causal thinking compared to the dynamic feedback perspective of a syndemic orientation (Homer and Milstein, 2003a; Milstein, 2002d, 2004c; Richardson, 1991). Whereas multi-level models are correlational and parse variance among parameters chosen from two or more theoretical levels (e.g., individuals and neighborhoods), dynamic feedback models allow analysts to develop and test hypotheses about closed-loop causal relationships. For example, the last bullet in Figure 4 suggests that one might examine the mutually reinforcing causal feedback among afflictions, living conditions, and public strength. A syndemic point of view therefore continues a rapid evolution—and accumulation—of theories about what causes population health problems. For the most part, however, all of these ideas remain alive in the public mind and in the professional literature.

This expansion of the conceptual landscape along with the widening portfolio of risks and diseases demanding some kind of comprehensive response has now stretched the mandates of the public health enterprise so far that even its leaders and teachers cannot succinctly describe it. Susan Scrimshaw, Dean of the School of Public Health at the University of Illinois at Chicago, has offered a magnum of champagne to any of her fellow deans who comes up with a one-sentence description of public health. So far, no one has claimed the prize (Bunk, 2002).

Today, perhaps the most prominent part of the public health landscape in the U.S. is the health care delivery system: an industry in its own right and now the largest sector of the U.S. economy, employing more people than any other, and accounting for 14.9% of the gross domestic product—estimated to reach to 18.4% by 2013 (Heffler, Smith, Keehan, et.al., 2004). Unfortunately, the ways that health agencies are responding to the increasing complexity that they face is, in many cases, adding further complications (Hirsch, Homer, McDonnell, et.al., 2005). Bureaucracies are proliferating, springing up to support categorical funding for separate programs that have great difficulty coordinating their efforts and are defended by advocacy groups representing single diseases, risk factors, or bodily organs. Back in 1988, the immense, unwieldy enterprise was officially declared to be a system in "disarray" (Institute of Medicine, 1988), and that diagnosis remains largely true today.

Almost two decades after that famous declaration, disarray still persists within and among organizations who must now contend not only with direct threats to the public's health but also with the system-wide organizational problems known as the "diseases of

24 Sydenham suggested that diseases like plague, smallpox, and dysentery were linked to certain conditions. Whereas under different conditions, a different cluster of epidemics would manifest. Scarlet fever, quinsy, pleurisy and rheumatism, for example, were grouped because they all were thought to depend upon a certain kind of susceptibility in the human body.

disarray" (i.e. hardening of the categories, tension headache between prevention and treatment, hypocommitment to training, cultural incompetence, political phobia, and output obsession) (Chambers, 1992; Wiesner, 1993). In addition, there are justifiable concerns about widening health disparities and the absence of strong leaders fuels a pervasive feeling of disorientation throughout the field. Worst of all, these three dilemmas—disarray, disparity, and disorientation—are themselves mutually reinforcing: they form a vicious cycle that threatens to undo progress of the past and expose people to preventable suffering at a time when old and new forms of affliction are becoming ever more daunting.[25]

The deficiencies of the health system and its record of lurching one-step-forward, two-steps-back have been criticized and lamented, but not without sympathy. As the authors of *The Future of Public Health* marveled, "the wonder is not that American public health has problems, but that so much has been done so well, and with so little" (Institute of Medicine, 1988:2). Much the same can also be said of public health efforts in nations around the globe.

Still, the fact remains that many important achievements of the past look exceedingly fragile today. The eradication of smallpox, a scourge for centuries, is rightly hailed as one of humanity's greatest triumphs (Fenner, 1988; Fielding, 1999; Foege, 1998). But even this treasured gain is vulnerable today because of the possibility of a malevolent unleashing of this dreaded disease from stockpiles originally held by former Cold War adversaries. In fact, the success of smallpox vaccinations around the world, and their suspension once the disease was eradicated, is a major factor in the degree of our current vulnerability. It highlights the pernicious legacy and the meager progress that we have made in eliminating the preventable causes of war, terrorism, and violent conflict (Bondurant, 1988; Levy and Sidel, 2000; Sharp, 2003; Sidel and Levy, 2003).

Tuberculosis, to take another example, is only one of many diseases that, instead of succumbing permanently to the power of drugs, mutates into drug-resistant strains. Sometimes, burden is not reduced so much as shifted. For example, progress in tobacco control in the United States has accelerated the sale and consumption of tobacco products in developing countries. And iatrogenic disease (i.e., afflictions caused by efforts to heal) take an enormous toll: 98,000 deaths in any given year from medical errors in hospitals alone (Kohn, Corrigan, Donaldson, 2000; Wachter and Shojania, 2004). According to the historian Robert Hudson, "iatrogenic diseases now constitute a significant portion of the total morbidity in industrialized nations; their descriptions fill a book of some 500 pages aptly titled "*Diseases of Medical Progress*" (Hudson, 1983:6).

25 Disarray and disorientation are related states with different origins and implications. Disarray is an organizational phenomenon, implying the need to rearrange existing parts of a system to improve its performance (usually in the short-term). Disorientation, by contrast, is a conceptual and moral phenomenon, borne of confusion about one's overall direction, place, and value in the world. Prolonged disorientation may lead to organizational disarray as misguided decisions result in poorly planned or fragmented structures. Conversely, prolonged disarray may lead to disorientation as frustration builds over an inability to effectively reach long-term goals. Also, repeated attempts to reorganize problems that are in fact rooted in disorientation may generate even deeper disarray. In such circumstances, no amount of rearranging will improve long-term performance and the very act of reorganizing could itself become disorienting. Effective responses to disorientation generally require new ways of thinking, framing problems, making decisions, planning, evaluating, organizing resources, and navigating change.

The Mismatch:

Using Step-wise Strategies to Direct System-wide Change

WHAT IS A MACROSCOPE?

We have only our brain--our intelligence and our reason--to attack the immense complexity of life and society. True, the computer is an indispensable instrument, yet it is only a catalyst, nothing more than a much-needed tool. We need, then, a new instrument. The microscope and the telescope have been valuable in gathering the scientific knowledge of the universe. Now a new tool is needed by all those who would try to understand and direct effectively their action in this world, whether they are responsible for major decisions in politics, in science, and in industry or are ordinary people as we are. I shall call this instrument the macroscope (from macro, great, and skopein, to observe).

The macroscope is unlike other tools. It is a symbolic instrument made of a number of methods and techniques borrowed from very different disciplines. It would be useless to search for it in laboratories and research centers, yet countless people use it today in the most varied fields. The macroscope can be considered the symbol of a new way of seeing, understanding, and acting. Let us use the macroscope to direct a new look at nature, society, and man and to try to identify new rules of education and action. In its field of vision organizations, events, and evolutions are illuminated by a totally different light. The macroscope filters details and amplifies that which links things together. It is not used to make things larger or smaller but to observe what is at once too great, too slow, and too complex for our eyes (human society, for example, is a gigantic organism that is totally invisible to us).

Formerly, in trying to comprehend a complex system, we sought the simplest units that explained matter and life: the molecule, the atom, elementary particles. Today, in relation to society, we are the particles. This time our glance must be directed toward the systems which surround us in order to better understand them before they destroy us.

Joël de Rosnay, 1979

Since the 1970s, health planners have understood that effective responses to the intertwined afflictions in populations require system-wide interventions (Canada Department of National Health and Welfare and Lalonde, 1974; Fawcett, 1991; Freudenberg, 1978; Green, Richard, Potvin, 1996; McLeroy, Bibeau, Steckler, et.al., 1988; Milio, 1981; Stokols, 1992; Syme, 1986). But the desire to achieve systemic change stands in opposition to what most health agencies are prepared to do. Ingrained in financial structures, problem-solving frameworks, statistical models, and the criteria for professional prestige is the idea that each affliction can be prevented individually by understanding its unique causes and developing targeted interventions. Evaluations confirm that this single-issue approach can be effective in reducing temporarily the rate of a given disorder, but it cannot serve as a means for fulfilling society's ongoing interest in assuring the conditions in which all people can be healthy. Nevertheless, most health ventures operate with resources focused on one disease or risk factor, leaving other problems to be addressed by parallel efforts.

Health care reform—or rather, the failure to achieve it despite six decades of repeated attempts—provides a stark example of how dynamically complex problems resist change when they are approached in a piecemeal way. That same history also teaches us that overly ambitious schemes can be equally ineffective because they tend to be undermined by numerous special interest groups. So how can those of us who share the goal of protecting the public's health better govern change when, like so many other phenomena, the health system exhibits policy resistance: that is, when it tends

to "delay, dilute, or defeat the effects of planned interventions" (Meadows, Richardson, Bruckmann, 1982; Sterman, 2000, 2006)?

One important—and still largely neglected—step is to try to see our health problems and our corresponding problem-solving strategies as part of a large, dynamic enterprise. Failure to do just that is precisely what sociologist Max Heirich identifies as the main analytic oversight contributing to so many unsuccessful health reform ventures.

> *Earlier efforts at reforming health-care policy have been ineffective for at least three reasons. First, problems were often tackled piecemeal, as though a single intervention in one area (even a major one) would correct the larger dynamic at work...Second, the more comprehensive reform plans...roused the opposition of interest groups and the larger public who distrusted government regulation; but even if they had succeeded politically, those proposals probably would not have succeeded practically, because they did not address more fundamental dynamics which were creating problems in health care....Third, even though problems in health care were approached using the same problem-solving formulas that were being applied elsewhere in the political economy, health-care dynamics were treated as if they existed independently of everything else that was happening in the political and economic system-a serious miscalculation.... Had problems not been approached in isolation, but instead viewed in terms of their relation to a larger series of changes occurring in the national and international political economies, a different series of policy options might have been explored. They were not explored, perhaps because most of the analytic strategies popular among academics, politicians, and policy makers fail to observe the system as a whole in ways that let policy makers shape individual choices. Even fewer analytic strategies have made it possible to discuss processes of mutual change that are occurring, or to analyze how innovations fit into larger nonequilibrium dynamics that are developing (Heirich, 1999).*

Seeing an entire system, rather than a set of discrete health problems demanding discrete responses, requires a certain amount of distance and perspective—something more akin to looking through a macroscope than a microscope (Rosnay, 1979). Just as the first astronauts were awed and profoundly moved by their first glimpses of the Earth from space, seeing and understanding a familiar terrain that they had never seen whole before, so can a macroscopic view of the health system reveal useful insights about how to navigate on the ground (White, 1998).

To illustrate the implications of this sort of macroscopic thinking, consider the three core public health functions: assessment, policy development, and assurance (Institute of Medicine, 1988, 2002a). Each of these functions can be approached either with a focus on a single, categorical problem or on the larger, more encompassing task of assuring equitable conditions for health. In large part, the core functions have been used primarily to organize and describe approaches to single, categorical programs. But with a syndemic orientation they may also be seen as equally appropriate aids in the craft of assuring conditions, provided that the concepts and methods that guide their fulfillment are changed to accommodate the shift in scale (Figure 5).

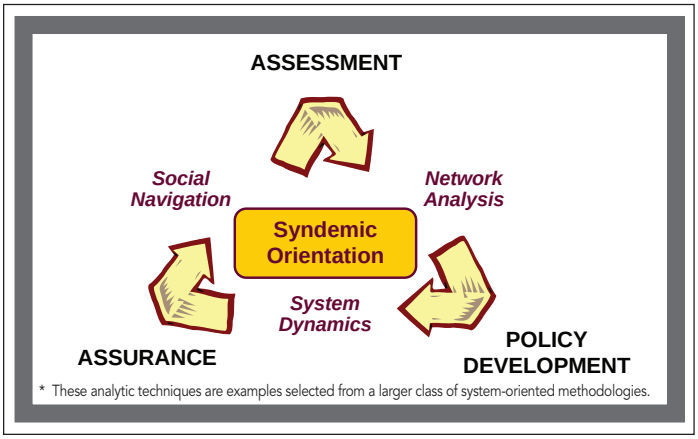


Figure 5: Core Public Health Functions and Selected Analytic Methods Supporting a Syndemic Orientation

Analytic techniques that demand linear approximations and similar kinds of simplifying assumptions may be acceptable when working under narrowly circumscribed conditions (i.e., within highly constrained organizational and temporal boundaries). But when operating on an ecological level, addressing the long-term effects of multiple, interacting afflictions in a region or given population—along with the many programs and policies designed to affect them—those former analytic conventions no longer suffice. System-oriented techniques with a greater capacity for understanding dynamic complexity must come to the forefront (Midgley, 2003). These methods do not replace, but rather extend the reaches of what we can learn about the forces that govern the public's health. The next section examines in greater depth some of the more significant shifts in thinking and practice that come about when using these techniques.

REORIENTING PUBLIC HEALTH WORK

Shifting Perspectives

Seeing through a syndemic orientation involves not just one, but a sequence of shifts in perspective. Each view offers a conceptual and a mathematical formalism that is both comprehensive and context-sensitive: a combination notoriously difficult to achieve using conventional schemes for planning and evaluating public health work (Milstein, 2004b).

In a world where everything connects to everything else, the many transformations that we strive to achieve become more sensible when seen within a defined, negotiated boundary. From this perspective, all relevant dynamics arise from the mutually reinforcing relationships among population health, living conditions, and the public's power to act. These constructs and their various connections provide a stable frame of reference as well as a rich space for thinking about public health work in a dynamic and democratic context (Figure 6).

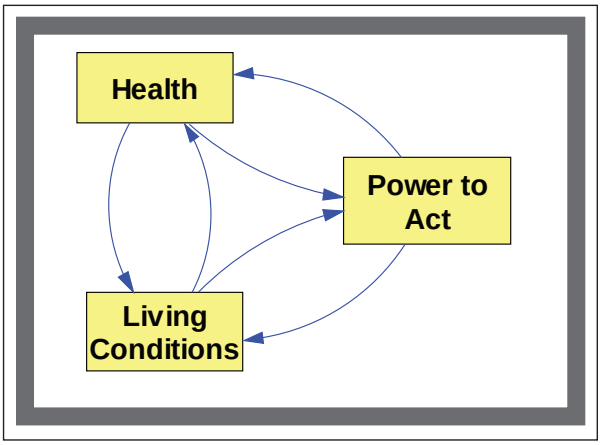


Figure 6: Conceptual Boundary for Public Health Work

This way of framing the landscape is, however, relatively unique in the health sciences. It not only recognizes the mutually reinforcing connection between health and living conditions but also regards people as having the power to alter their own health as well as their social and physical environment, even while recognizing that those powers are themselves contingent on characteristics of people and the world in which we live.

The convention in other forms of health research is to begin by conceptualizing a specific disease or risk factor, and then use that as the boundary for all subsequent analysis and action. This point helps clarify why the problem of "confounding" is so central to epidemiologic inquiry. Most epidemiology textbooks introduce the notion of confounding within the first several pages. It is a fundamental principle lying at the core of an epidemiologic orientation. Confounding occurs when the true relationship between an exposure and a disease is obscured by the presence of another factor that is related to both. Variables that function as confounders are described as being of "no intrinsic interest" to the study; sometimes they are labeled "nuisance variables" (Kleinbaum, Kupper, Muller, 1988:9). It is the analyst's job to exclude confounding influences from being an alternative explanation in the causal relationships that he or she wishes to understand. The problem of confounding takes on a different complexion when the confounder is not another exposure, but a second kind of affliction. For example, the causal relationship between substance abuse and suicide is confounded by depression, which has its own independent relationships to both substance abuse and suicide. The convention in epidemiology is to isolate even the partial effects of an exposure by devising alternative research designs, statistical control procedures, or a combination of methods. The fact remains, however, that the three afflictions are acknowledged to be causally connected, and therein lies a similarity—indeed a complementarity—between the concept of confounding and that of a syndemic. Both perspectives share a concern for identifying relationships between afflictions. But they differ sharply in how those associations are handled conceptually and analytically. Whereas epidemiologists seek to exclude or neutralize the influence of confounders, persons working from a syndemic orientation choose to expand their frame of reference and question what it is that explains the overall dynamic formed by the relating afflictions.

Therefore the conventional approach, with its emphasis on excluding confounders, prohibits a full view of the social system in which different kinds of people, different kinds of problems, and different kinds of problem- solving strategies all interact. The alternative is to first specify a place or a population as the initial referent, and then cooperate with residents or members to address the entire set of forces that constitute the health threat

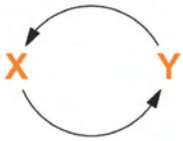
that they face. In this way, a place- or population-based orientation acknowledges more of the plurality that exists throughout the health system (in terms of people, problems, and policies). That alone makes it an essential analytic technique for interpreting the dynamic, democratic forces that we wish to study.

The place- or population-based approach also has the virtue of being more efficient in its application. Rather than proliferating models by the number of different problems found in a group, as is required when each model is bounded by a different disease or risk factor, the alternative approach builds a single model for each place or population, extending further only when it is necessary to expand the inquiry to other groups. Questions about generalizability, in this context, may focus on the extent to which different dynamics are at work in one venue versus another, rather than being confined to conversations about the representativeness of one group for another. It is precisely this virtue that enables a syndemic orientation to be both comprehensive and context-sensitive, an attribute nearly impossible to achieve when a single disease or risk factor is used as the initial referent.

In addition, a greater range of phenomena may be considered when a larger social system is within the analytic frame. Not only is it possible to evaluate changes in the rates at which afflictions form (as is done in conventional epidemiology), but analysts may press on to explore transformations in the conditions that leave people vulnerable to afflictions, as well as changes in the kinds of resources that are organized and cultivated when responding to health threats. This ability to relate health status with changes occurring in other areas of society is an improvement over conventional analytic techniques wherein the conditions that give rise to disease and the activities of people to protect themselves both lie beyond the conceptual boundary (Hancock and Bezold, 1994).

It may be useful to think concretely about three basic types of relations that give rise to change: *connection, influence, and direction*. One may distinguish among these relations according to the unique properties of the information required to understand each (Table 1).

TABLE ONE

Relation	Connection	Influence	Direction
Questions	What links to what?	What causes what?	Where are we? Where can we go?
Data	Proximity	Feedback	Directional
Visualization			

Three Types of Relations Supporting a Syndemic Orientation

To comprehend connections, one gathers proximity data to discover "what links to what" (e.g., by exchanging information or resources)? To assess causal influences, one examines feedback data, which address the question, "what causes what?" And to direct the course of change, one needs navigational data, which answer the most pragmatic questions of all: "where are we?" and "where can we go from here?" Connection, influence, and direction are the pillars that make a syndemic orientation appropriate and practical as a foundation for routine public health work.

The first step in using this orientation involves seeing more than one problem at a time; this is the crux of the syndemic idea. Within the boundary of a chosen place or population it is possible to focus on health problems individually, and on broader clusters of affliction formed by their relationships (Figure 7). Mapping connections among health problems provides a more complete picture of the health challenge that people face. It highlights ties among different disease processes, which often can pose as much of a problem as the diseases themselves. Sometimes even more so, because the overall burden of affliction in a population can persist unless all major causal forces are taken into account.[26]

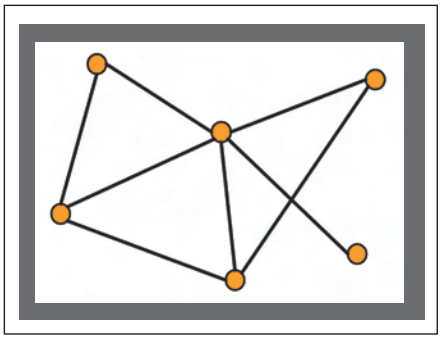


Figure 7: Nework View

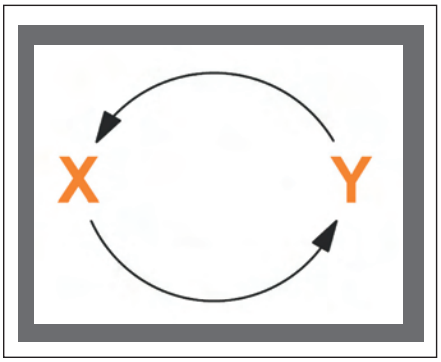


Figure 8: Systems View

In the most basic sense, a syndemic is defined by the presence of mutually reinforcing relationships or "affliction cross-impacts" (Centers for Disease Control and Prevention, 2001; Homer and Milstein, 2002a; Singer, 1996). If those relationships can be estimated—for example, through effects on incidence, recovery, or severity—then network analysis procedures may be used to measure the strength and structural properties of the entire constellation of disorders (Scott, 2000; Wasserman and Faust, 1994). Having that information, in turn, would bring public health assessments to a new level of sophistication.

Seeing syndemics as structured constellations of affliction might enable us to think more pragmatically about integrated intervention strategies. Even as colleagues continue to address specific epidemics, others operating from a syndemic orientation may begin to devise long-range policies that engage a different set of causal drivers: those associated with larger syndemic networks.

Mapping affliction ties could also improve communication among health professionals and citizen leaders who possess other kinds of expertise. For instance professionals who are trained as disease specialists generally focus on the unique aspects of each disease (represented by the nodes in Figure 7). Whereas leaders without professional training, but who are steeped in neighborhood context, tend to focus on the ties. That may be an oversimplification, but it is frequently true that those who perceive themselves as insiders and who lead health ventures on behalf of themselves and others tend to look beyond specific risks and diseases to see those forces that hold larger constellations of disorders together. As one example, consider the highly contextualized orientation used by leaders of the People's Health Movement (People's Health Movement, 2004). By collaborating in drawing syndemic networks, health professionals and other citizens would inevitably have to develop a common language, which in turn would help forge a closer, more authentic connection in their work.

Next comes the shift from recognizing linked afflictions to understanding causality within a dynamic feedback system (Figure 8). To comprehend why syndemics develop and how they can be controlled, one must step back even farther and take in a broader sweep of time and social space. For example, to explain why a whole *pattern of affliction* develops (e.g., an intergenerational health inequity), it is necessary to look beyond the immediate causes of prevalent afflictions themselves.

The analytic boundary must widen to include, at a minimum, interactions among various types of afflictions, the changing character of people's living conditions (which configure vulnerability to afflictions of many forms), as well as fluctuations in the public's strength to address them both. A feedback model can relate these various forces to one another, allowing analysts to examine interactions over time and watch trends unfold dynamically. When *x* and *y* affect each other, "one cannot study the link between *x* and *y* and, independently, the link

26 Some scholars have formalized this idea using the concept of non-specific mortality, which refers to situations where overall mortality in a population remains relatively constant even after dramatic reductions in specific causes of death (Tesh, 1988).

between *y* and *x* and predict how the system will behave. Only the study of the whole system as a feedback system will lead to correct results" (System Dynamics Society, 2002). For most public health problems, particularly those with long time delays like chronic diseases or changes in the physical environment, this approach to modeling yields more precise information about the causal influence of forces that are neither close in time nor near in space to the health events that individuals experience.

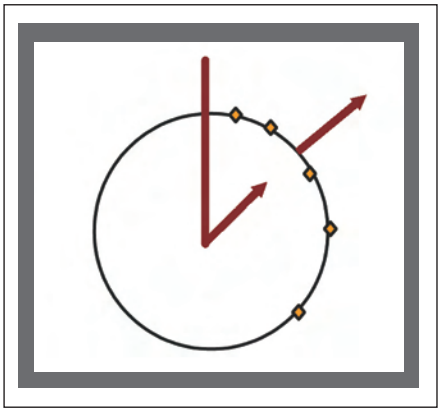


Figure9: Navigational View

Dynamic modeling also allows planners to simulate policy scenarios under different conditions. It offers a virtual world for learning in which rehearsals and controlled experiments can be conducted as a prelude to introducing policies in the real world (Casti, 1997; Foresight and Governance Project, 2002; Maier and Grossler, 2000; Schon and Rein, 1994; Schrage, 2000; Sterman, 2000). This ability to search for policies that can be effective—without the expense, risk, delays, and other barriers to learning inherent in full scale or real time experimentation—expands greatly the range of interventions that can be contemplated.[27] And that confers a substantial advantage when crafting actions to protect the health of entire populations.

A final shift embraces the world of political action, where policy becomes reality. Insights from systems modeling often reveal a number of plausible futures, immediately raising questions about strategic direction and agency. Whose interests are aligned with health? What forms of resistance might be encountered? Which paths toward implementation are possible? Who has the freedom/power to make healthier choices? Who will do the work to enact new policies? Whose values will be upheld when making trade-offs? How will we chart progress toward healthier conditions? These kinds of questions carry us into the sphere of social navigation.

The navigational view, while focused on the specific goal assuring equitable conditions for health is paradoxically the broadest of all because it frames change in those conditions as the result of choices among any number of possible directions (Figure 9). Those directions may be represented formally using circular statistics, as they are in physical navigation (Batschelet, 1981; Fisher, 1993; Jammalamadaka and Sengupta, 2001); however their meaning in this context pertains entirely to the contours of human values, to the goals we set for our future. This portrayal highlights tensions between advocates of change in one direction versus those of another, thereby allowing an assessment of power differences and the health implications of different policy positions (Krieger, Northridge, Gruskin, et.al., 2003; Mindell, Ison, Joffe, 2003; Taylor and Quigley, 2002; World Health Organization, 2004a). When guided by an explicit moral compass (see page 44), public health workers may use a navigational approach to transcend ad hoc problem solving and exert greater influence in society's overall governance. It offers tools for keeping us on course toward a safer, healthier future.

The navigational view also corrects a false presumption, now deeply held by many American citizens, that health professionals are the only ones qualified to work on health problems (Scutchfield, Ireson, Hall, 2004; Sirianni and Friedland, 2001b; Snyder, 1999). In fact, genuine movement toward healthier conditions is not possible unless most citizens, working individually and collectively, make healthier choices in their public and private lives (Jennings and Hanson, 1995b; Kari, Boyte, Jennings, 1994). As the renowned historian Henry Sigerist put it:

> *The people's health...is a concern of the people themselves. They must want health. They must struggle for it and plan for it. Physicians are merely experts whose advice is sought in drawing up plans and whose cooperation is needed in carrying them out. No plan, however*

27 This use of simulation modeling is roughly analogous to the use of animal models as a precursor to human biomedical research, though the stakes of animal research are far higher given that it intervenes in living organisms rather than virtual systems.t even after dramatic reductions in specific causes of death (Tesh, 1988).

> *well devised and well intentioned, will succeed if it is imposed on the people. The war against disease and for health cannot be fought by physicians alone. It is a people's war in which the entire population must be mobilized permanently (Sigerist, 1996:p.227).*

The craft of social navigation applies well-established techniques for physical navigation (e.g., positioning, direction-setting, correction) to transformations in the social world (Polynesian Voyaging Society, 2002; Thompson, 2000a). It draws together concepts and methods from fields as diverse as economics, democratic organizing, and evolutionary biology to understand the processes of directed social change (Banathy, 2000; Boyte, 2004b; Chambers and Cowan, 2003; Etzioni, 1991b; Freire, 2000; Gecan, 2002; King, 1967; Laszlo, 2001; Moyer, 2001; Nye and Donahue, 2000; Salk, 1973; Sen, 1999; Sharp, 1973b; Tarrow, 1998). In the 20th century, much of that direction pointed toward dangerous destinations (e.g., global warfare, environmental degradation, profit-driven "disease promotion" (Freudenberg, 2005).

With these three distinctive points of view—syndemics, systems, and navigation—we see that certain aspects of the overall orientation incorporate modern features of systems science and political thought, but that most of the underlying concepts are not themselves new. In fact, public health historians may well point to times prior to the advent of biomedical specialization when syndemic thinking was even more pronounced. Still, the implications of adhering to this orientation as a formal part of public health work remain largely unexplored, in part because it is only in the last decade that we have developed a language and a set of tools to effectively combine these perspectives with those that shape our prevailing approach to public health work.

Nevertheless, it will likely take decades more for such transformations in thinking and practice to flourish fully. At this early stage, it is apparent that the orientation holds promise for confronting modern health challenges. It does not impose a single, rigid model but instead offers a systems-oriented, politically engaged, and philosophically conscious frame of reference that health professionals and other citizens can use for thinking and working effectively together.

Seeing Health Protection as a Whole System

Perhaps the most pervasive image used to describe the essence of public health work is that of a river filled with people flowing toward a dangerous waterfall. Unable to get out of the current, the people cannot save themselves and so their fate rests with those of us on shore, those who see the problem and are moved to respond. How we act, in turn, depends on what we see, how we think, and what we regard as plausible responses.[28] It is from this simple caricature that we inherit the language of upstream and downstream effort, first popularized by John McKinlay in the late 1970s (McKinlay, 1979), as well as our most basic notions about the effects of each (Gutman and Clayton, 1999; Mayer, Brown, Linder, 2002; McKinlay and Marceau, 2000c; Richter and Laster, 2004; The Lancet, 1994).

Observers standing downstream, below the waterfall, see an urgent crisis of tragic proportions. They search frantically to find anyone who somehow survived the drop amidst the many who inevitably drowned; and when they locate someone who can still be saved, they dive heroically into the churning, deadly waters in an all-out effort to bring them ashore. Theirs is instinctive, immediate, self-sacrificing work, requiring outbursts of tremendous skill, energy, and technological prowess (Kidder, 2004). These helpers quickly tire, yet the flow of people over the waterfall continues, so they call forcefully for others to help in their arduous, but life-saving work.

Soon, the downstream river banks team with rescue workers and equipment in support of a crisis that they are unable to stop. Immersed in the frenzy of dragging drowning people from the water, those who work downstream feel that they have no time to think about what is happening upstream—nor the wherewithal to do much about it anyway. They regard the scene before their eyes as the place where all the action is—and the tremendous gratitude of the people whose lives they save each day solidifies that view.

Upstream, on the shore above the waterfall, most observers do not notice any problem at all; and the ones that do, perceive it as having very different dimensions. Unable to see exactly what is happening below, they are not aware of the catastrophe unfolding. Some hear the calls for assistance and rush to help with the rescue effort. Others see only swimmers in flat water without thinking about the danger ahead. Even the swimmers themselves may not understand the full scope of their predicament. But certain observers—those who know the terrain best, who appreciate how powerful the current is and where it goes—recognize the need for immediate action. Animated by the foresight of an impending tragedy, they begin alerting people to the danger ahead and extending lifelines to encourage their peers safely ashore. Skeptics, both in the water and on land, may resent or resist this flurry of effort in the face of an invisible problem. But still, an ambitious enterprise develops to help people out of the river, all in the name of prevention.

News of the crisis eventually travels even farther upstream. First to people on the bridge, who set out to repair the hole where most of the swimmers fell through. And then to engineers at the dam, who manage to close the broken flood gate and dry up the river itself.

Despite being so contrived, this parable of public health work is told and retold in schools of public health throughout the world. It illustrates the natural, humane tendency to care for those who fall ill as well as the profound inadequacy of relying solely on those last minute services. More importantly, it reveals practical opportunities to avert tragedy long before the worst occurs; and it underscores what Bill Foege, former CDC Director and now senior strategist for the Gates Foundation, famously observed: "public health thinkers see into the future, for they understand that it is the first cigarette that kills and not the last" (Foege, 2000). If the river symbolizes the dynamic flow of time across the lifespan (or across generations), then the many actors along its shore—both upstream and down—represent the enormous cast of characters who are in a position to help safeguard the public's health—before, during and after adversity sets in.

28 This idealized depiction of the public health enterprise rests on at least two questionable assumptions, which become even more dubious under a syndemic orientation. It suggests that people are largely powerless to influence their own health; and it implies that there is only one river placing people in jeopardy.

Upstream action tends to be held as the ideal of public health work and its relative infrequency is rightfully criticized as the chief failing of our society. But in the macroscopic view that a syndemic orientation offers, we see not just the need for vigorous upstream effort, but rather the imperative to organize a balanced system of health protection: one that orchestrates as seamlessly as possible a variety of simultaneous efforts to safeguard people's health (Jackson, Valdesseri, CDC Health Systems Work Group, 2004). Figure 10, developed in collaboration with system dynamics expert Jack Homer, presents a sketch of what such a system might include (Milstein and Homer, 2003).[29]

The four boxes represent different states of health that people in a population could enter. Think of them as bathtubs, each with a different level of water (or prevalence of people) (Booth-Sweeney and Sterman, 2000). These groups range from a population of safer, healthier people to those whose complicated afflictions put them on the verge of premature death. The double arrows indicate transitions between one health state and another with valves controlling the rate of flow (or the speed at which people move). Susan Sontag captured this same fluid character of population health when she spoke in more dichotomous terms of us all having "dual citizenship" among the well and the sick.

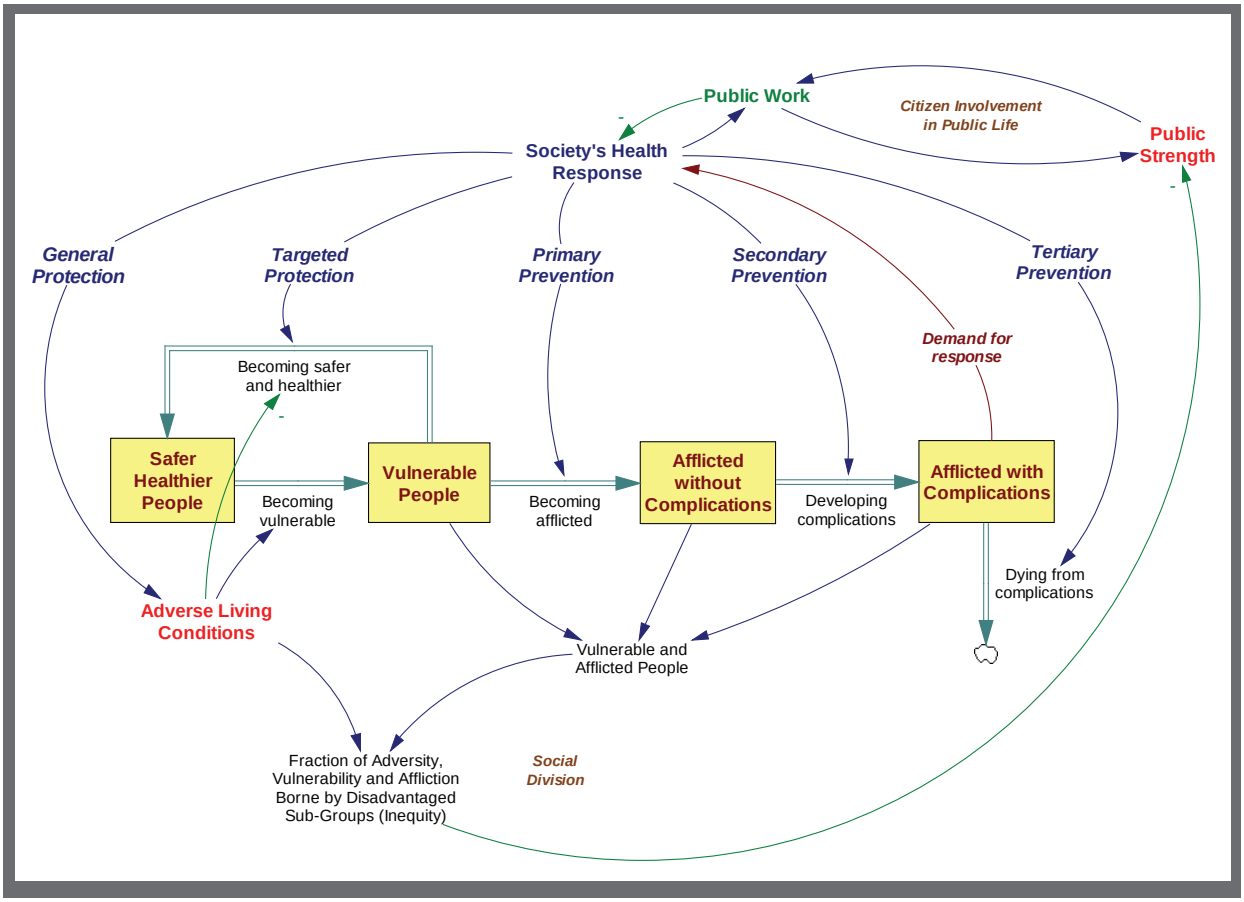


Figure 10: A Balanced System of Health Protection

29 A more complete dynamic hypothesis is presented in (Milstein and Homer, 2003).

Illness is the night-side of life, a more onerous citizenship. Everyone who is born holds dual citizenship, in the kingdom of the well and the kingdom of the sick. Although we all prefer to use only the good passport, sooner or later each of us is obliged, at least for a spell, to identify ourselves as citizens of that other place (Sontag, 2002:3).

Movement between these kingdoms—and how long our "spells" in each state last—is influenced to varying degrees by our genetic inheritance; exposures to environmental conditions at home, work, play and elsewhere; individual behaviors in response to those environments (or in spite of them); social networks; income; education; receipt of health care services; and thousands of other factors. Moreover, any one of these factors may influence and be influenced by the others, forming a massively entangled feedback dynamic that drives movement throughout the system.[30]

As the waterfall parable illustrates, our organized responses to the flow of population health —irrespective of how strong the current is or how well we understand its dynamics below the surface— have the potential to govern how the future unfolds. Decisions about how far up and downstream we work literally affect who lives, who dies, who bears the burdens of vulnerability and affliction, and how hard we must all work in the process. Each distinct type of response, however, requires that different actors engage in different kinds of effort with very different effects. It is these dynamics of the overall health protection system that Figure 10 attempts to formalize.

As the number of people with afflictions and complications rises, the demand for some kind of societal response builds. Initially, that response might be concentrated entirely downstream in an effort to slow the rate at which people are dying prematurely (tertiary prevention). Regardless of how successful that work is, its limited impact—signaled by the continued growth of people with afflictions and complications—eventually prompts a complementary effort to reduce the rate at which people are developing complications (secondary prevention). By that same logic, the response portfolio expands still further to include efforts to limit the number of people who are becoming afflicted in the first place (primary prevention).

Most formal teaching, research, and policy analysis tends to focus on one or more of these three responses: primary, secondary, and tertiary prevention.[31] The best that we can do, one may conclude from mainstream authors, is prevent people at risk from becoming sick, suffering complications, and dying prematurely. But even a rudimentary system analysis suggests that there is more to the story.

Over the past four decades, as ecological and systems thinking have reshaped our collective consciousness (Green, Richard, Potvin, 1996; McLeroy, Bibeau, Steckler, et.al., 1988; Stokols, 1996), it has become increasingly clear that we need not accept health risks at face value. Instead, we may "question the givens" by examining and ultimately transforming the myriad ways in which human societies configure and distribute vulnerability differentially through our public and private choices. This line of inquiry joins health science with a vast history of ideas about power, how it is used, and how it affects both people and the world in which we live (Berlin, 1996; Zinn, 1999).

Even before turning to the formidable task of developing theories about the social production of risks and diseases (Krieger and Zierler, 1996), there are practical steps that we can take to complete our map of the health system. Returning to Figure 10, we may look still farther upstream, beyond primary prevention, by recognizing that those who become afflicted come from a group who are vulnerable to the risks for one or more types of disease, injury, or disability.[32] Likewise, the population of

30 Gross effects of the health system's behavior can be observed by tracking changes over time in the fraction of the total population in each of these four health states. If used in this way, the population stock-and-flow structure provides a dynamic accounting system for assessing progress toward the goal of enlarging the number of people in the safer and healthier state, or least maximizing the time they stay outside of the more downstream states, perhaps measured as the cumulative number of person-years spent in each.

31 A notable exception is the concept of "primordial prevention," which seeks to prevent future disease by influencing its social determinants. This evocative label was coined by Henry Blackburn in 1982 and is still commonly discussed among scholars of cardiovascular disease (DeBusk, 1999; Farquhar, 1999; James, 1999; Watkins, 1984).

32 Most studies indicate that populations with one risk factor are far less common than those with multiple risk factors (Atkins and Clancy, 2004; Hahn, Vesely, Chang, 2000). This adds further support to the syndemic view that vulnerable populations are prone to several forms of interacting afflictions.

vulnerable people comes from those who are safer and healthier, through a process of becoming vulnerable to adverse living conditions that—for whatever reason—they are unable to avoid. Placing these population groups on the map reveals two additional types of health response: targeted protection and general protection.

As the figure indicates, public work powers the overall societal response, but each of the five particular response types has a different structural property in that each affects a different rate of flow. The three downstream actions are labeled prevention because they work to prevent or slow the progression from an undesirable health state to one that is even worse. By contrast, the two upstream actions are protective in that they seek to help people move away from positions of vulnerability (targeted protection), or eliminate the adverse conditions that threaten people's health and loom so large as culprits in the forced migrations from the kingdom of the well to the kingdom of the sick (general protection). The capacity to perform public work in any of these modes, however, rests on the degree of public strength, which itself is undermined by the processes of social division or enriched through social equity. Unlike material resources, such as money or technology, public strength builds with its use as citizens enter and become involved as actors in governing public life (Boyte, 2004b).

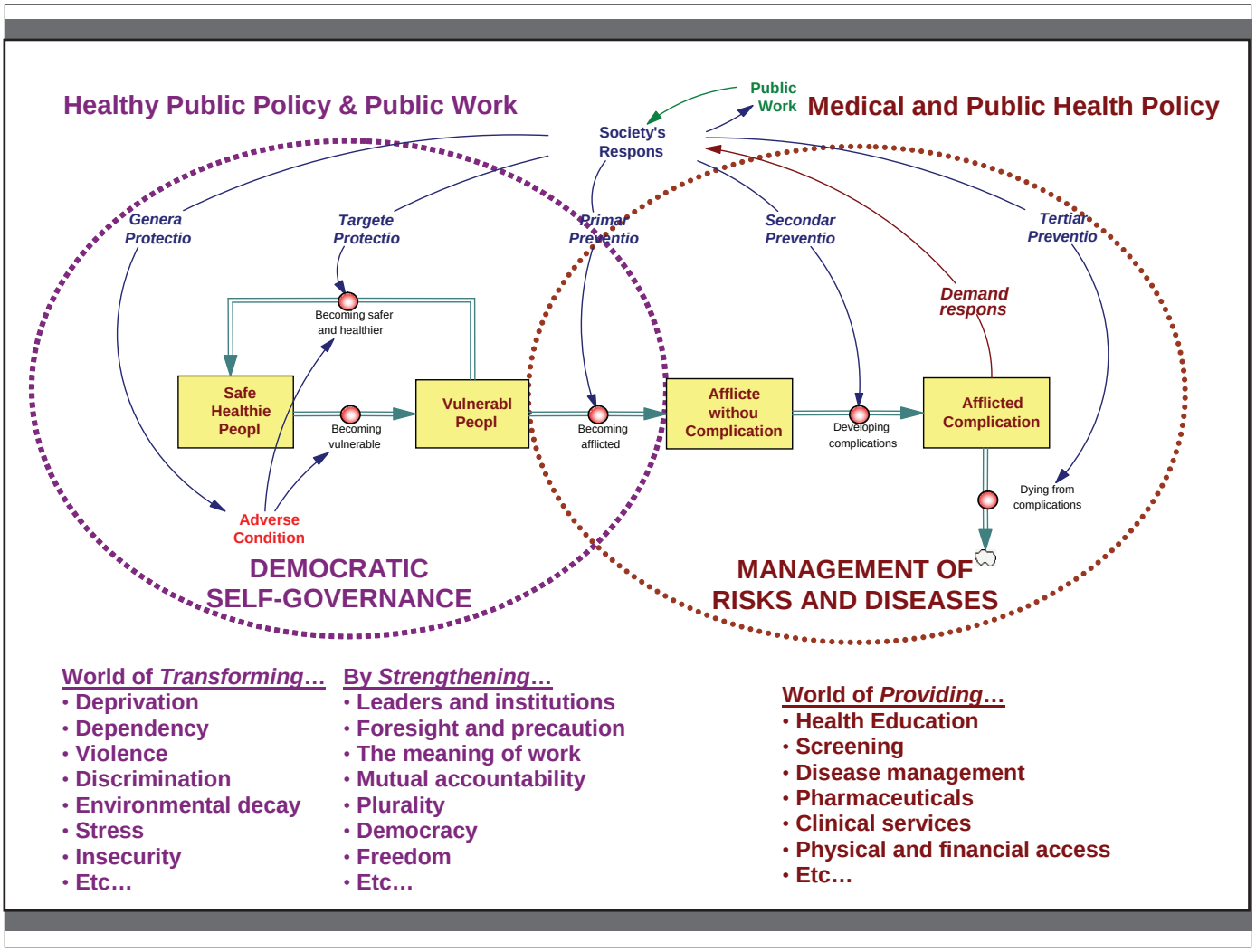


Figure 11: Balancing Two Areas of Emphasis

In 2004, CDC Director Julie Gerberding announced that, "we are redefining CDC as the nation's health-protection agency" (Park, 2004). With that, she signaled an interest in expanding the organization's scope of concern beyond what had been implied by the previous moniker: the nation's prevention agency.[33] In a nationwide satellite broadcast intended to articulate the rationale for this shift in strategy, Gerberding used a simplified version of the graphic in Figure 10 to explain the profound imbalance in downstream vs. upstream effort, as well as CDC's commitment to help correct the problem.

> *The importance of this diagram is that it indicates that the far right-hand side, where we're talking about secondary or tertiary interventions and end of life care, are the place where we make most of our national investments in health. Those categories on the left side of the graph deal with safer healthier people and keeping them from experiencing the vulnerabilities, whether that's lifestyle vulnerabilities or societal vulnerabilities that place them at risk for disease. We simply are underinvested in these compartments. One major task that CDC is intending to address is balancing this portfolio of our health system so that there is much greater emphasis placed on health protection, on making sure that we invest the same kind of intense resources into keeping people healthier or helping them return to a state of health and low vulnerability as we do to disease care and end of life care. (Centers for Disease Control and Prevention, 2004c)*

To move in this direction requires far different strategies and tactics, as well as contributions from new and more diverse sets of actors. It requires a better balance between two areas of emphasis that even today are often pitted against one another, viewed with mutual acrimony, or simply seen as worlds apart (Figure 11).

The effective management of risks and diseases is a world of providers providing. They offer a wide range of services, information, and support intended to help people in need: health education, screening, medical monitoring, pharmaceuticals, clinical services, physical and financial access to care. But no matter how well or how extensively they provide these things, the waves of vulnerable and afflicted people may keep coming because, structurally speaking, such services are virtually powerless to affect those upstream flows.

Transforming the conditions that leave people vulnerable to the large constellation of modern afflictions is a tall order (and a partial explanation of why it happens so rarely). Many of the most adverse living conditions—like severe deprivation, dependency, violence, discrimination, environmental decay, stress, and insecurity—have been entrenched within certain subgroups for decades or centuries. Changing them requires strengthening leaders and institutions and moving fearlessly towards the practice of democratic pluralism: that is, a system of governance wherein all citizens not only coexist but thrive. It requires shifting power relationships that, not coincidentally, are just as entrenched as the adverse conditions themselves. This is the world of intense public organizing, day-to-day work by citizens to shape a commonwealth that upholds their values. It demands self-governance by means of politics in the nonpartisan sense of powerful, creative engagement in public life (Boyte, 2004b; Crick, 1993). It is a world that many public health professionals and institutions have shied away from toward the end of the 20th century, to the approval of some and the dismay of others (Baum and Sanders, 1995).

As uncomfortable as this nonpartisan but politically-engaged emphasis can be for those who would separate epidemiology from action (Atwood, Colditz, Kawachi, 1997, p.1604; Rothman and Poole, 1985), it seems no longer optional (if ever it were).[34]

---

33 The words "and prevention" were added to CDC's name—but not its acronym—in 1992 to underscore a renewed emphasis on preventive action. The idea of protection, by contrast, has taken on added significance in this era of war and bioterrorist threats. But even before these most recent events, the idea of protecting the public from various types of harm and vulnerability has been a strong force in public health thinking, all the way back to figures like Hygeia in Greek mythology and her counterparts in other systems of belief. Although the term protection is not used as often as prevention among health professionals, outside the profession—with members of the public—it seems to have greater resonance, conjuring reassuring notions of safety, watchfulness, and active caring (Kirby, Taylor, Freimuth, et.al., 2001). Even without the name, the public may regard CDC as working in this protective mode, which could account as part of the reason why Americans rate CDC highest among all federal agencies in annual opinion polls (Associated Press, 2004).

34 There are, of course, some instances in which even nonpartisan political practices are prohibited, such as Congressional lobbying by federal employees.

One of the truths that public health assessments have documented over the years is that the distributions of vulnerability and affliction do not occur randomly in human populations (Antonovsky, 1967). Across the globe, the heaviest burdens fall upon those who are socially marginalized, disenfranchised, or oppressed, whether they live in North Dakota or North Korea (People's Health Movement, 2004; World Health Organization, 2004b). Even new forms of affliction, as was the case with HIV/AIDS, quickly gravitate to take hold among minorities (Mann, Tarantola, Netter, 1992). This concentrates disease among disadvantaged groups, who then become even more vulnerable as health threats reinforce one another in a vicious cycle. 1967).

Equipped with scientific knowledge about disease causation, health professionals have been quick to predict how the future may unfold. But in the past three to four decades many health agencies—and the staff who lead them—have become relatively reluctant to enter the public arena where navigational choices are made.[35] Strong traditions in the field favor anticipating the future, instead of actively governing it (Bambra, Fox, Scott- Samuel, 2003, 2005). Those who operate from a syndemic orientation challenge that stance by expanding the boundaries of scientific thought and action in at least four directions (Figure 12).

> *Public health*
> *is the art of using science to expand the boundaries of what is possible.*
> *— Michael Resnick*

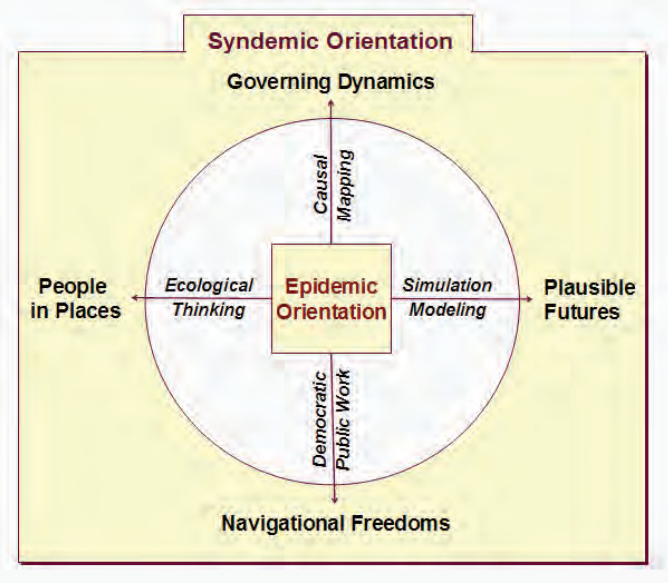


Figure 12: Expanding Boundaries of Public Health Science

If ours is an era of enlarging imagination, then it has become so because innovators, in increasing numbers, are

- acknowledging the interdependency of people in places;
- perceiving more of the dynamics that govern patterns of health, vulnerability, and affliction;
- searching purposefully for the many plausible futures that could unfold; and/or
- working democratically with other citizens to build the public strength needed for navigating change and expanding people's freedoms.

It is possible to observe recent innovations pressing in all four of these directions—not often simultaneously in any one instance, but collectively across the field. In dozens of daily examples, health workers pursue these imaginative directions in new ways and with new intensity, aided by an array of ever-changing conceptual and methodological tools. The outward lines in Figure 12 highlight just a few of these tools—ecological thinking, causal mapping, simulation

35 Efforts to reduce tobacco consumption are a notable—and successful—exception. Efforts to limit gun violence are another exception, albeit with less measurable success to date.

modeling, and democratic public work—which are indicative of whole classes of similar methods that support a syndemic orientation.[36] They also stand for techniques that have yet to be devised, but most likely will be in the years ahead as we come to appreciate the significance and pragmatic importance of enlarging our work along these dimensions. The next section provides a glimpse into how these illustrative methods alter public health thinking and thereby open new possibilities for transforming both the world and the health of people in it.

Relational or ecological thinking situates people in places, revealing a world of interdependent systems from the local to the global. This reinforces the inherent interconnection among people and among places, providing a mandate for working toward global health equity. The North Karelia Project in Finland, described in the following section, exemplifies how the citizens of a large region and later of an entire nation used insights about their local economy, culture, and values to radically alter their own health futures.

Causal mapping is a technique to examine the structural dynamics that govern health problems. By creating and analyzing these maps, it may be possible to identify certain high-leverage drivers with system-wide influence, and thereby simplify the operational objectives for health action even while aligning the efforts of more diverse stakeholders. One of the many virtues of causal mapping is that it allows surprising or counterintuitive insights to surface and be better explained, as was the case in an analysis (summarized below) on the timing and sequence of outside assistance in neighborhoods challenged by multiple epidemics.

A closely related technique, simulation modeling, puts causal maps in motion, compressing decades into seconds, and allowing analysts to play out long-term scenarios of various policy options. This tool helps planners better understand the connection between structure and behavior in our dynamically complex world by providing a way to explore a wide set of plausible futures. It also gives policy makers the opportunity to assemble broader support for a desired course of change, and to rehearse how they may handle periods of declining performance. In the example below, simulation modeling is used to study a particularly vexing syndemic: diabetes in the era of accelerating obesity.

Finally, democratic public work builds the public strength that is needed in an open society for all citizens to have the freedom to protect themselves and to participate in navigating the course of change. Unleashing the energy of youth, as described below, is one inspiring and far-sighted way of changing individuals and societies for generations to come. Another is to consciously change the culture and organizational character of public institutions, as the CDC is now undertaking with its Futures Initiative (Centers for Disease Control and Prevention, 2004d). Each of these examples provides a glimpse into the transformations that are so central to the further flourishing of a syndemic orientation.

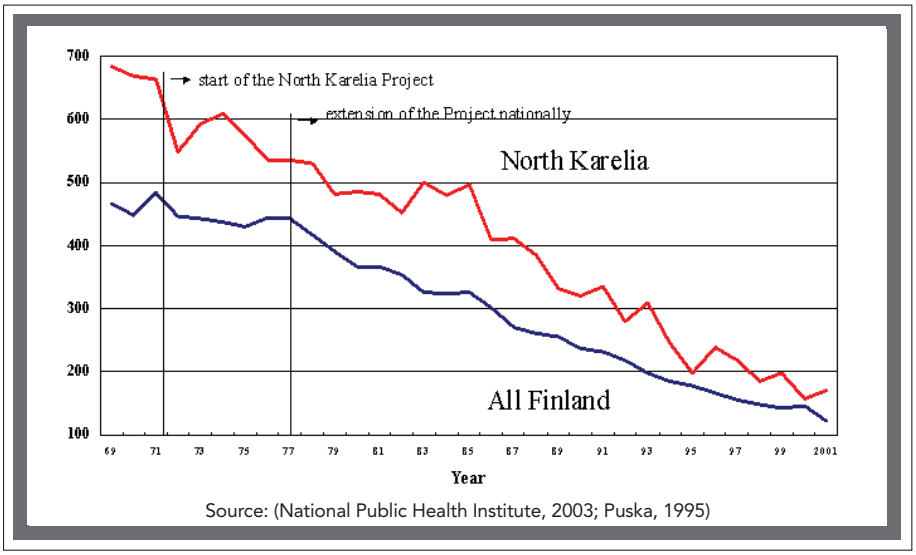
36 Other intriguing approaches could have also been highlighted, such as network analysis (Scott, 2000; Wasserman and Faust, 1994), agent-based modeling (Rahmandad and Sterman, 2005), complex adaptive systems (Olson and Eoyang, 2001; Tan, Wen, Awad, 2005), human systems dynamics (Eoyang, 2003; Eoyang, 2001; Human Systems Dynamics Institute, 2003), appreciative inquiry (Cooperrider, Sorensen, Whitney, et.al., 2000), health impact assessment (Davenport, Mathers, Parry, 2006; Quigley, Keville, Taylor, 2005; World Health Organization, 2005b), summary measures of population health (Murray, Lopez, Salomon, et.al., 2002; Veerman, Barendregt, Mackenbach, 2005), geographic information systems (Ong, Graham, Houston, 2006), storytelling (Kibel, 1999), journey mapping (Kibel, 2001), power and interest mapping (Hildreth, 1998), futuring (Bezold and Hancock, 1993; Garrett, 1999), guided evolution (Banathy, 2000), large group methods for enhancing democratic participation, and many more.

TRANSFORMING CONDITIONS

The Example of North Karelia[37]

The successes of the North Karelia Project in Finland—in which heart disease, stroke, lung cancer, and other noncommunicable diseases declined dramatically over several decades—are legendary within the public health field (Puska, 1995, 2002). Both students and veterans of public health history are familiar with the project's steeply pitched graphs (for example, Figure 13) and the general outlines of the story of how a dedicated group of Finns transformed the eating and smoking habits of an entire generation (Vartiainen, Jousilahti, Alfthan, et.al., 2000). The achievements in North Karelia are a source of optimism and envy in the United States, where health protection efforts over the same time period did not yield results anywhere near as dramatic, comprehensive, nor sustained as these (Hancock, Sanson Fisher, Redman, et.al., 1997).

The North Karelia Project deserves its reputation, but the story is in fact more complicated and interesting than its common depiction as a successful community-level behavioral change venture. In fact, the events in North Karelia exhibit several innovations that are prototypical of a syndemic orientation, although the project began long before that word was even imagined. The distinctive approach used in North Karelia sprang from some of the same sources that we have examined earlier: a strong sense of place, intense concern that residents of that place were unnecessarily vulnerable to multiple afflictions, a passion for redirecting health futures in jeopardy, and an unwavering attention to relationships among people, problems, and the possibilities for change. These features, in turn, led to public actions that simultaneously strengthened people's power, expanded people's choices, instituted norms of widespread accountability, and ultimately transformed adverse living conditions along with the health indices that they engender. When viewed through a syndemic macroscope, the success of the North Karelia Project is awe-inspiring, but it does not seem peculiar to Finnish culture as some contend. It seems, instead, to be the well-earned result of concerned, humane, directed work, informed by pragmatic ecological thinking about the relationship between people and places.



Source: (National Public Health Institute, 2003; Puska, 1995)

Figure 13: Coronary Heart Disease Mortality Rates in Finland and in the North Karelia Region, per 100,000, Men Aged 34–65, 1967—2001

37 This section was informed greatly by participating in August 2003 in the week-long North Karelia International Visitors' Programme (National Public Health Institute, 2003). Visiting Helsinki, Joensuu, Ilomantsi, and other towns where the project began—and where it remains very much alive today—provides insights that are not contained even in the voluminous publications by and about the project. Thanks to the openness of the research team in Helsinki (led by Erkki Vartiainen, Aulikki Nissinen, and Pekka Puska) and the practical intervention team in Joensuu (led by Vesa Korpelainen), we visitors had an opportunity to speak directly with the bakers, newspaper publishers, food scientists, school teachers, berry farmers, restauranteurs, elected officials, entrepreneurs, physicians, housewives, grocers, and others whose work made the project so unique and successful.

Launching a Cultural Movement for Health

The origins of the North Karelia Project go back to an epidemiological study in the late 1960s, which compared the health status of residents of Eastern and Western Finland with that of other populations around the world. The study concluded that Finnish men between the ages of 30 and 59—particularly those in the North Karelia region—had the highest rates of heart disease mortality in the world. At the time, our understanding of cardiovascular risk factors was just beginning to take shape. The prevailing wisdom suggested that the high rate of disease was tied to Finnish propensities for smoking, eating high-fat foods, and being less physically active than their counterparts elsewhere—all of which were especially true of the dairy farmers in North Karelia. Clinicians and public health researchers were understandably alarmed by these findings. Less predictable was the reaction of the citizenry in general. Soon after the results were announced, a group of civic leaders grew so angered by the health crisis that they petitioned the Finnish government for assistance in organizing some kind of response.

This early interaction among physicians, researchers, and impassioned citizens is an important feature of the North Karelia story. The initial impetus for action came not only from epidemiological evidence, but equally from the hearts of those with roots in the region who were active in its public life.[38]

The Finns rejected the notion that heart disease and other chronic illnesses are problems only for those at highest risk. Even those with low and moderate levels of risk still develop these afflictions, albeit at a lower rate. With many more people in the middle area of the risk distribution compared with those in the high risk tail, helping everyone to change even a bit promises large effects for the population as a whole. Following Geoffrey Rose's strategy of population-based preventive medicine (Rose, 1992), leaders of the North Karelia Project regarded their high mortality rate as a signal that the entire distribution of risk across the population had to be shifted. They did not set out to improve the health of particular people, but rather to assure safer, healthier conditions in Finland itself.

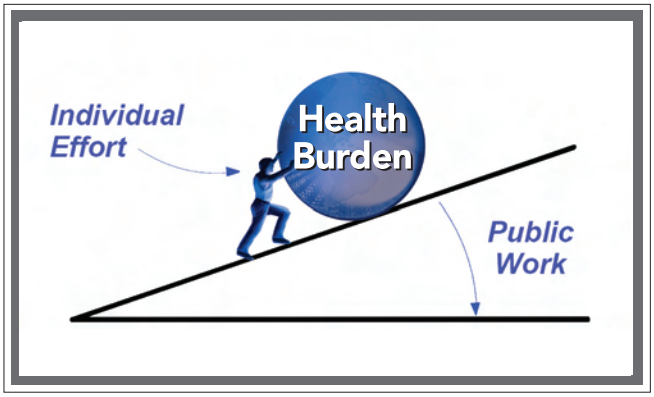


Figure 14: Public Work Enhances Individual Effort

There were no illusions that such large-scale change would come easily. Individuals would ultimately have to put forth the effort to alter their own risk behaviors. However, the architects of the North Karelia Project understood that organized public work ventures could substantially ease the burdens, increase the rewards, and expand the freedoms for all people to stop smoking, improve their diet, boost their level of physical activity, and make other health-related changes (Figure 14; adapted from: Puska P. North Karelia International Visitors' Program, 2003).

The project's approach was firmly rooted in behavioral theory and health planning models (McAlister, Puska, Salonen, et.al., 1982; Puska, 1995). These conceptual frameworks provided a stable set of concepts for guiding the project, even as it evolved over several tumultuous decades. Part of that flexibility was due to the project's open approach to action planning, constantly inviting creative contributions from those outside the core project team. The health crisis affected everyone in the entire population, either directly or indirectly, and so the call to contribute spread throughout the region. Given this orientation, the researchers made a crucial decision in their evaluation planning. Instead of adhering to a single, inflexible

38 Among those early leaders, Pekka Puska emerged as a central figure. A young doctor with familial ties to North Karelia, Puska proved tremendously insightful and effective in organizing the initial demonstration project. He quickly became the scientific lead for the project, and later was elected to represent the region in Parliament. In 2000, with decades of experience leading the Finnish effort, Puska became Director General of the National Public Health Institute in Finland (KTL). He was also called upon by the World Health Organization to lead their health promotion and chronic disease prevention operations from 2001-2003.

intervention protocol, a more comprehensive, ecological strategy was framed around the pragmatic principle that any number of actions may be introduced by any number of actors, either simultaneously or in sequence. Whatever sense of control the project leaders may have relinquished in taking this stance (if any at all) was offset by their conviction that massive citizen effort was necessary to spread and cement the changes they sought.

There is no doubt that the talents and persistence of world-class health professionals were crucial to the project's success. But the engagement of ordinary citizens who felt connected to and angered by the tragedy of so many early deaths galvanized the entire effort, transforming it from an ad hoc disease prevention project into a serious cultural movement for better health that continues even today. Those citizens who launched the North Karelia Project pushed for recognition from their elected officials, while also holding themselves accountable by devoting their own time, energy, and talents to the work.

Many creative innovations were devised not by experts with technical training in health care or public health, but rather by citizens who were moved to ask themselves, "What can I do to make it easier for people in North Karelia to be healthy?" To that straightforward question came an array of astonishing answers. Bakers devised lower-fat loaves, working for years to perfect breads that had less salt, more fiber, and still pleased their customers' palates. Sausage makers added mushrooms to their products to increase vegetable consumption. A food scientist at the University of Helsinki discovered a breakthrough way to lower cholesterol in margarine and immediately approached the dairy and margarine industries so that they could incorporate his discovery.

Each of these examples illustrates the ecological thinking and public-spirited orientation that animated the project. Over the years, people from many walks of life found ways of applying their particular skills and talents to the health issues before them, whether or not health was seen as falling within their scope of responsibility. No one directed the baker, sausage maker, and food scientist to pursue innovations that would make it easier for their fellow citizens to eat more healthfully, but they did. They regarded the entire population's health as a goal worthy of their own work—now newly understood as public work—with themselves, their families, and their nation as beneficiaries.

Identifying and Fighting Afflictions

The project was organized initially to respond to excessive heart disease deaths. It later expanded to address a constellation of other interrelated afflictions such as stroke, diabetes, cancers, alcohol use, depression, and others. In the late 1960s and early 1970s, the initial focus on smoking, high-fat diets, and physical activity was something of a leap of faith. These risk factors, while clearly viable suspects for heart disease (and other chronic illnesses), were by no means supported by the body of evidence that exists today.[39]

One early decision in the education realm was to avoid over-complicating the messages from the project to the public. Instead of a deluge of detail on fat content, lipids, blocked arteries, and the like, messages emphasized that people had choices to make about their consumption of food and tobacco and their willingness to become more physically active. The project team's goals were to make at least some of the difficult choices easier for people and to reward them when they did make healthier choices.

They were aided tremendously in these efforts by several unique features of Finnish society: an advanced welfare state with universal access to health care services and a rate of newspaper readership approaching 100%. Communicating with the population directly through news articles, editorials, and letters to the editor was a valuable and extremely effective tool in Finland, one that the North Karelia Project used to the fullest.

39 Results published by the Finnish researchers, in fact, provided some of the strongest evidence available about cardiovascular disease and other chronic illnesses.

Examining Living Conditions and Crafting System-wide Change

The people of North Karelia used a combination of individual action and collective political organizing to change the conditions in which they were living—conditions that they were beginning to see as lethal. Tobacco consumption was curtailed through legislative means (e.g., taxation, restricting the places where one could smoke), food labeling requirements were changed (e.g., forcing manufacturers to specify not only low-salt or low-fat content, but also high-salt and high-fat as well), and entire industries were shifted. Within the dairy industry, low-fat milk and cheese production increased to the point where, in 2002, a 5%-fat cheese won a food industry award for best new product and was sold out for weeks. Berry farming and consumption were also promoted to make up for declining dairy revenue, in part by convincing the Finnish Army to offer local berry juice in its food services to stimulate demand for the berry farmers' products.

Naturally, these achievements were not won without engaging those individuals and institutions whose cultural, economic, and political interests were threatened by the prospect of change. The dairy industry, for example, was not only an important part of the economy, but represented a culturally resonant way of life for generations of Finnish families. High-fat eating habits, such as lavishly buttering bread and consuming cream and rich cheeses at every meal, were a deeply entrenched source of enjoyment, ritual, and pride. Finland even had laws on the books—promoted by the dairy industry—that banned the mixing of butter and oil. Eventually, through the deliberate work of the project, these high-fat eating habits came to be seen in a new light. And the law that prohibited adding oil to butter was eventually overturned in the wake of massive kitchen disobedience among thousands of housewives who believed that some dilution could be tolerated in the name of their families' and the nation's health. Cultural pride, in this case, was transformed from obstacle to strength, as it fueled the public work that literally redirected the lines on the heart disease charts.

Building the Power to Act and Guiding Social Change

Looking back from our vantage point today, it is easy to see how much public strength was already present when the citizens of North Karelia wrote their petition and began organizing a serious response. They were outraged, but in a constructive way: willing to pitch in, to confront people who may disagree, and to work out viable solutions. They had dedicated allies in the clinical realm who found ways of guiding and educating without interfering or dissipating people's passion for change. Everyone—politicians, physicians, bakers, schoolteachers, dairy farmers—read the newspapers, which in turn featured daily information and frank exchanges about what the North Karelia Project and its supporters truly value along with the perspectives of those who disagree. Despite their different interests—or rather by working in and through them—the Finnish people came to see a very different future from the one on the immediate horizon and they chose to move in a safer, healthier direction.

In the United States, we view this display of civil, democratic work with envy, recognizing that it gave the Finns a significant advantage in their struggle to improve adverse living conditions. Instead of depleting their reserves of this potent elixir, their endeavors to redirect the course change only built more public strength.

More recently, however, these same Finnish newspapers have been calling for a "New North Karelia Project" to focus on alcohol and problems facing youth. Whereas many threats of the last century have been brought under control, the modern globalizing world is now presenting a new list of afflictions and conditions to concern North Karelians: cheap liquor imports from Estonia, high-tech desk jobs curtailing physical activity, increased smoking rates among teenagers and women, as well as growing rates of injection drug use, suicide, and depression. These are more difficult problems to address, less amenable to the "simple message" strategy that worked so well for diet-related risk factors. Whether the relationships and public strength built so effectively during the project's first three decades can adapt to these new challenges is an unfolding and fascinating question.

Viewed through a syndemic orientation, the need for intense, place-based, public health work in North Karelia—and in all regions of the world—will continue ad infinitum. Our efforts to assure healthful conditions remain constant, but the challenges to be met and the horizons to be explored change with the constant flow of time and endless stream of physical and social evolution. As navigators in this epic journey, one of our most valuable skills is the ability to anticipate change, so it is to that task that we now turn.

Anticipating Change

Instead of concentrating exclusively on what is most likely to happen (the probable future), which is the goal in most types of forecasting, system dynamics (SD) modeling supports a pragmatic, navigational view: one based on moving consciously among the larger set of trajectories that could plausibly unfold.[40] This shift from the probable to the plausible is subtle, but significant. "Most organizations plan around what is most likely," observed Clement Bezold and Trevor Hancock in an overview of the health futures field. "In so doing, they reinforce what is, even though they want something very different" (Bezold and Hancock, 1993). Furthermore, considering that Hancock is one of those most responsible for launching the worldwide Healthy Cities/Healthy Communities movement (Hancock, 1993; International Healthy Cities Foundation, 2002; Norris and Pittman, 2000), he speaks from experience when he describes the power that is often unleashed when we plan around plausible futures.

> *Too often our image of the future is the scenario we think will most likely happen. If we don't like the way we think things are going, this may bring with it an awful sense that the light at the end of the tunnel is a train bearing down upon us. The probable future is something that seems to be done to us, something over which we have little or no control, and often something we don't like very much. If health futures (as a field) focuses too much upon the probable, which it has a tendency to do (planners, be they politicians, civil servants, or private business persons, like to know what to plan for, as do ordinary people), then it runs the risk, perhaps inadvertently, of disempowering people and denying them choice....The energy and creativity released in a "preferable future" process can be quite astonishing. (Hancock and Bezold, 1994:25).*

Just as architects learn their craft by studying prototype designs in a studio before introducing (or imposing) them on the real world, so can SD modeling help us to reflect with one another on our most important values, anticipate plausible futures, and choose among them in more open and ethical way. The methods offer a rare avenue for learning and experimenting in a simulated world before rushing into the high stakes enterprise of acting in the real one.

Considering how useful SD modeling can be, the next section goes into more depth about its core principles and then illustrates the technique through two examples: (1) a causal map of factors affecting outside assistance in a divided neighborhood that is challenged by multiple afflictions; and (2) a simulation model designed to explore plausible futures for diabetes prevalence in the wake of rising obesity.

The System Dynamics Approach

SD modeling is a way of mapping and then modeling the forces of change in a dynamic system so that their influences on one another can be better understood and the overall direction of the system can be better governed (Milstein and Homer, 2005; Sterman, 2000). The methodology enables planners to assemble their knowledge of a problematic situation into a single, visible dynamic hypothesis and then, using computer simulations, to formally compare various scenarios for how to navigate change. The emphasis is not on forecasting the future, but rather on learning how our actions in the present can trigger plausible reactions both far away and over time (Sterman, 2006). With its ingenious use of simulation games as a virtual world for interacting with an SD model, the learning that occurs is often visceral and emotional rather

40 System dynamics is one particular methodology within the larger class of simulation modeling techniques (Forrester, 1961, 1989; Sterman, 2000).

than purely cognitive or conceptual (Foresight and Governance Project, 2002). As such, SD is a powerful tool for discovering how to move more effectively and ethically in a dynamic and democratic world (Forrester, 1971; Meadows, Richardson, Bruckmann, 1982; Meadows and Robinson, 1985; Sterman, 2002).

With a nearly 50-year history since its development by Jay W. Forrester at the Massachusetts Institute of Technology (Forrester, 1991), SD modeling today is used productively in many fields of human endeavor (Roberts, 1999a; Sterman, 2000). Influential applications encompass projects in human service delivery (Levin and Roberts, 1976), urban development (Forrester, 1969), corporate management (Forrester, 1961); (Pidd, 1996), energy and global ecology (Ford, 1999; Meadows, Randers, Meadows, 2004), K-12 education (Forrester, 1994; Saposnick, 2004), and dozens more.

There are also numerous applications in the health area specifically (Hargrove, 1998; Milstein and Homer, 2005; Taylor and Lane, 1998). Some examples include studies of

- Cardiovascular disease (Hirsch and Wils, 1984; Homer, Hirsch, Minniti, et.al., 2004; Luginbuhl and Hirsch, 1981; Homer, Milstein, Wile, et.al., in press);
- Cervical cancer (Royston, Dost, Townshend, et.al., 1999);
- Chlamydia (Royston, Dost, Townshend, et.al., 1999; Townshend and Turner, 2000);
- Cocaine (Homer, 1993);
- Dengue fever (Ritchie-Dunham and Mendez Galvan, 1999);
- Diabetes (Homer, Hirsch, Minniti, et.al., 2004; Homer, Jones, Seville, et.al., 2004; Jones, Homer, Murphy, et.al., 2006; Milstein, Jones, Homer, et.al., 2007);
- Dental care (Hirsch and Killingsworth, 1975; Levin and Roberts, 1976);
- Drug-resistant pneumococcal infections (Homer, Ritchie-Dunham, Rabbino, et.al.,2000);
- Heroin (Levin, Roberts, Hirsch, 1975);
- HIV/AIDS (Dangerfield, Fang, Roberts, 2001; Homer and St. Clair, 1991; Roberts and Dangerfield, 1990);
- HMO planning (Hirsch and Miller, 1974);
- Mammography (Fett, 2001);
- Mental health (Levin and Roberts, 1976; Smith, Wolstenholme, McKelvie, et.al., 2004);
- Obesity (Abdel-Hamid, 2002, 2003; Homer, Milstein, Dietz, et.al., 2006);
- Patient flows (Lane, Monefeldt, Rosenhead, 2000; Wolstenholme, 1996, 1999);
- Performance assessment (McDonnell, Heffernan, Faulkner, 2004); • Public health emergencies (Hirsch, 2004; Hoard, Homer, Manley, et.al., 2005);
- Public health planning (Hirsch and Immediato, 1999; Hirsch and Immediato, 1998; Homer and Milstein, 2004; Homer, Hirsch, Milstein, 2007; Innovation Associates and New England Health Care Assembly, 1997);
- Tobacco (National Cancer Institute, 2005; Roberts, Homer, Kasabian, et.al., 1982; Tengs, Ahmad, Savage, et.al., 2005; Tengs, Osgood, Chen, 2001; Tengs, Osgood, Lin, 2001); and
- Syndemics (Homer and Milstein, 2002a, 2003b, 2004)

Still, the SD methodology is not routinely taught in schools of public health despite its tremendous potential for illuminating some of the most challenging phenomena that confront the field (Homer and Milstein, 2003a; Milstein, 2003b). For instance, public health scholars could use SD in innovative ways to study

- Individual diseases and risk factors (e.g., by examining momentum and setting justifiable goals);
- Mutually reinforcing afflictions (syndemics) (e.g., by exploring interactions among related afflictions, adverse living conditions, and the public's capacity to address them both);
- Program dynamics (e.g., by analyzing the system-wide impacts of comprehensive programs with interacting components);
- Regional dynamics (e.g., by incorporating the mediating effects of local conditions, histories, capabilities, and constraints);
- Life course dynamics (e.g., by following health trajectories across life stages)

- Capacities and cost-effectiveness (e.g., by understanding how ambitious health ventures may be configured without overwhelming/depleting capacity—perhaps even strengthening it);
- Value trade-offs (e.g., by developing a deeper analysis of phenomena like the imbalance of upstream-downstream effort, growth of the uninsured, rising costs, declining quality, and entrenched inequalities);
- Organizational management (e.g., by linking balanced scorecards to a dynamic understanding of processes and goals);
- Public deliberation and scenario planning (e.g., by bringing more structure, evidence, and insight to public dialogue and judgment).

Part of what makes SD modeling so well-suited for public health work is that it adheres to a feedback view of causal processes (Richardson, 1991). This perspective stands in contrast to the variable-as-cause orientation that typically frames most population health problems and policies (Susser, 1973, 1991, 2001). The variable-as-cause approach is event-oriented in that it tends to examine one event in relation to another without necessarily understanding the patterns or the structural dynamics out of which those events emerge. To take an extreme example, if it takes six drops of reagent to achieve crystallization in a chemical experiment, a strict event- or variable-oriented causal analysis might erroneously conclude that the first five were ineffective and that only the last drop caused the change. Dose response is, of course, a major factor in conventional causal reasoning. But just imagine if those "drops" corresponded to changes in scores of health-related exposures moving through different pathways and spread out over days, years, or decades. Would we even notice their accumulation, much less their combined influence?

The opposite view, well articulated by the early 20th century social reformer Jacob Riis, becomes a source of optimism in a world filled with long delays and incremental movement toward goals.

> *When nothing seems to help, I go and look at a stonecutter hammering away at his rock perhaps a hundred times without so much as a crack showing in it. Yet at the hundred and first blow, it will split in two, and I know it was not that blow that did it—but all that had gone before (Loeb, 1999).*

There is much more to the feedback or design view of causality than mere patience and hope (Argyris, 1996; Dent, 2003). As Richardson noted, paraphrasing Jay Forrester, it is all about finding the right vantage point.

> *The feedback perspective stems from viewing the system from 'a very particular distance,' not so close as to be concerned with the action of a single individual, but not so far away as to be ignorant of the internal pressures in the system. (Richardson, 1991)*

When a system's whole structure is understood as the source of observed events—rather than just one or several external variables—there is an incentive to stand back far enough away from potentially misleading or disorienting details and get a fuller picture of the terrain. Some scholars refer to this special point of view as "the overview effect" (White, 1998) or "10,000 meter thinking" (Richmond, 1993, 2000). SD modelers have found that a broad scope is generally needed for finding effective solutions to dynamically complex problems (Homer and Hirsch, 2006; Sterman, 1998). This wide-angle, macroscopic perspective also avoids blaming or scapegoating individuals for seemingly unproductive actions, recognizing that if other people were put in the same position and exposed to the same pressures, they too might behave in similar ways. According to MIT management professor John Sterman, this tendency to blame other people rather than system structure is so strong that psychologists refer to it as the "fundamental attribution error." Instead, Sterman recommends that we concentrate on "designing organizations in which ordinary people can achieve extraordinary results" (Sterman, 2000:17).

Another benefit to the system-as-cause point of view is that it paves the way for a complementary form of experimental inquiry through simulation. Heightened awareness of our vulnerability to a vast array of terrorist attacks has introduced many public health workers to wonders of scenario planning or simulated event exercises. For example, in May 2004, "more than 100 CDC personnel from all levels of the organization participated in the agency's first ever full-scale internal emergency management exercise" (Nellis and Birch, 2004). Reflecting on the experience, Duane Smith observed that:

It is important to exercise your plan before an event really happens…You need to validate your procedures. You need to see that the plan and reality are the same. It's also a federal regulation to hold exercises. And it's a good idea to get people thinking about their roles and how they will support the agency well before a crisis occurs.

If the benefits of rehearsal and simulated response are so great, then why aren't these techniques used more commonly in other areas of public health work? Why are there now federal regulations to exercise our plans for counter-terrorism, but no such mandate to play out policies for responding to the long list of other risks and diseases that threaten population health to a far greater degree?

Modern computing power has removed many barriers to rehearsing even very complicated scenarios in a compressed time frame. This technology enables planners to evaluate the results of their decisions under controlled conditions rather than relying only on observations in the messy and slow real world. The prospect of developing better health policies through simulation studies offers numerous advantages for public health work. As Sterman puts it,

Even the best conceptual models can only be tested and improved by relying on the learning feedback through the real world...This feedback is very slow and often rendered ineffective by dynamic complexity, time delays, inadequate and ambiguous feedback, poor reasoning skills, defensive reactions, and the costs of experimentation. In these circumstances, simulation becomes the only reliable way to test a hypothesis and evaluate the likely effects of policies (Sterman, 2000).

Another reason for turning to simulation is the potential for SD analyses to yield insight into the ethical dilemmas associated with different decisions. Unintended effects resulting in health inequities, for example, or trade-offs pitting the afflicted against the vulnerable, or people in the present against our children in the future, are examples of the sort of ethical implications that are unlikely to surface when using conventional approaches for policy analysis (Daniels, 2006). Or, if they do surface, to be divisive or to generate short-term actions that eventually worsen problems in the long-term.

Magnussen et. al. provide the example of macro-economic pro-growth policies in developing countries, pursued by international aid agencies and governments in these countries. These policies, they argue, have the tendency to "provide better opportunities to those with resources and high levels of education, while large segments of the population without these assets are unlikely to benefit and may in fact become casualties of economic transition. Thus, it is the duty of health policymakers to signal when other policies may undermine efforts to promote health equity" (Magnussen, Ehiri, Jolly, 2004:174).

SD modeling is designed to capture the dynamic complexity inherent in feedback systems, large or small, but the technique itself is not necessarily complex.[41] In fact, its use is growing in K-12 schools nationwide precisely because it provides a flexible framework for eliciting students' mental models and for integrating knowledge across the curriculum. Educators say that it helps young people develop a serious understanding of the complex world in which we live along with a pragmatic outlook better suited to navigating the changes in store (Creative Learning Exchange, 2002; Forrester, 1994; Richmond, 1993). With its broad, endogenous point of view, SD modeling also highlights forces that are under people's control, instead of purely exogenous influences (if any truly exist). It rightfully endows each of us with insider status in the systems that affect our lives, positioning us as "systems citizens" with all of the responsibilities, powers, and freedoms that full citizenship bestows (Meadows, 1991; Richmond, 2002; Richmond, 2003; Ulrich, 2000).

This notion of systems citizenship explains why a methodology that seems, on its surface, to require proficiency in esoteric mathematics and sophisticated computer skills is not only accessible to us all, but in fact benefits from the inclusion of diverse perspectives. Individuals with special modeling expertise are, of course, critical in any SD project. But their role is best understood as part of a larger group model building enterprise,

41 Specialized SD modeling software, such as Vensim (Ventana Systems, 2004) and Stella/iThink (Isee Systems, 2004), makes it possible to develop and use dynamic maps and models without having to do the complex computer programming upon which they are based.

involving stakeholders with varying points of view and widely diverse talents (Andersen, Richardson, Vennix, 1997; Richardson and Andersen, 1995; Vennix, 1996; Vennix, Andersen, Richardson, 1997). An expert modeler working alone at a computer is unlikely to develop a sound model of real world social dynamics; and even if he or she did, it would be unlikely to be used (Roberts, 1999b). Technical expertise alone is insufficient, in part, because all models require boundary judgments that, in turn, affect which facts are considered relevant as well as normative values about their merit, worth, or significance. Ulrich explains that this essential task of drawing boundaries cannot be justified as the domain of experts alone.

> *Professional expertise does not protect against the need for making boundary judgements; on the contrary, it depends on them just like everyday knowledge. Nor does it provide an objective basis for defining boundary judgements. It's exactly the other way round: boundary judgements stand for the inevitable selectivity and thus partiality of our propositions. It follows that experts cannot justify their boundary judgements (as against those of ordinary citizens) by referring to an advantage of theoretical knowledge and expertise. When it comes to the problem of boundary judgements, experts have no natural advantage of competence over lay people. (Ulrich, 2000:8)*

Instead, modeling experts and non-experts alike must continually engage in an open dialogue about our problems, how we frame them, and the subsequent implications for change. The inclusive ethic and the emancipatory spirit that animates such critical systems thinking makes it a powerful adjunct to participatory action research (Scholl, 2004) and citizen-centered public health work.

Ulrich also contends that efforts to recognize and critique boundary judgements create the conditions for authentic communication, even in circumstances where there is no consensus or even agreement about facts and values.

> *Once we understand the role of boundary judgements and know how to deal with them in an open and reflective way, we can grant one another the right to having different rationalities; we can begin to understand, and agree upon, the sources of dissent. Thus we can learn to understand one another even though we cannot agree, as our needs and interests are genuinely different. (Ulrich, 2000:7)*

If systems thinking relies on—and indeed facilitates—boundary judgments, which in turn, reveal a plurality of equally legitimate ways of knowing and valuing the world, then we may better appreciate the profound claim, best articulated by public opinion researcher Daniel Yankelovich in his chapter "*You Can Argue with Einstein*," that,

> *For certain purposes, public judgment should carry more weight than expert opinion — and not simply because the majority may have more political power than the individual expert but because the public's claim to know is actually stronger than the experts'...the judgment of the general public can, under some conditions, be equal or superior in quality to the judgment of experts and elites who possess far more information, education, and ability to articulate their views. (Yankelovich, 1991:220)*

Steps in SD Modeling

SD modeling supports a pragmatic, navigational view by pursuing four general lines of inquiry (Figure 15):

- Why are certain aspects of the system changing?
- Where is the system headed if no new action is taken?
- How else can the system behave, if different decisions are made?
- Who has the power to move the system in a safer, healthier direction?

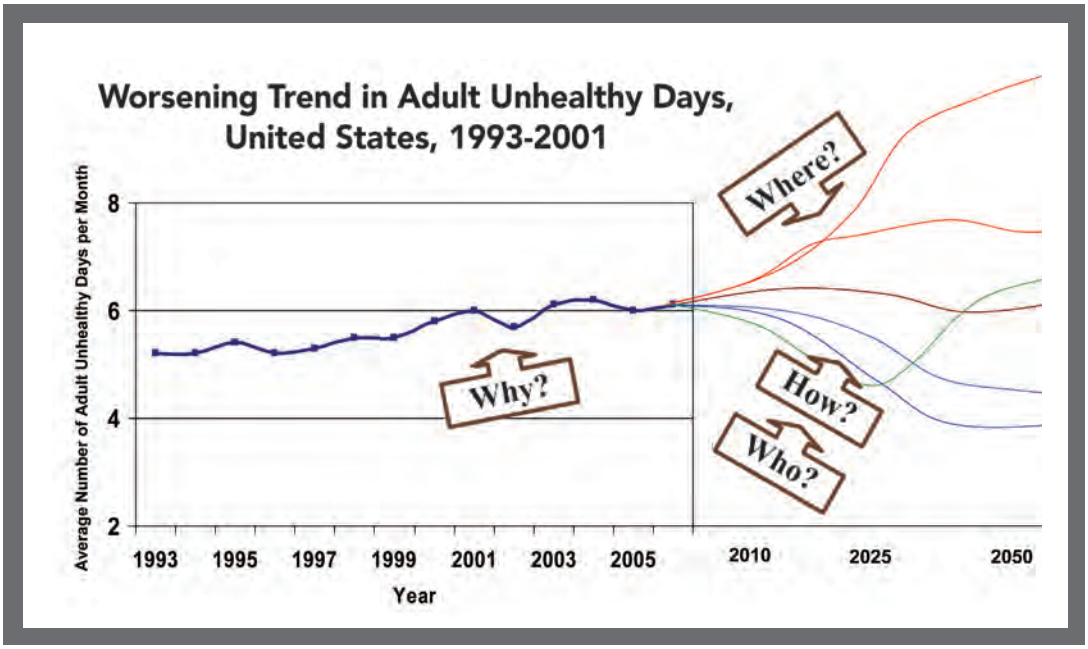


Figure 15: System Dynamics Modeling Addresses Navigational Questions

To answer these questions, SD modeling proceeds iteratively through the following general steps (Homer, 1996) (Figure 16):

- Identify a persistent problem that exists, in part, because of dynamic complexity. The emphasis on *dynamic complexity* does not refer to problems that have many parts (i.e., combinatorial complexity), but rather to problems that involve mutually reinforcing factors (e.g., behavioral feedback), accumulations over time, significant delays between actions and effects, or non-linear patterns of change (e.g., better-before-worse or vice versa);
- Develop a preliminary dynamic hypothesis (causal map) by identifying which causal forces are at work and how they relate to one another;
- Convert the hypothesis into a formal computer model. This is done by writing a system of differential equations, calibrating them based on available data, and noting any areas of uncertainty, which then become the focus for sensitivity analysis. In other words, uncertainty or lack of previously collected data is not a fatal flaw for SD modeling, as it can be for statistical techniques such as regression modeling or structural equation modeling (Randers, 1980);
- Use the computer model to conduct controlled simulation studies, with the goal of learning how the system behaves and how to govern its evolution over time;
- Choose among the set of plausible futures those that best reflect stakeholder values and that strike an acceptable balance among inevitable trade-offs.
- Keep repeating the process, creating better hypotheses, models, policy insights, and more effective action with each iteration.

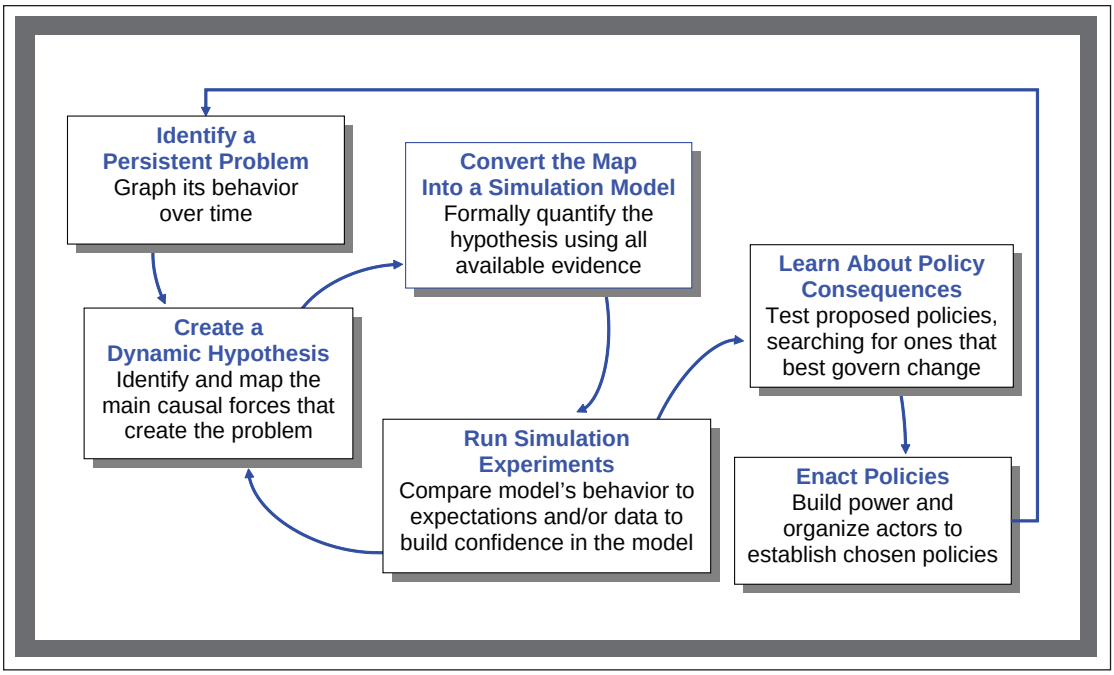


Figure 16: Iterative Steps in System Dynamics Modeling

The next two sections illustrate several of these steps in action. The first example summarizes the results of a real-world, well-funded, high-stakes application of simulation modeling to study diabetes dynamics in the wake of the obesity epidemic. The second, by contrast, is a hypothetical scenario in which causal mapping and simulation modeling are used to improve long-term grantmaking strategy in a neighborhood struggling against an entrenched syndemic.

Simulation Modeling: Finding Plausible Futures for Diabetes Prevalence[42]

In each of the past three decades in the United States, national health objectives have been set 10 years into the future and published as the *Healthy People Objectives for the Nation* (United States Public Health Service, 1980, 1990, 2000). These objectives define specific, numerical targets for reductions in most major health problems as well as for increases in the prevalence of health-promoting behaviors. Michael McGinnis, a chief architect of the Healthy People enterprise, asserts that, "Of the broad range of governmental responsibilities in public health, perhaps none is more fundamental than the obligation to provide perspective and direction to guide health programs along a productive course— the agendasetting function" (McGinnis, 1985)

Considering the widespread use and significance of the Healthy People (HP) objectives for planning and evaluating public health work at all levels of practice, health care practitioners may expect national health objectives to be feasible, that is, to be achievable within the specified time frame. However, *Healthy People* objectives may not always meet this feasibility standard (Mendez and Warner, 2000). The objectives for 2010, in particular, were set on the basis of a policy goal of eliminating health disparities among racial and ethnic groups.

Consequently, planners used a "better than the best" approach wherein each objective was set at a level better than that of the "best" (i.e., most healthy) racial or ethnic group. That approach advanced health equity as an important philosophical ideal, which, in turn, generated an ambitious aspiration for health policy-making. But it may not have yielded, in all cases, objectives that are achievable and compatible with other public health objectives. In addition, the practice of conducting midcourse reviews and periodic evaluations of progress toward meeting HP objectives may convey the impression that the numerical targets are actually achievable by 2010 and are therefore meaningful referents for assessing progress (Mukhtar, Jack, Martin, et.al., 2006; United States. Office of Disease Prevention and Health Promotion, 2006).

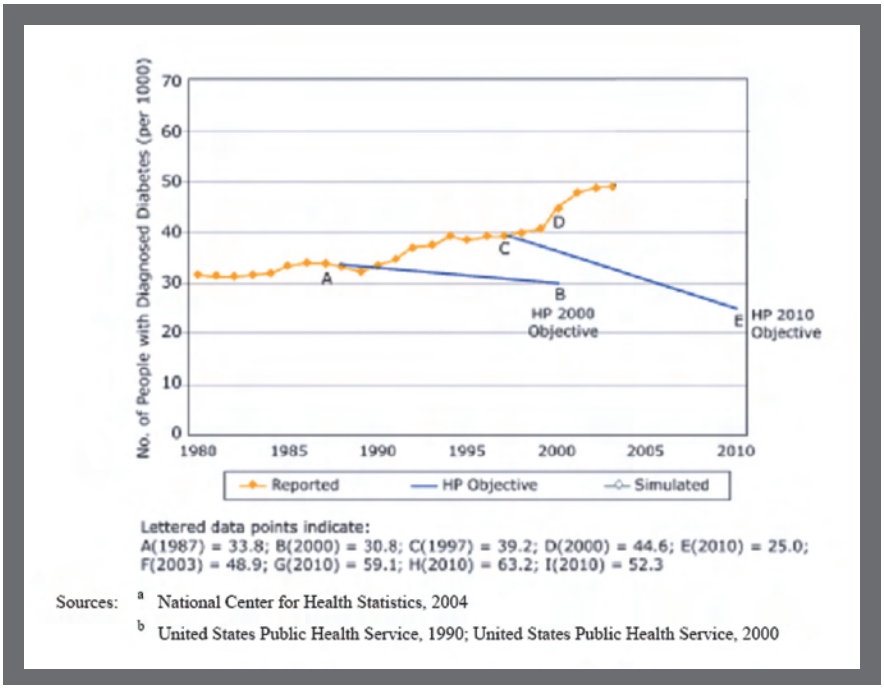


Figure 17: Diagnosed Diabetes Prevalence per Thousand Total Population—United States, 1985–2003[a], with Healthy People Objectives 2000 and 2010 [b]

Questioning whether long-range objectives can, in fact, be reached also raises questions about the thinking and analytic procedures that guide objective-setting itself, a complicated and still- poorly understood dimension of public health science. In this section, we examine how a team of inves-tigators used system dynamics simulation methods to (1) inter-pret the U.S. track record regarding the diagnosed prevalence of diabetes; and (2) anticipate plausible futures through 2010 under various scenarios.

42 Material for this section comes from an ongoing collaborative project known as the CDC Diabetes System Modeling Project (involving Jack Homer, Drew Jones, and Don Seville as the lead system dynamics modelers, along with Joyce Essien, Dara Murphy, myself, and many others as the CDC participants). Additional details on the project can be found in Homer, Jones, Seville, et.al., 2004; Jones, Homer, Murphy, et.al., 2006. The text for this section is adapted from Milstein, Jones, Homer, et.al., 2007.

Tracking Past Performance

Figure 17 displays the observed trend in diagnosed diabetes prevalence per thousand population between 1985 and 2003; it also shows the two paths projected in the HP 2000 and HP 2010 documents. In 1990, after three decades of mostly rising prevalence (Kenny, Aubert, Geiss, 1995), the HP 2000 baseline was set using 1987 data (point A), and the objective called for an 11% reduction by 2000 (point B). During the intervening years, diagnosed prevalence did not decrease but instead increased 33% (from point B to D). The official HP 2000 final review reported that diagnosed prevalence "moved away from target" by 367% (calculated by comparing the D-to-B gap with the A-to-B target decrease) (National Center for Health Statistics, 2001).

The *Healthy People* 2010 objective (based on 1997 data) called for an even more ambitious 38% reduction (from point C to E). But again, surveillance data reveal a worsening trajectory. From 1997 to 2003, diagnosed prevalence rose another 25% (point C to F), making the 2010 objective even more unattainable.

What accounts for these discrepancies between objectives and actual experience? Are they due to poor performance of the overall national health protection strategy, which includes an array of separately focused programs and policies (Murphy, Chapel, Clark, 2004)? Or, are they perhaps the result of a flaw in the attainability of the numerical targets themselves? If the latter is the case, what are some of the more plausible trajectories that might unfold by 2010?

Members of the CDC Diabetes System Modeling Project (Homer, Jones, Seville, et.al., 2004; Jones, Homer, Murphy, et.al., 2006) sought to answer these questions by conducting a series of simulation experiments using an existing system dynamics model designed specifically to explore the population dynamics of diabetes in the United States (Homer, Jones, Seville, et.al., 2004; Jones, Homer, Murphy, et.al., 2006). The model was designed to explore the incremental effects of a variety of possible policy interventions on the burden of diabetes. To achieve this result, the SD model, unlike other diabetes models (for example, a Markov model by Honeycutt et al (Honeycutt, Boyle, Broglio, et.al., 2003)), comprehensively accounts for a chain of population flows that begins when a person becomes at risk for diabetes and continues through initial onset, diagnosis, progression, and death. Such breadth of scope allows the SD model to anticipate nonlinear changes in variables, such as the incidence rate, that narrower models would miss (Homer, 2006).

The SD diabetes model was developed using well established techniques for model formulation and testing (Forrester, 1961, 1969; Homer and Hirsch, 2006; Homer and Oliva, 2001; Sterman, 2000, 2001). Data obtained from national health surveys (i.e., the National Health Interview Survey, the National Health and Nutrition Examination Survey, and the Behavioral Risk Factor Surveillance System), the U.S. Census, and publications in the scientific literature are the foundation for parameter selection and estimation. Some parameter estimates could be drawn directly from available information, while others were obtained through a process of historical curve-fitting analogous to statistical regression (for more detail see Homer, 2006; Jones, Homer, Murphy, et.al., 2006) .

The Structure of the Diabetes System

The group's first step toward assessing the dynamics of the diabetes system was to develop a structural stock-and-flow diagram. Such a diagram specifies how population groups accumulate in several states of health (such as people with prediabetes, uncomplicated diabetes, and complicated diabetes) along with the rates at which people flow from one health state to the next (Jones, Homer, Murphy, et.al., 2006). The full model contains many such states and rates; however, Figure 18 shows only a simplified and generic view for explanatory purposes.

Figure 18 shows how changes in the diagnosed prevalence of any disease, not only diabetes, may be depicted. One may think of the box labeled *diagnosed prevalence* as a bathtub, with the level of water representing the number of people who have been diagnosed with a disease (Booth-Sweeney and Sterman, 2000). The rate at which people are *being diagnosed* (or diagnosed onset) is analogous

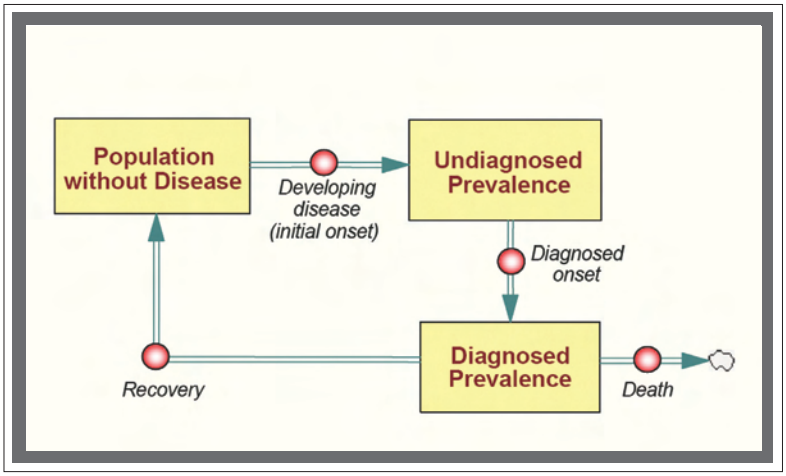


Figure 18: Generic Stock and Flow Structure for Diagnosed Prevalence of a Disease

to the rate at which water flows from a faucet into the tub, and the rates of *recovery* or *death* for people with diagnosed disease are analogous to the rates at which water flows out of the tub through two separate drains. As the figure indicates, all changes in diagnosed prevalence must be accounted for by changes in the related flows. The flows of births, migration, deaths among those without the disease, as well as deaths among the undiagnosed group are relevant, but for clarity, are not depicted in the figure.

What do we know about the elements of Figure 18 with respect to diabetes? The following is a summary of the evidence that the team was able to compile.

- *Diagnosed Prevalence:* Historical data for 1980-2003 are in Figure 17. In 2000, about 12.0 million people of all ages in the United States had diagnosed diabetes, of whom 98% were adults aged 20 and over. This translates to about 4.4% of the total population and 6.0% of the adult population (Centers for Disease Control and Prevention, 2005b; Honeycutt, Boyle, Broglio, et.al., 2003).
- *Diagnosed Onset:* About 880,000 cases of diabetes were newly diagnosed in 1997, and that figure rose to 1.1 million by 2000, of whom more than 96% were adults. This translates to a diagnosis rate among the adult population of about 5.2 per thousand in 2000 (Centers for Disease Control and Prevention, 2005b; Honeycutt, Boyle, Broglio, et.al., 2003).
- *Recovery:* Recovery is a significant factor for many acute illnesses. But for diabetes, as for all chronic diseases that lack a full and permanent cure, it is virtually non-existent.
- *Death Among those Diagnosed:* Diabetes, like other chronic diseases, has a relatively small annual death rate. In 2000, of the 12.0 million people with diagnosed diabetes, about 500,000 (4.2%) died (Honeycutt, Boyle, Broglio, et.al., 2003), including approximately 213,000 deaths (a rate of about 1.8% per year) attributed to complications of the disease (Centers for Disease Control and Prevention, 2005b).
- *Undiagnosed Prevalence:* Since 1976, a random sample of participants in the periodic National Health and Nutrition Examination Survey (NHANES) without a diagnosis of diabetes were selected for a blood glucose test (Kenny, Aubert, Geiss, 1995). By dividing the number of people found to have diabetes by the total number of people tested, re searchers estimated the fraction of Americans with diabetes whose disease was undiagnosed for each of the following NHANES periods: 1976-1980: 38%; 1988-1994: 36%; and 1999-2000: 29%(Gregg, Cadwell, Cheng, et.al., 2004).
- *Population without Diabetes:* This category includes people with normal glycemic levels, as well as people whose moderately elevated blood sugar qualifies them as prediabetic. Based on blood testing data from NHANES 1988-1994, about 40% of Americans aged 40-74 have prediabetes (Centers for Disease Control and Prevention, 2005b; Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, 2003). Extrapolating to the rest of the adult population (taking into account estimated differences in prediabetes prevalence for ages 18-39 and 75+, based on historical data on age-specific diabetes incidence (14), and projecting forward in time, the team estimated that at least 52 million (or 25%) of American adults 18 and over were prediabetic in the year 2000.

Exploring Scenarios for the Future

The SD model tracks the flows and accumulations of people with normal glycemic levels, undiagnosed or diagnosed prediabetes, undiagnosed or diagnosed diabetes without complications, and undiagnosed or diagnosed diabetes with complications. The model specifies key factors—some of them potentially amenable to policy intervention—that may change over time and that affect the model's population flows. These variable policy factors include the prevalence of obesity (i.e., the leading modifiable risk factor for diabetes); the prevalences of glycemic screening, prediabetes management, and diabetes management; as well as the percentage of the population with access to preventive care (Jones, Homer, Murphy, et.al., 2006). A "scenario" involves specifying future values of each variable factor. The model may then be simulated to explore the consequences of any given scenario for future trajectories of diagnosed prevalence and other measures of disease burden.

A Status Quo Future

Results from the team's first simulation experiment focused on a status quo future, in which it is assumed there are no further changes, starting in 2004, in the scope or effectiveness of prevention, detection, or management efforts, nor in population obesity.

In Figure 19, the line marked "status quo" (from point F to G) shows that diagnosed prevalence increased steadily from 1990 to 2003.

A straightforward comparison of the estimates of inflow (diagnosis) and outflow (death) explains why the upward trend in diabetes prevalence, which began around 1990, will not soon abate. If the diagnosed onset rate in 2000 of approximately 1.1 million cases per year and the death rate of about 500,000 per year were to stay the same, the diagnosed prevalence would continue to increase. Although the model suggests that this gap between inflow and outflow is gradually closing, the inflow of diagnosed diabetes onset would have had to drop substantially (e.g., by about 50% in 2006) just for diagnosed prevalence to stop increasing, let alone to begin decreasing.

Accounting for Program/Policy Interventions

The SD model revealed certain insights about the long-term effects of interventions to reduce onset, boost detection, or better manage the disease. For example, aside from prevalence, another *HP 2010* objective calls for the diagnosed percentage of cases of diabetes to increase from 68% to 80% (Objective 5-4). Such an increase in detection would, in terms of Figure 18, increase the flow of people being diagnosed, and thereby increase diagnosed prevalence above what it otherwise would have been. Figure 19 quantifies the effect of this scenario as the difference between points H and G (i.e., 63.2 vs. 59.1 in the year 2010).

Yet another *HP 2010* objective calls for an 11% reduction in the diabetes-attributable death rate (Objective 5-6), a result presumably to be achieved through improved disease management. The structure in Figure 18 indicates that a reduction in the outflow of people dying also *increases* diagnosed prevalence: as the outflow drain becomes smaller more people with the disease remain alive (i.e., stay in the bathtub). Figure 19 does not display a curve for this scenario because it overlaps the status quo line (i.e., 59.3 vs 59.1 in the year 2010). The inconsistency in these HP 2010 objectives for diabetes is clear: meeting the objectives for increasing the diagnosis rate or decreasing the mortality rate would, in both cases, tend to increase the prevalence of diagnosed diabetes further upward and away from its *Healthy People 2010* objective.

One type of public health intervention that might reduce diagnosed prevalence is an effort to reduce initial onset of diabetes. *Healthy People 2010* calls for a 29% reduction in the number of new cases per thousand (Objective 5-2), presumably to be achieved through a combination of efforts to detect and manage prediabetes, perhaps combined with efforts to reduce the leading modifiable risk factor for prediabetes and diabetes, namely obesity. A reduction in the flow of initial disease onset is clearly a move in the right direction because it leads to a lower diagnosed prevalence than would be the case under the status quo (i.e., without an intervention to reduce onset of disease). But a reduction in diagnosed prevalence *relative to the status quo* is not the same as an absolute reduction over

time—an actual reversal of growth. The previous comparison of the inflow and outflow rates in Figure 18 indicated that a reduction in onset on the order of 50% would be required to halt the growth in diagnosed prevalence. Still, one may ask, to what extent could a 29% reduction in onset at least slow the growth of diagnosed prevalence?

To address this question, the group simulated an intervention starting in 2003 that by 2010 reduces diabetes onset 29% below its 1997 level. The effect on diagnosed prevalence is shown in Figure 19 as the line labeled "meet onset objective." From 2003 to 2010, diagnosed prevalence per 1,000 population increases by 7% (from F to I), as opposed to increasing by 21% (from F to G) in the status quo scenario (i.e., 52.3 vs. 59.1 in the year 2010). Slower growth certainly signifies improvement but may disappoint those expecting an absolute decline in prevalence following such an ambitious and successful effort to reduce initial onset.

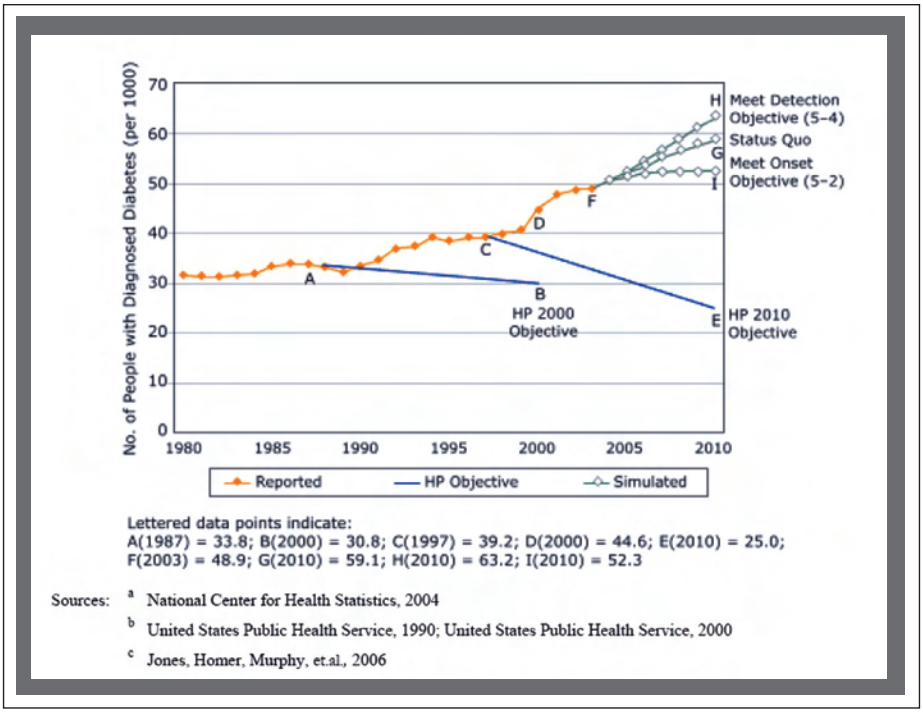


Figure 19: Diagnosed Diabetes Prevalence per Thousand Total Population—United States, 1985–2003[a], with Healthy People Objectives 2000 and 2010 [b], and Simulation Model Output 2003–2010[c]

Thus, the simulation model helps quantify what the stock-and-flow logic of Figure 18 and numerical analysis suggested previously: namely, that the 29% target is too modest a reduction in onset to achieve the desired reduction in prevalence and can only slow the growth of prevalence. The simulation model can also be used to explore more extreme possibilities. For example, what would happen if initial onset were to drop suddenly to zero during 2004? The simulation model suggests that even under this impossible-to-achieve scenario, diagnosed prevalence would fall only by 14% from 2003 to 2010 (data not shown). This relatively modest reduction occurs in part because of some continued new diagnosis during this period (diagnosis may continue even though initial onset has ceased) and in part because of the relatively small death rate among people with diabetes (only about 4% per year). The 14% reduction in diagnosed prevalence during 2003-2010 in this most optimistic scenario still falls far short of the 38% objective in Healthy People 2010.

Learning to Chart Plausible Paths

Based on their innovative analyses, the team concluded that the *Healthy People 2010* objective for reducing diagnosed diabetes prevalence by 38% will not be achieved—not because of ineffective or under-funded health protection efforts, but rather because the objective itself is unattainable given the historical processes under way. Moreover, if current investments in diabetes screening and disease management do succeed in diagnosing a greater fraction of the undiagnosed and in enabling people to live longer lives with the disease, then diagnosed prevalence will move still farther away from the *Healthy People 2010* target.

When called upon to set long-range numerical targets for health indicators, particularly those that may be viewed as intervention outcomes, it is important to recognize that the diagnosed prevalence metric is prone to misinterpretation and unrealistic expectations. There are two basic reasons for this difficulty.

1. The task of setting plausible prevalence objectives requires an understanding that the growth in prevalence of many chronic diseases can, at best, be slowed and reversed only gradually. This is because the outflow of death is small relative to the inflow of disease onset (perhaps, as in the case of diabetes, because of a decades-long increase in the at-risk population), and there is no significant outflow of recovery. Therefore, the task of reducing prevalence is like attempting to return a fast-moving train to a station that it passed miles back: the first requirement is to slow down, not reverse direction.

2. Furthermore, successful interventions to increase disease detection and management result in people living longer with their disease rather than dying prematurely of it. But by increasing detection and extending life, such interventions also have the effect of increasing diagnosed prevalence. The only practical way of slowing (let alone reversing) the growth in diagnosed prevalence is through health protection programs that reduce initial disease onset. However, initial onset must not only decline, but must fall far enough to more than offset the increase due to improved detection and management. Prevalence objectives will not be achievable unless this fact is taken into account.

If prevalence objectives are to be attainable within their specified time frame, it is important first to recognize what the future trajectory would be under status quo assumptions and then to factor in the effects of any planned interventions, recognizing that some may undercut the effects of others. In the case of diabetes, the team found that current conditions—without any new interventions—would drive diagnosed prevalence to increase another 21% from 2003 to 2010. Current detection and care initiatives, if successful, will increase that number even further. If the emphasis on reducing prevalence is intended to help assess the performance of those interventions working to reduce diabetes onset, then planners wanting to set future targets should take as a starting point both the status quo future and the compounding effects of successful detection and control interventions.

Recognizing the Benefits of Formal Modeling

Simulation modeling helps improve our collective understanding of health and disease dynamics, and in turn, supports the development of long-range objectives that are both achievable and mutually consistent. Such models enable planners and policymakers to explore for themselves the plausible short- and long-term consequences of historical trends and compare the effects of alternative interventions before committing limited resources. For that reason, diabetes program planners in Vermont, Minnesota, California and other states are now working with members of the CDC Diabetes System Modeling team to use the model described here as a support for their efforts to set plausible and internally consistent objectives for diabetes-related outcomes at the state level (Edelman, 2006; Murphy, Homer, Nanavati, et.al., 2006). Planners in Minnesota, California, Alabama, Tennessee, and Florida are currently exploring similar uses.

Without the reality checks available through formal system science methods, long-range target setting may fall prey to the weaknesses of flawed and sometimes biased intuition or mental models (Booth-Sweeney and Sterman, 2000; Sterman, 2000). Intuition may often neglect real-world sources of inertia and delay and suggest that things can change more rapidly than is actually possible. The prevalence of a chronic disease like diabetes changes only gradually, because, as noted above, its outflow of death is relatively small and recovery is not possible. In this respect, chronic diseases are unlike many acute infectious diseases such as influenza or measles, where patients do not linger in the disease condition for years, but instead either recover or die relatively quickly. For such acute diseases, the large outflow creates a close correlation between drops in onset and drops in diagnosed prevalence. For chronic illnesses, however, drops in onset do not correlate with immediate drops in prevalence; instead, they correlate with prevalence *increasing more slowly.*

Those working to prevent and manage chronic diseases may use stock-and-flow diagrams to develop a clearer understanding of the characteristic dynamics of these diseases. In

addition, simulated policy experiments may bring new insights to the task of charting a viable course for the nation's health. That approach could help ensure that numerical objectives are mutually consistent and achievable within their stated time frames. The objectives may still be difficult to achieve in practice, and in that sense may be aspirational; but even aspirational objectives can and should be crafted in a way that is consistent, logical, and feasible given the causal structure of the system and the historical processes under way.

Although simulation models can help improve our understanding of chronic disease dynamics, they have several inherent limitations. All models are incomplete simplifications of reality and their conclusions are affected both by structural boundaries and the uncertainties of the data with which they are calibrated (Sterman, 2002). Techniques such as boundary critique (Ulrich, 2002) and sensitivity testing (Sterman, 2002) can be used to assess the extent to which model findings may be affected by those simplifications and uncertainties. In the case of the diabetes SD model, sensitivity testing suggests that the magnitudes of its simulated futures, such as those seen in Figure 19, are subject to some imprecision due to uncertainties about input parameters, but that the directions of change and, thus, the general findings, are unaffected by those uncertainties.

Even with their inevitable imprecision and incompleteness, however, the formal tools of system dynamics can enhance learning and decision-making, and that is their primary purpose (Sterman, 2000, 2006). In particular, these tools can improve our collective intuition about how interventions will affect health indicators over many years within the complex systems of cause and effect that shape the public's health

Causal Mapping: A Dynamic Hypothesis on the Problem of Outside Assistance[43]

Whereas the preceding section recounted an effort to understand better the dynamics of a single disease, the following example uses a hypothetical situation to illustrate how causal mapping and simulation modeling may support much broader, syndemic thinking.

Imagine a neighborhood that, like too many in the United States and around the world, is struggling against adverse living conditions (e.g., poverty, crime, gang violence, substandard housing, joblessness, proximity to a toxic waste site). Not surprisingly, many residents report a high number of unhealthy days per month, citing a long list of intertwined afflictions that are poorly managed and rarely prevented (e.g., asthma, cancer, diabetes, HIV/AIDS, substance abuse, depression, violence, and more). Leaders in the neighborhood are trying valiantly to keep things from getting worse, but their people and resources are badly organized and collectively they lack the necessary power or public strength to effect change.

A local philanthropic organization with ties to the neighborhood supports the residents' struggle and wants to help. Their assistance can take one of three broad forms: (1) enhancing efforts to respond one by one to the most prevalent or burdensome afflictions; (2) improving the adverse living conditions that leave people vulnerable to one or more of those afflictions; or (3) building greater public strength so that the residents have a greater capacity to work across their differences in pursuit of better health for all. These three forms of assistance can be provided individually, in combination, or in sequence over a period of 12 years and decisions about the combination and/or sequence of assistance can be revised every four years.

Everyone agrees on the goal of increasing the number of healthy days (i.e., reducing the overall burden of affliction), recognizing that adverse living conditions and public strength are closely.

43 Material for this section comes from an ongoing collaboration with system dynamics expert Dr. Jack Homer. The text was drawn primarily from a conference presentation written jointly by Dr. Homer and myself (Homer and Milstein, 2004). Additional details about this line of inquiry may be found in Homer and Milstein, 2002a, 2002b, 2003b, 2004; Milstein, 2006.

linked to that goal and may undermine it if left unaddressed. But they are puzzled about how best to configure and allocate the philanthropy's assistance. What strategy makes the most sense in this situation? After several unproductive meetings, the neighborhood residents and their allies jointly decide to embark on an SD modeling project.

The dynamic nature of their problem is clear enough: a veritable perfect storm involving the convergence of entrenched adverse living conditions, multiple afflictions, and low levels of public strength. Many of the factors that make the situation resistant to change are also familiar: insidious cross-impacts among the afflictions; a high fraction of people at risk; widening social disparities; divided rather than united efforts, where only doctors, social workers, and health professionals are thought to have a meaningful role to play.

With subtle but steady facilitation from an experienced SD modeler, the group gathers their insights, along with information gleaned from interviews and available literature, and eventually articulates a dynamic hypothesis about how the neighborhood health system functions and where each type of outside assistance fits in. After developing several iterations of their hypothesis, the group settles on a set of 13 feedback loops (Figure 20), defined as follows.[44]

- **Syndemic** (R1): Each affliction increases vulner-ability to other afflictions, thereby amplifying the effect of increases or decreases in the prevalence of individual diseases Also

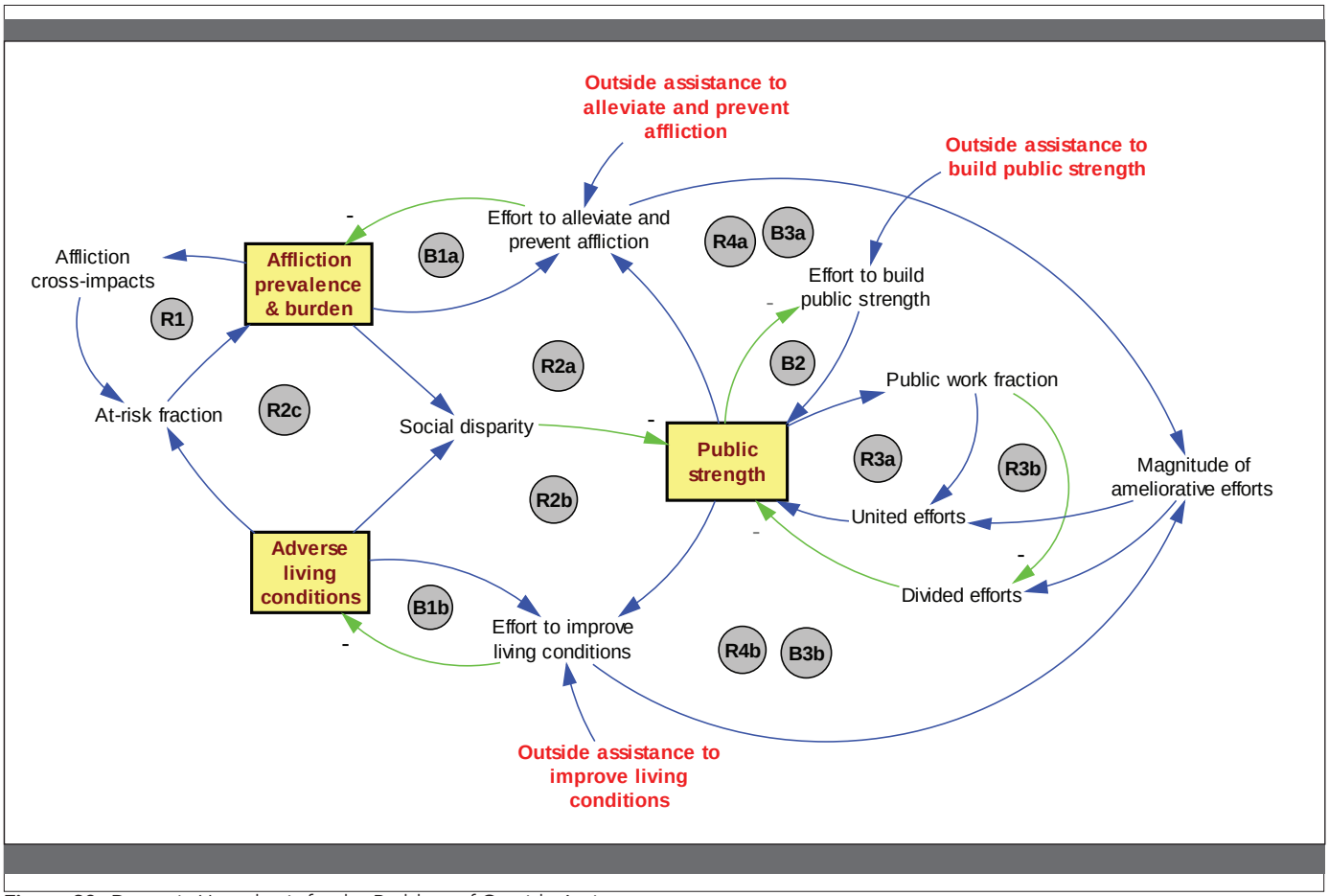


Figure 20: Dynamic Hypothesis for the Problem of Outside Assistance

44 The relationships hypothesized in Figure 20 are based on a synthesis of public health literature as well as participant observations from myself and colleagues regarding the dynamics of neighborhood-based health improvement ventures. It is a general theory, meant to fit any neighborhood and any cluster of afflictions. The model has not yet been applied to any particular circumstance, and for this reason should be considered exploratory and suggestive, not a model that is fully tested and determined to be reliable for decision making in specific situations.

contributing to the population's vulnerability in a syndemic are adverse living conditions (Wilkinson, 1996; Wilkinson and Marmot, 2003; World Health Organization, 2005a).

- **Citizen Response** (B1a, B1b, B2): Area residents make efforts to fight affliction and adverse living conditions in response to their prevalence, and to build greater public strength when it is perceived as low through organizing and leadership development (Chambers and Cowan, 2003; Fawcett, Francisco, Hyra, et.al., 2000; Freudenberg, Eng, Flay, et.al., 1995; Gecan, 2002; Goodman, Speers, McLeroy, et.al., 1998). Outside assistance may bolster such efforts.

- **Social Disparity and Public Strength** (R2a, R2b, R2c): Response efforts, especially those to improve adverse living conditions, are greater in magnitude when citizens are strong and unified through democratic institutions that acknowledge their individual differences and interests. But public strength is hindered by social disparity, which, in turn, is made worse by the prevalence of problems among a subset of society that is often feared or distrusted (Wilson, 1990). Because the prevalence of these problems can undermine the public unity needed to fight them, the problems may go unchecked and spread further than they would otherwise.

- **Public Strength and Public Work** (R3a, R3b): Public strength is also affected by the character of the response efforts themselves (Fawcett, Francisco, Hyra, et.al., 2000). When problems spread in an area with strong public institutions, the response tends to be more multi-faceted and elicit greater contributions from ordinary citizens in the form of "public work," a united process that reinforces public strength (Boyte, 2004b; Boyte and Kari, 1996a; Kari, Boyte, Jennings, 1994). Conversely, when problems spread in an area with weaker democratic institutions, problem-fighting efforts tend to be led by small groups of professionals who specialize in those problem areas, a divided process that ends up reinforcing the public's weakness (Benveniste, 1977; Illich, 1982; Light, 1997; Polsky, 1991; Rosenberg, 1989; Starr, 1982).

- **Present Strategy and Future Strength** (R4a, R4b, B3a, B3b): Strategies for fighting afflictions or improving living conditions today may also affect people's ability to mount similar efforts in the future. Outside assistance given to a weaker neighborhood for problem fighting may amplify the divided response and undermine the citizens' internal response capability. Outside assistance to build public strength, however, may revitalize democratic institutions and prepare citizens to make a more united response. The existence of these reinforcing loops around public strength suggests that the question of how best to provide outside assistance in an afflicted neighborhood is not a simple one. It may be best in some situations to provide outside assistance that emphasizes the building of strength more than the direct fighting of problems.

Satisfied that these hypotheses capture the essence of their dilemma, the team presses on to put these causal relationships into the testable form of a simulation model. This entails using the best information available to assign numerical values and functional forms that indicate how these forces relate to each other. Reference data were unavailable or inadequate to inform many parts of the model (such as past and current levels of public strength), however, the group was able to make reasoned assumptions and later conduct sensitivity tests to examine the significance of uncertain parameters. In this way, the model was initialized to depict a relatively weak neighborhood vulnerable to the high affliction prevalence typical of a syndemic. The initial "basic setting" assumed that the particular cluster of afflictions includes strong cross-impacts, the baseline prevalence of adverse living conditions is relatively high, and the baseline public strength is relatively low.[45]

Figure 21 presents simulation results, depicting the growth of affliction burden (i.e., unhealthy days per person per year) over a 20-year period for each of four scenarios. In each scenario, affliction prevalence was set at time 0 to a value

45 For precise figures describing how these and other parameters were set, see Homer and Milstein, 2004.

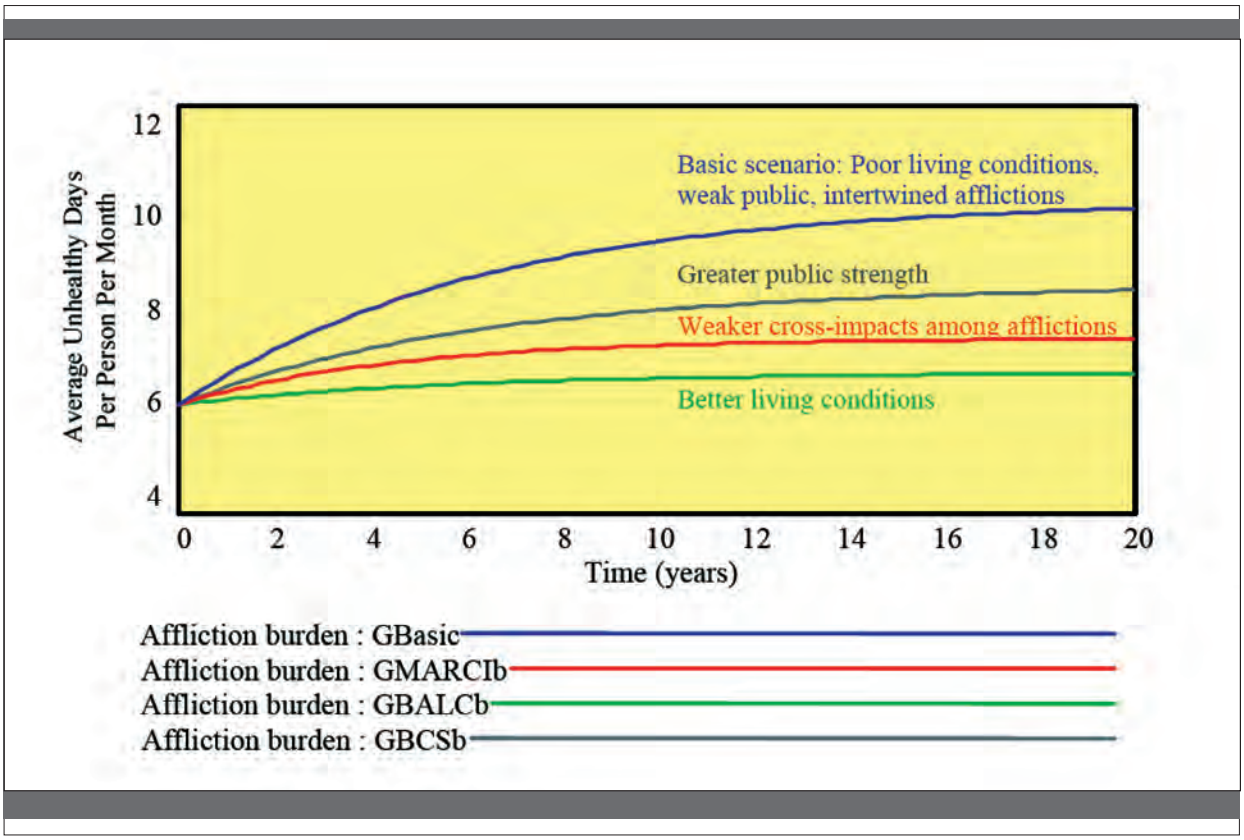


Figure 21: Simulating the Development of a Syndemic—Four Scenarios

of 20%, which corresponds to an affliction burden of 6.0: the nationwide average in 2001. This initial condition represents the health status of the population prior to the development of a syndemic, or perhaps describes that portion of the population that is new to the neighborhood in question.

Over a period of 20 years, affliction burden under the model's basic setting (the blue line) grows and finally settles at an affliction burden of 10, which is quite high for an entire neighborhood.[46] During these two decades, both the reinforcing and the balancing loops described above are active, but in these scenarios no outside assistance is provided. The result is a pattern of growth that is most rapid initially but then decelerates and converges to a steady-state value. With the increase in affliction comes greater social disparity and, consequently, some erosion in public strength (not shown). Although this erosion does weaken the problem-fighting loops somewhat, the effect is gradual and does not result in explosive growth in affliction.

In the three other scenarios, one or another of the "pessimistic" assumptions of the basic setting is relaxed, and the result is less growth in affliction burden. These are the assumptions described above regarding affliction cross-impacts, baseline adverse living conditions prevalence, and baseline public strength. The results give some indication of how important each assumption is to determining the steady-state level of affliction in the model. The impact of adverse living conditions on vulnerability is perhaps the most important (see the green line). Also of great importance is the affliction cross-impact effect (see the red line). Of somewhat less importance in the model, though still significant,

46 The CDC's Healthy Days survey (Centers for Disease Control and Prevention, 2003a; Zahran, Kobau, Moriarty, et.al., 2005) asks individuals to describe their overall health as excellent, good, fair, or poor, and then to estimate their number of unhealthy days per month. In the 2001 survey, 15% of the 200,000 surveyed described their health as fair or poor, with an average of 15.7 unhealthy days per month, while 85% described their health as excellent or good, with an average of 4.3 unhealthy days per month. The overall average of 6.0 thus disguises a very skewed distribution of unhealthy days. For a neighborhood to have an overall average of 10—still assuming that 15.7 represents fair or poor, while 4.3 represents excellent or good—the fraction reporting fair or poor would have to be 50%, much greater than the national average of 15%.

is the effect of public strength on problem fighting (see the gray line). One reason that public strength is not quite as important as the other factors is that some professional efforts to fight individual afflictions can be undertaken, with limited citizen involvement, even in a weaker neighborhood with fewer organizational resources.

Although the model is exploratory and imperfect in many respects (as all useful models must be), the team is convinced that it behaves sensibly and, therefore, can support their thinking about how to devise an optimal assistance scheme. The model includes the three available types of outside assistance—support for fighting afflictions (AF), improving adverse living conditions (LC), and building public strength (PS). In the real world, resources for assistance may take many forms (i.e., money, information, personnel, material) but they are nevertheless limited in amount and duration, so priorities are needed. The model does not specify the size of the budget in dollars, but instead describes outside assistance as a total pie of 100% that must be divided among the AF, LC, and PS types. Model parameters specify the cost effectiveness (broadly speaking) of each type of assistance in terms of its per-unit ability to boost effective response efforts in the neighborhood. The model is set up so that assistance may be provided for a total of 12 years (T0 to T12), and the decision about how to allocate assistance may be made and revised at three specific times: at T0, at T4, and at T8, to reflect typical grantmaking cycles.

The group's ultimate goal when experimenting with the model was to minimize the average affliction burden, both during the 12 years of assistance and for some time following its conclusion. An evaluation period starting at T4 and ending at T20, with outside assistance ending at T12, allowed team members to look symmetrically at eight years during which assistance is active as well as eight years of the post-assistance period. As with other aspects of the modeling, the choice of this evaluation period was guided by common sense and remained open to change, for it is possible that moving the evaluation start time or end time could affect the results, as discussed below.

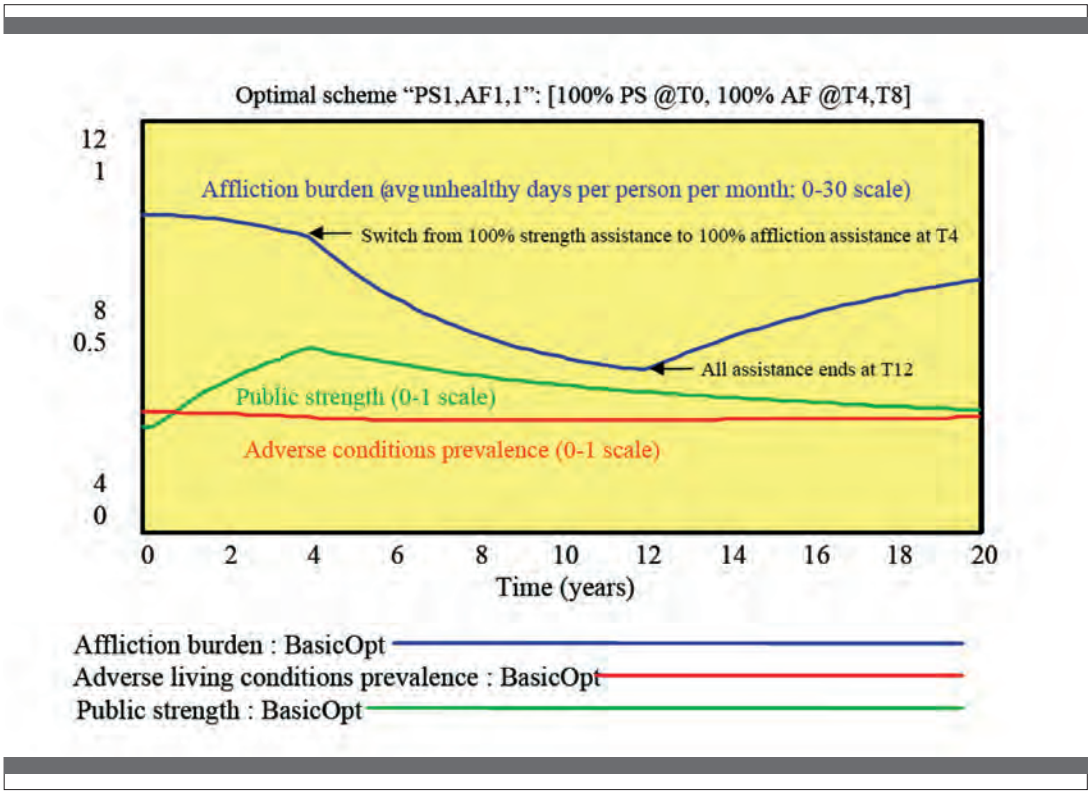


Figure 22: Results under Basic Setting with Optimal Assistance Scheme

Tests under the basic setting revealed an optimal assistance scheme to be one that starts with 100% public strength (PS) assistance at T0, then switches to 100% affliction-fighting (AF) assistance thereafter (at T4 and at T8), with no assistance to improve living conditions (LC).[47] This scheme is labeled "PS1,AF1,1", and its results are presented in Figure 22.

The initial PS assistance builds public strength for the first four years, thereby strengthening the citizens' collective capacity for fighting afflictions and adverse living conditions, and ensuring that subsequent problem fighting will be more unified and do less to undermine public strength. The switch to AF assistance at T4 greatly boosts the affliction-fighting programs, and the affliction burden is reduced dramatically over the next eight years.

However, after the assistance concludes at T12, the affliction burden rebounds significantly. The magnitude of this rebound is related to the fact that public strength gradually erodes after the end of PS assistance at T4, so that by T12 the neighborhood's internal capacity to organize effective affliction fighting efforts is not as great as it would have been had the PS assistance continued.

Figure 23 compares the optimal PS1,AF1,1 scheme under the basic setting with three other assistance schemes, in terms of their impacts on affliction burden.

- A scheme that involves using only affliction-fighting assistance ("AF111") results in more reduction in affliction initially (through T6) compared with the optimal scheme, but less reduction through T12, followed by a similar rebound in affliction through T20..
- A scheme which involves using only assistance for improving living conditions ("LC111") reduces affliction to a degree nearly identical to the optimal scheme during the first four years, but not nearly as much during the next eight. Though the improved living conditions and reduced affliction burden persist beyond T12 with little rebound, the optimal scheme is still superior to LC111 until T18.

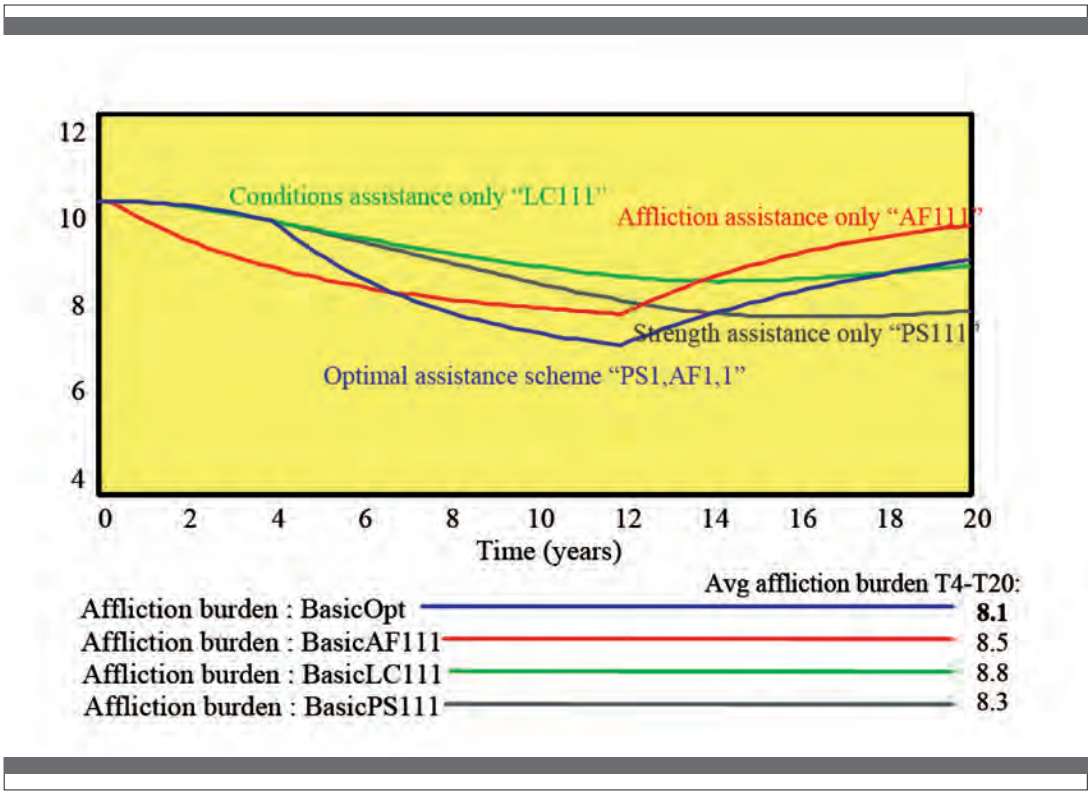


Figure 23: Comparison of Affliction Burden Under Basic Setting for Four Different Assistance Schemes

47 It must be emphasized again that even with thorough sensitivity testing, an exploratory model such as this is prone to some misspecification, which could affect the results. Any results discussed here must therefore be taken as suggestive rather than prescriptive.

- A scheme which involves using only strength-building assistance ("PS111") has results similar in pattern but uniformly superior to those of LC111 after T4. As in LC111, the improvements persist beyond the termination of assistance at T12 with little rebound, but because the improvements under PS111 are greater than those of LC111, the advantage of the optimal scheme over PS111 is less distinct. In particular, while the affliction burden is higher under PS111 than under the optimal scheme through T14, it is lower thereafter, and increasingly so.

The finding that PS111 is superior to LC111 after T4 may at first seem to contradict the previous finding from Figure 21 that better living conditions do more to reduce the growth of affliction than greater public strength does. But in those alternative growth scenarios we assumed better living conditions or public strength from the start, reflecting enduring qualities of the neighborhood. In contrast, in Figure 23 the improvement is caused by outside assistance, a process that has some negative side effects.[48] These side effects undermine public strength to some extent, and therefore hinder local problem-fighting efforts. As a result, LC assistance fails to make as much improvement in living conditions and affliction burden as one might expect based on Figure 21 or the first four years of Figure 23.

The fact there are allocation schemes superior to PS1,AF1,1 early and late in the simulation (AF111 is superior prior to T6, and PS111 is superior after T14) suggests that perhaps the optimal allocation scheme could be different for evaluation periods other than T4 to T20. Further model testing indicates that changing the evaluation start time to T0 does not affect the choice of optimal scheme, but extending the evaluation end time can change the optimal scheme to one that puts more emphasis on PS assistance. If the evaluation end time is extended to something in the range of T21 to T26, the optimal scheme becomes "PS11,AF1", with 100% PS assistance at T0 and T4, then AF assistance at T8. If the evaluation end time is T27 or later, the optimal scheme becomes PS111, with 100% PS assistance throughout the 12 year period of assistance. Given fundamentally weak democratic institutions in the neighborhood, the longer the period of post-assistance evaluation is, the more priority one must give to public strength during the period of assistance, so as to minimize the post-assistance rebound in affliction.

Even with an exploratory model, not yet verified and refined through case study application, it was possible for the team members to better appreciate the dynamic impacts of various types of outside assistance on population health. One insight, familiar to seasoned leaders in the neighbhoord, is that the first priority of philanthropies or government wanting to help neighborhoods that are weak and struggling against multiple afflictions should be to assist in building public strength (enabling a greater degree of citizen-led public work), perhaps even before substantial assistance is provided for direct fighting of prevalent diseases.

Another insight suggested by the modeling is that outside assistance aimed directly at improving living conditions may often be insufficiently cost-effective, due to time lags and unintended side effects, to warrant making such assistance a high priority in the absence of widespread citizen participation—this despite the fact that adverse living conditions are a powerful determinant of vulnerability to affliction.

The power of a useful simulation model lies not only in the identification of hypotheses for optimal decision making, but also in the ability it provides to explain how those hypotheses emerge logically from a feedback structure that integrates the best available knowledge on the subject. The insights described above, for example, reflect the presence in the model of relationships depicting the perverse effect that problem-fighting programs may have on public strength when the democratic institutions are weak and people are divided to begin with—exactly the opposite of what the philanthropists intended.

48 The reinforcing R3 loops of Figure 20 can undermine public strength when LC assistance is overlaid onto a situation in which public strength is relatively low to begin with. Greater outside assistance to improve living conditions means more effort to improve living conditions, thus greater magnitude of ameliorative efforts, and thus—in the context of low public strength and low public work fraction—more divided efforts, which are afurther drag on public strength.

DIRECTING CHANGE

If we want to work toward a future that is not dominated by the inequity of allowing some of us to endure excessive vunlerability, along with the constant and growing pressure of vulnerable people becoming diagnosed with an array of mutually reinforcing diseases, then we must endeavor to expand people's freedoms to make healthier choices. This task requires us to embrace the power of public work in its largest democratic sense and then direct it toward creating a balanced system of health protection. Thinking in the most practical terms, we must ask, "who is going to do that work?"

Public work calls on each of us—as we observed in Hawaii, East Brooklyn, and North Karelia—to labor side-by-side with people unlike ourselves in an effort to establish healthful conditions for all. Strictly speaking, the more appropriate question is not, "Who will do this work?" but rather "Are we preparing our children for it?" If not, our failure to do so must stand as one of the greatest threats to the health of populations and the health of our democracy. If not, we are squandering the creative energy of each generation, and virtually guaranteeing a future in which health and other human service professionals must set up elaborate operations downstream to save the few they can amidst the many who will inevitably (and unnecessarily) be lost (Landau, 1997; Landau-Stanton, 1990; Seaburn, Landau-Stanton, Horowitz, 1995). As Harry Boyte and his colleagues at the Center for Democracy and Citizenship have argued, we can no longer afford to raise young people under the adage that "youth are the leaders of tomorrow." Rather, young people at every age must come to see and experience themselves as important, powerful players right now (Boyte and Farr, 1997; Hildreth, 1998; Hildreth, 2000; Public Achievement, 2004).

Equal to the priority of introducing youth to the realm of nonpartisan politics is the task of bringing professionals, and the institutions that they lead, out into the world of citizenship. After all, it is professionals who currently command the resources and possess the mandate for organizing health protection ventures. But many professionals worry that a deeper engagement in political action— even in the broadest nonpartisan sense—will somehow undermine their expertise or cloud their objectivity (Fortun and Bernstein, 1998). This view implies that

becoming and behaving as a professional must also mean standing outside the public. As Len Syme, one of the pioneers of social epidemiology, candidly disclosed,

> *All of us know that we need to work with the community {as an empowered partner}. We may know it, but we also know how difficult it is to do. Especially if you have been trained, as I have been, to be an arrogant, elitist, prima donna expert. We are experts, after all, and all we are trying to do is help people by sharing our expertise. And therein lies the not-so-boring problem. (Syme, 2004)*

What changes when experts act more like citizens? In a way, we get the best of both worlds: the specific knowledge and insights from their specialized training, as well as the combination of pragmatism and creativity that come from an approach grounded in a respect for others. Table 2 contrasts the focus, discourse, stance, goals, philosophies, and skills that are most salient under the outside expert vs. citizen actor framings.

Almost by definition, many professionals are vulnerable to becoming separated from the public they purport to serve because the institutions in which they work tend to emphasize the first

	Outside Expert	Citizen Actor
Concerns	• Efficiency of means • Emphasis on "*How to...*"	• Consistency of values between means and ends • Emphasis on "*Why to...*" and "*How to...*"
Discourse	• Technical	• Political (nonpartisan)
Stance	• Seeing from one or more disciplines	• Seeing from the world or a particular place
Goal	• Fix problems	• Create values • Develop capacities • Exercise freedoms
Philosophy	• Positivism	• Pragmatism
Key actor(s)	• Authorities and people with credentials • Partners	• Citizens (each with his or her own expertise)
Skills	• Disaggregation • Analysis	• Visioning • Integration and disaggregation • Analysis and synthesis • Cycles of organizing, acting, and reflecting
Commitments	• Experimenting • Proving	• Promising • Forgiving
Dynamic Focus	Part ⟷ Part Parts ⟶ Whole	Greater Whole Parts ⟷ Wholes

Table 2: Two Contrasting Orientations: Outside Expert and Citizen Actor[49]

49 Adapted and synthesized from Arendt, 1958; Boyte, 2004a; Eoyang, 2001.

column over the second. Certainly, public health organizations are not unique in this regard. But they can become pioneers of a new approach (Boyte and Kari, 1996b). Following this path may be fraught with difficulty, but it promises to nurture cadres of citizen-professionals whose dual role is celebrated rather than undercut.

One example of the sort of change that is possible on an institutional level is evident in the CDC Futures Initiative (Centers for Disease Control and Prevention, 2004d). Since 2003 CDC's workforce has been engaged in an intensive strategic direction-setting effort that touches on many of the questions raised above about the relationship between expertise and public health work. The Futures Initiative has many elements that foster a stronger public sensibility: an "outside-in" view, inviting honest input from both traditional and nontraditional partners; a commitment to public dialogue about CDC's organization, strengths, and shortcomings; more transparent processes for decision-making and governance than in the past; a shift to viewing members of the general public as the primary customers for the agency's services; and a growing focus on achieving real health protection impact across every lifestage, in a variety of places, and under many preparedness scenarios (Centers for Disease Control and Prevention, 2005a).

If enacted, these new directions and the synergy among them bode well for the future. Yet these changes in perspective also highlight some specific and potentially uncomfortable challenges. Beyond incorporating new and different voices into CDC's work, a harder task will be creating an enduring culture of public-minded, citizen-professionals among the agency's scientists, researchers, and administrators.

CDC staff have plenty of company in other scientific institutions in the cherished belief that scientific pursuits are somehow removed (and perhaps even excused) from engagement in the political arena. This attitude separates public health professionals from the citizens they serve and from their own potential contributions. To achieve meaningful changes in the conditions for health, the public health workforce will have to address this issue head-on.

A further challenge is the double-edged sword of seeing members of the public as *customers* of prevention services. The decision to position members of the general public in this way is meant as a tribute: the customer as king, driving what we do, how we communicate it, how we gauge the success of our efforts. Yet buried within that relationship is a hierarchical power dynamic that may not be intentional, but is still potentially destructive to the larger endeavors of building public strength and assuring equitable conditions for health.

First, despite eliciting input from various members of the public (through mechanisms like commentary on draft documents, focus groups, representation on coalitions and evaluation teams, and survey research), CDC's communication with its customers overwhelmingly moves in one direction: from the agency's experts outward. Moreover, the nature of this arrangement seems to have been solidified, at least linguistically, with the creation of a new Center for Health Marketing (Centers for Disease Control and Prevention, 2004b).

Second, the CDC's historic tendency to address separately the array of risks and diseases for which it bears responsibility is cemented by the practice of grouping citizens into market segments by their common problems. This approach, if pursued exclusively, has the untoward consequence of labeling people as problems rather than acknowledging their status as fellow citizens capable of working to achieve a healthier future.

As the CDC and other health institutions wrestle with these dilemmas they may find inspiration in the perspective Harry Boyte articulated in his essay on "Professions as Public Crafts."

> *The National Commission on Civic Renewal defined democracy as "neither a consumer good nor a spectator sport, but rather the work of free citizens engaged in shared civic enterprises." To spread such a dynamic view of democracy on any significant scale in our world of large systems and extensive, information-based occupations will require new models of professional training and practice that adapt themes of craft and "publicness" for today (Boyte, 2000:1).*

REFLECTING ON PUBLIC. HEALTH. WORK.

At the outset of this study, we observed that the pioneers of the public health field did not change the world or human nature, but rather adjusted the relationship of people to their world. In doing so, they began a process of questioning the givens and recognizing a persistent feature of our lives together: we live trapped between the world as it is and the world as it should be, perpetually forced to confront the world as we make it.

This notion of the world as we make it—just like the call to perform public health work in the face of seemingly insurmountable threats—bestows upon each of us a somewhat troubling sort of importance and agency. As the writer Thomas Vargish notes:

> *When most of us are presented with the ultimata of potential disaster, when we hear that we "must" choose some form of planned stability, when we face the "necessity" of a designed sustainable state, we are being bereaved, whether or not we fully realize it. When cast upon our own resources in this way we feel, we intuit, a kind of cosmic loneliness that we could not have foreseen. We become orphans. We no longer see ourselves as children of a cosmic order or the beneficiaries of the historical process. Limits to growth denies all that. It tells us, perhaps for the first time in our experience, that the only plan must be our own. With one stroke it strips us of the assurance offered by past forms of Providence and progress and with another it thrusts into our reluctant hands the responsibility for the future." (Meadows, Meadows, Randers, 1992:xvi-xvii.)*

For some, the notion that we cannot rely only on strategies that proved successful in the past but rather must transform the very nature and boundaries of public health thinking is a source of deep anguish; for others, it inspires optimism and intense action. Both groups, however, may find common ground in the trio of features that Hannah Arendt saw as essential to the human condition: *mortality, natality, and plurality* (Arendt, 1958). To the gains that we are obliged to solidify and hopefully exceed in eliminating premature mortality, we must now do more to embrace the expansive implications of our natality. Each successive generation introduces new lives who bring with them

endless possibilities for new ways of thinking and further action. As for our plurality, "humans have the paradoxical commonality of being each and every one unique" (Arendt, 1958:176). "That is, we are plural not because we are variations of a kind of which scientists and/or philosophers can discern its truth but because we are radically particular" (Minnich, 2003:109). Such individuality, to the extent that we acknowledge it, confers upon us an abundant reservoir of potentially transformational public strength. When this potential is taken seriously, used constructively, replenished and expanded with each generation, it yields a fourth dimension of the human condition that Arendt herself implied but never quite named: *directionality*. Working in and through our differing self-interests to protect the things we truly value gives us a moral compass and a unique strength to steer clear of calamity in pursuit of the happiness that only safer, healthier and more equitable futures can bring.

In the daily conduct of public health work, it is easy to skip over these all-too-familiar words and miss opportunities to reflect on the meanings they hold. Despite its present state of disarray and disorientation, our system for performing public health work may in fact still succeed to the extent that it reclaims the ethics of its name.

Public signifies themes of plurality and nonpartisan, democratic politics in action;

Health signifies a value for life, stewardship of the things we consider special, preparation for nonviolent conflict, and harmony of body, mind, spirit, and environment.

Work implies an arduous and continual endeavor to direct change and chart progress.

Returning to the questions that first inspired this study, we can say that a syndemic orientation involves a reclaiming of these three words, which mean so much more together than they do separately. By guiding and informing public health work on an evolving journey to assure healthful living conditions for all, the novelty of a syndemic orientation is that it returns us to the roots our field, changing not just people's relationship to the world but the world that we make together through our concerned, humane, and directed work.

GLOSSARY

Adverse living conditions
Adverse conditions encompass any circumstances that inhibit a person's or a group's freedom to live, to become safer and healthier, and to develop their full potential. They include any deviation from prerequisite conditions for life and human dignity (e.g., physical extremes, violence, deprivation, disconnection). Phenomena like hunger, war, environmental decay, homelessness, illiteracy, and various forms of injustice are all examples of adverse living conditions.

Related Concepts

- Risk Conditions (Green and Kreuter, 2004)

Affliction
A condition of pain, suffering, or distress caused by adversity or poor health. Affliction is an aggregate concept or summary indicator encompassing any and all deviations from a state of the highest possible physical, mental, social, and spiritual well-being. In that sense, to live with an affliction is antithetical to the ideal of living in full health. Although health encompasses more than the absence of disease; affliction always erodes health. This is true regardless of whether the state of affliction emanates from epidemic (sporadically occurring) or endemic (commonly occurring) conditions, or a combination of forces. The concept of affliction relates closely to the societal purpose of public health work, which is to assure the conditions in which all people can be healthy. In practice, this requires that citizens work continuously to create and protect the conditions for maximal well-being for all. Failure to do so may expose people to unnecessary adversity and leave them vulnerable to affliction both by virtue of that undue adversity and through an immense range of specific risks and diseases.

Related Concepts

- Morbidity
- Disease, illness, sickness, impairment, disability, and handicap (Susser, 1990)
- Unhealthy days (Centers for Disease Control and Prevention, 2000)
- Health adjusted life expectancy (Manuel, Schultz, Kopec, 2002)
- Summary measures of population health

Conscience
Derives from the Latin root scire, meaning to know. Conscience places efforts to acquire knowledge through science–as well as the actions that flow from it–within a framework of evaluative judgment. That framework, importantly, is not only self-referential (i.e., applying scientific criteria to judge scientific merit) but also concerned with the role of science in solving public problems and advancing human development. When enacted with conscience, public health work includes "a moral or ethical aspect to one's conduct together with the urge to prefer right over wrong" (American Heritage Dictionary, 2000). It is this conscience (sometimes referred to a "moral compass") that places science in service of common sense and imposes boundaries on the kinds of procedures that may be used legitimately to acquire knowledge or pursue human values.

Related Concepts

- Science
- Consciousness

Consciousness
Derives from the Latin root scire, meaning to know. Consciousness situates knowledge in a larger context that includes self-awareness of the endeavor to acquire knowledge itself. Conscious science, therefore, expands the scope of knowledge to include information about "one's environment and one's own existence, sensations, and thoughts."

Related Concepts

- Science
- Consciousness

Design causality
A view of causal relationships in which the particular organization or configuration of variables at work in a problematic situation is understood as the source of observed behavior rather than any one or set of factors unto themselves. The emphasis is on understanding interdependence, closed-loop feedback, accumulations, delays, and non-linearities (Richmond and Peterson, 1997).

Related Concepts

- Variable causality (Evans, 1976, 1993; Parkin, 1873; Susser, 1973, 1991, 2001)
- System-as-cause (Richmond, 1993, 2000; Richmond and Peterson, 1997))
- Closed-loop feedback causality (Richardson, 1991; Sterman, 2000)

Disarray
Disarray is an organizational phenomenon, implying the need to rearrange existing parts of a system to improve its performance (usually in the short-term). Prolonged disarray may lead to disorientation as frustration builds over an inability to effectively reach long-term goals. Also, repeated attempts to reorganize problems that are in fact rooted in disorientation may generate even deeper disarray. In such circumstances, no amount of rearranging will improve long-term performance and the very act of reorganizing could itself become disorienting.

Related Concepts

- Disorientation

Disease prevention
A type of public health work enacted to avoid or delay the onset or progression of one or more diseases. At least three sub-types of disease prevention may be recognized: primary prevention seeks to reduce disease incidence; secondary prevention seeks to reduce the development or severity of disease complications; and tertiary prevention seeks to reduce preventable mortality due to disease complications.

Related Concepts

- Health
- Disease
- Health Protection

Disease prevention programs
Planned, organizational efforts designed to avoid the onset, progression, or premature mortality associated with one or more defined diseases.

Disorientation
A conceptual and moral phenomenon, borne of confusion about one's overall direction, place, and value in the world. Prolonged disorientation may lead to organizational disarray as misguided decisions result in poorly planned or fragmented structures. Effective responses to disorientation generally require new ways of thinking, framing problems, making decisions, planning, evaluating, organizing resources, and navigating change.

Related Concepts

- Disarray
- Wayfinding

Endemic

1. A familiar, entrenched phenomenon, like the persistent appearance of a disease in a particular region, that occurs in a population at an expected rate;
2. The relatively constant presence of a phenomenon caused by commonly occurring conditions.

Epidemic

1. An unusual phenomenon, like the rapid and widespread onset of a disease, that occurs in a population at a rate higher than expected;
2. The sudden outbreak and spread of a phenomenon caused by sporadically occurring conditions.
3. The relatively constant presence of a phenomenon caused by commonly occurring conditions.

Health

1. Well-being, welfare, safety
2. "A state of the highest possible physical, social, and mental well-being, and not merely the absence of disease or infirmity...Within the context of health promotion, health has been considered less as an abstract state and more as a means to an end which can be expressed in functional terms as a resource which permits people to lead an individually, socially and economically productive life. Health is a resource for everyday life, not the object of living. It is a positive concept emphasizing social and personal resources as well as physical capabilities" (World Health Organization, 1998).

Related Concepts

- Health-related quality of life (Centers for Disease Control and Prevention, 2000)

Health promotion
"The process of enabling people to increase control over, and to improve their health" (World Health Organization, 1998).

Related Concepts

- Health improvement

Health protection
A type of public health work enacted to support or safeguard the health and safety of the public. At least two sub-types of health protection may be recognized: targeted protection seeks to move people from an existing position of affliction or vulnerability to one of relative safety and health; and general protection seeks to reduce or remove sources of vulnerability for entire populations.

Related Concepts

- Health
- Disease
- Disease prevention

Health protection system
A societal enterprise designed to assure the conditions in which all people can be healthy.

Living conditions
"Living conditions are the everyday environment of people, where they live, play and work. These living conditions are a product of social and economic circumstances and the physical environment–all of which can impact upon health–and are largely outside of the immediate control of the individual" (World Health Organization, 1998).

Related Concepts

- Prerequisites for health (World Health Organization, 1986)
- Predisposing, enabling, and reinforcing factors (Green and Kreuter, 2004)

Macroscope
"A symbolic instrument made of a number of methods and techniques borrowed from very different disciplines. The macroscope filters details and amplifies that which links things together. It is not used to make things larger or smaller but to observe what is at once too great, too slow, and too complex for our eyes..." (Rosnay, 1979)

Related Concepts

- Systems thinking (Midgley, 2003; Richmond, 2000; Richmond and Peterson, 1997)
- The overview effect (White, 1998)
- Multimethodology (Mingers and Gill, 1997)

Moral compass
A set of negotiated conditions/goals–or moral values– that provide direction when navigating change.

Related Concepts

- Conscience

Policy resistance
The tendency for interventions to be delayed, diluted, or defeated by the response of the system to the intervention itself (Sterman, 2000).

Power
"The ability to act on a number of issues in a variety of ways," and get a reaction (Gecan, 2002:7).

Related Concepts

- Broad-based power organizing (Chambers and Cowan, 2003; Gecan, 2002)
- Dynamics of power (Sharp, 1973, 1980)
- Public strength
- Collective efficacy (Sampson, Raudenbush, Earls, 1997)
- Community capacity (Chaskin, 1999; Goodman, Speers, McLeroy, *et.al.*, 1998)
- Community empowerment (Laverack and Wallerstein, 2001; Wallerstein and Bernstein, 1994)

Protect
To secure or safeguard against harm, allowing continued existence and vitality, as well as further evolution and reproduction, if appropriate.

Related Concepts

- Safeguard
- Secure
- Celebrate
- Sustain

Public

1. Matters pertaining to and governed by people as a plural whole
2. Open, visible, able to seen by many

Public health work
Sustained, visible, serious effort by a diverse mix of citizens that assures the conditions in which people can be healthy.

Related Concepts

- Public work (Center for Democracy and Citizenship, 2001)

Public work
Sustained, visible, serious effort by a diverse mix of ordinary people that creates things of lasting civic or public significance (Center for Democracy and Citizenship, 2001)

Related Concepts

- Good work (The GoodWork Project, 2002)

Public strength

1. The power of citizens to direct the course of change toward a negotiated set of valued conditions/goals;
2. Vitality of a society's public sphere, the health of its *polis.*

Related Concepts

- Community strength (Bartle, 2002)
- Community capacity (Chaskin, 1999; Goodman, Speers, McLeroy, *et.al.*, 1998)
- Civic/community organizing (Alinsky, 1946, 1971; Chambers and Cowan, 2003; Sirianni and Friedland, 2001)
- Community mobilizing (Kretzmann and McKnight, 1993)
- Community empowerment (Laverack and Wallerstein, 2001; Wallerstein and Bernstein, 1994)
- Politics (Crick, 1993)
- Power (Foucault, 1980; Sharp, 1973, 1980)
- Liberation (Freire, 2000)

Science
Derives from the Latin root scire, meaning to know. A means of acquiring knowledge through explicit procedures such as action, reflection, observation, identification, description, experimental investigation, and theoretical explanation of phenomena.

Related Concepts

- Conscience
- Consciousness

Social navigation

1. A form of organized action concerned with directing the course of social change toward a negotiated set of valued conditions/goals;
2. A set of analytic methods devised for understanding goal-directed movement; specifically, for charting progress in the trajectory of social change and for judging proximity to a set of valued conditions/goals..

Related Concepts

- Planning/evaluating (Ginter, Duncan, Capper, 1991; Green and Kreuter, 2004; Rittel and Webber, 1972)
- Ends and means (Huxley, 1937)
- Progress (Bury, 1920)
- Human development (Sen, 1999; United Nations Development Programme, 2004))
- Turning points (Abbott, 1997; Capra, 1982)
- Muddling through (Lindblom, 1959))
- Social movement (Goodwin and Jasper, 2004; Hoffer, 1951; Horton and Freire, 1990; Laszlo, 2001; Morris and Mueller, 1992; Sheller, 2001; Tarrow, 1998)
- Governance (Etzioni, 1991; Kooiman, 2003; Nye and Donahue, 2000)
- Conscious/guided evolution (Banathy, 2000; Hubbard, 1998; Salk, 1973)
- Wayfinding (Beaglehole and Bonita, 1998; King 1967; Thompson, 2000)
- Journey mapping (Kibel, 2001)
- Futuring (Garrett, 1999)
- Moral compass

Syndemic
Two or more afflictions, interacting synergistically, contributing to excess burden of disease in a population.

Related Concepts

- Synergism of plagues (Wallace, 1988; Wallace and Wallace, 1997)

Syndemic orientation
A way of thinking about public health work that focuses on connections among health-related problems, considers those connections when developing health-related policies, and aligns with other avenues of social change to assure the conditions in which all people can be healthy.

Related Concepts

- Social ecology (Green, Richard, Potvin, 1996; Stokols, 1996; Stokols, Allen, Bellingham, 1996)

Transition
Change or movement from one to state of a system to another, typically measured by a flow-rate.

Variable causality
A view of causal relationships in which one or more factors are assigned the role of a proximal or distal cause. Common assumptions are that the factors are independent, causality runs in one direction, and impacts are instantaneous, linear and constant (Richmond and Peterson, 1997).

Related Concepts

- Design causality (Argyris, 1996; Dent, 2003)
- System-as-cause (Richmond, 1993, 2000; Richmond and Peterson, 1997)
- Closed-loop feedback causality (Richardson, 1991; Sterman, 2000)

Wayfinding
Knowing where you are, your destination, following a viable route, recognizing your destination, and reflecting on the journey. When people cannot do any or all of these things, we say they are *disoriented*. (http://www.wayfinding.com/disorient.htm)

Related Concepts

- Disorientation

Work
The operation of a force in producing movement

- Power
- Public strength

REFERENCES

Abbott A. On the concept of the turning point. *Comparative Social Research* 1997;16:85-105.

Abdel-Hamid TK. Modeling the dynamics of human energy regulation and its implications for obesity treatment. *System Dynamics Review* 2002;18(4):431-47.

Abdel-Hamid TK. Exercise and diet in obesity treatment: an integrative system dynamics perspective. *Medicine and Science in Sports and Exercise* 2003;35(3):400-13.

Ackerknecht EH. Anticontagionism between 1821 and 1967. *Bulletin of the History of Medicine* 1948;22:563.

Aday LA. *At risk in America: the health and health care needs of vulnerable populations in the United States.* San Francisco, CA: Jossey-Bass Publishers, 2001.

Aday LA. Reinventing public health: policies and practices for a healthy nation. San Francisco, CA: Jossey-Bass, 2005.

Addams J. *Democracy and social ethics.* Urbana, IL: University of Illinois Press, 2002.

Alcoholics Anonymous. *Historical data: the birth of A.A. and its growth in U.S./Canada.* Alcoholics Anonmymous, 2004. Accessed December 2, 2004 at <http://www.alcoholicsanonymous. org/default/en_about_aa_sub.cfm?subpageid=27&pageid=24>.

Alinsky SD. *Reveille for radicals.* Chicago, IL: University of Chicago press, 1946.

Alinsky SD. *Rules for radicals: a practical primer for realistic radicals.* New York, NY: Random House, 1971.

American Heritage Dictionary. *The American heritage dictionary of the English language.* 4th ed Boston,MA: Houghton Mifflin, 2000.

Andersen DF, Richardson GP, Vennix JAM. Group model building: adding more science to the craft. *System Dynamics Review* 1997;13(2):187-201.

Annie E. Casey Foundation. *End games: the challenge of sustainability.* Baltimore, MD: Annie E. Casey Foundation, 2002.

Antonovsky A. Social class, life expectancy and overall mortality. *The Milbank Quarterly* 1967;45(2):31-73.

Antonovsky A. A call for a new question--salutogenesis--and a proposed answer--the sense of coherence. *Journal of Preventive Psychology* 1984;2:1-13.

Arendt H. *The human condition.* Chicago: University of Chicago Press, 1958.

Argyris C. Actionable knowledge: design causality in the service of consequential theory. *Journal of Applied Behavioral Science* 1996;32(4):390-408.

Ashoka. *What is a social entrepreneur?* Ashoka Innovators for the Public, 2004. Accessed September 25, 2004 at <http://www.ashoka.org/fellows/social_entrepreneur.cfm>.

Associated Press. Americans rate CDC highest among 11 federal agencies. *Wall Street Journal* 2004 November 24.

Atkins D, Clancy C. Multiple risk factors interventions: are we up to the challenge? *American Journal of Preventive Medicine* 2004;27(2 (Supplement 1)):102-103.

Atwood K, Colditz GA, Kawachi I. From public health science to prevention policy: placing science in its social and political contexts. *American Journal of Public Health* 1997;87(10):1603-1606.

Baer HA, Singer M, Susser I. *Medical anthropology and the world system.* 2nd ed Westport, CT: Praeger, 2003.

Baker EL, Koplan JP. Strengthening the nation's public health infrastructure: historic challenge, unprecedented opportunity: it takes a system that is competent to handle routine public health situations to handle the emergencies. *Health Affairs* 2002;21(6):13.

Baker EL, Potter MA, Jones DL, Mercer SL, Cioffi JP, Green LW, Halverson PK, Lichtveld MY, Fleming DW. The public health infrastructure and our nation's health. *Annu Rev Public Health* 2005;26:303-18.

Baker R. *Human navigation and the sixth sense.* New York, NY: Simon and Schuster, 1981.

Bambra C, Fox D, Scott-Samuel A. *Towards a new politics of health.* Liverpool, England: University of Liverpool, Politics of Health Group; Discussion paper no. 1; June, 2003. <http://www.liv.ac.uk/PublicHealth/Publications/publications01.html>.

Bambra C, Fox D, Scott-Samuel A. Towards a politics of health. *Health Promotion International* 2005(dah608):1-7.

Bammer G. *Integration and implementation sciences:* building a new specialisation. Cambridge, MA: The Hauser Center for Nonprofit Organizations, Harvard University 2003.

Banathy BH. *Guided evolution of society:* a systems view. New York, NY: Kluwer Academic / Plenum Publishers, 2000.

Bartle P. *Elements of community strength.* The Participatory Development Forum, 2002. Accessed November 14, 2002 at <http://action.web.ca/home/pdforum/readingroom.shtml?sh_itm=8459cbfe0510112d37c8b79f629f7e 22&AA_EX_Session=66aa0933e7fa8484fe2557808492ba50>.

Batschelet E. *Circular statistics in biology.* New York, NY: Academic Press, 1981.

Baum FE, Sanders D. Can health promotion and primary health care achieve Health For All without a return to their more radical roots? *Health Promotion International* 1995;10:149-160.

Bazerman MH, Watkins M. *Predictable surprises: the disasters you should have seen coming, and how to prevent them.* Boston, MA: Harvard Business School Press, 2004.

Beaglehole R, Bonita R. *Public health at the crossroads: achievements and prospects.* 2nd ed New York, NY: Cambridge University Press, 2004.

Beauchamp DE. Public health as social justice. *Inquiry* 1976;13:3-14.

Bell FC, Miller ML. Life tables for the United States social security area, 1900-2100. Baltimore, MD: Social Security Administration Office of the Chief Actuary 2005. Available at <http://purl.access.gpo.gov/GPO/LPS80312>.

Benveniste G. *The politics of expertise.* 2d ed San Francisco, CA: Boyd & Fraser Pub. Co., 1977.

Berkman LF, Glass T, Brissette I, Seeman TE. From social integration to health: Durkheim in the new millennium. *Social Science and Medicine* 2000;51(6):843-57.

Berkman LF, Kawachi I. *Social epidemiology.* New York, NY: Oxford University Press, 2000.

Berlin I. *The sense of reality: studies in ideas and their history.* London: Pimlico, 1996.

Berry W. Solving for pattern. In: *The Gift of Good Land.* San Francisco: North Point; 1981. p. 134-45.

Bezold C, Hancock T. *An overview of the health futures field.* Geneva: WHO Health Futures Consultation; July 19-23, 1993.

Blaisdell RK. The health status of Kanaka Maoli (Indigenous Hawaiians). *Asian American and Pacific Islander Journal of Health* 1993;1(2):117-60.

Blaisdell RK. *Känaka Maoli A Mau.* Pacific Region Indigenous Doctors Congress; Honolulu, HI; May 29-Jun 2, 2002. Available at <http://www.teora.maori.nz/SITE_Default/SITE_x-popups/xfiles/ 2880.pdf>.

Bohm D. *Wholeness and the implicate order.* Boston, MA: Routledge & Kegan Paul, 1981.

Bondurant JV. *Conquest of violence: the Gandhian philosophy of conflict.* New rev. ed Princeton, NJ: Princeton University Press, 1988.

Bondurant JV, Fisher MW. *Conflict: violence and nonviolence.* New York, NY: Leiber(Atherton, 1973.

Booth-Sweeney LB, Sterman JD. Bathtub dynamics: initial results of a systems thinking inventory. *System Dynamics Review* 2000;16(4):249-286.

Bornstein D. *How to change the world: social entrepreneurs and the power of new ideas.* New York, NY: Oxford University Press, 2004.

Bowen GL, Martin JA, Mancini JA, Nelson JP. Community capacity: antecedents and consequences.*Journal of Community Practice* 2000;8(2):1-21.

Boyte HC. *Professions as public crafts.* Wingspread Conference on New Information Commons; Racine,WI: Center for Democracy and Citizenship; 2000. Available at <http://www.publicwork.org/pdf/workingpapers/Public%20crafts.pdf>.

Boyte HC. Doctoral education for the 21st century: reframing scholarship in mass communications. *Civic Engagement News* 2004a;5.

Boyte HC. *Everyday politics: reconnecting citizens and public life.* Philadelphia, PA: University of Pennsylvania Press, 2004b.

Boyte HC. Reconceputlizing citizenship as public work. In: *Citizenship in Latin America:* Woodrow Wilson Institute; 2005.

Boyte HC, Farr J. The work of citizenship and the problem of service-learning. In: Battistoni RM, Hudson WE, editors. *Experiencing citizenship: concepts and models for service-learning in political science.* Washington, DC: American Association for Higher Education; 1997. <http://www.publicwork.org/pdf/workingpapers/probServiceLearning.pdf>.

Boyte HC, Kari NN. *Building America: the democratic promise of public work.* Philadelphia: Temple University Press, 1996a.

Boyte HC, Kari NN. Turning our jobs into public work. In: Boyte HC, Kari NN, editors. *Building America: the Democratic Promise of Public Work.* Philadelphia: Temple University Press; 1996b. p. 164-188.

Brandt A, Gardner M. Antagonism and accommodation: interpreting the relationship between public health and medicine in the United States during the 20th century. *American Journal of Public Health* 2000;90(5):707-715.

Brown VA. Towards an epidemiology of health: a basis for planning community health programs. *Health Policy* 1985;4(4):331-40.

Brunskill AJ. Re: "Who made John Snow a hero?" *American Journal of Epidemiology* 1992;135(4):451-2.

Buchanan DR. *An ethic for health promotion: rethinking the sources of human well-being.* New York, NY: Oxford University Press, 2000.

Bunk S. Heyday for prevention? - After bioterrorism, prevention science surfaces, and Research! America steps in as an advocate. *The Scientist* 2002;16(1):4.

Bury JB. *The idea of progress.* London: Macmillian, 1920.

Canada Department of National Health and Welfare, Lalonde M. *A new perspective on the health ofCanadians; a working document.* Ottawa, 1974.

Canovan M. Introduction. In: Arendt H, editor. *The human condition.* Chicago: University of Chicago Press; 1998. p. vii-xx.

Capra F. *The turning point: science, society, and the rising culture.* New York, NY: Simon and Schuster, 1982.

Casti JL. *Would-be worlds: how simulation is changing the frontiers of science.* New York, NY: J. Wiley, 1997.

Center for Democracy and Citizenship. *The concept and philosophy of public work.* Center for Democracy and Citizenship, 2001. Accessed June 7, 2004 at <http://www.publicwork.org/1_2_philosophy.html>.

Centers for Disease Control and Prevention. Toxic shock syndrome--United States. *MMWR* 1997;46(22):492-3; discussion 494-5.

Centers for Disease Control and Prevention. Improvements in workplace safety--United States, 1900- 1999. *MMWR* 1999;48(22):461-9.

Centers for Disease Control and Prevention. *Measuring healthy days: population assessment of health related quality of life.* Atlanta, GA: U.S. Department of Health and Human Services, 2000a.

Centers for Disease Control and Prevention. *Public health's infrastructure: a status report.* Atlanta, GA: Centers for Disease Control and Prevention 2000b. <http://www.phppo.cdc.gov/owpp/docs/library/2000/PH%20Infrastructure.pdf>.

Centers for Disease Control and Prevention. *Spotlight on syndemics.* Syndemics Prevention Network, 2001. Accessed December 15, 2002 at <http://www.cdc.gov/syndemics>.

Centers for Disease Control and Prevention. *Health-related quality of life.* National Center for Chronic Disease Prevention and Health Promotion, 2003a. Accessed October 14, 2004 at <http://www.cdc.gov/hrqol/>.

Centers for Disease Control and Prevention. *A public health action plan to prevent heart disease andstroke.* Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention, 2003b.

Centers for Disease Control and Prevention. 150th anniversary of John Snow and the pump handle. *MMWR* 2004a;53(34):783.

Centers for Disease Control and Prevention. *CDC announces new goals and organizational design.* Atlanta, GA; May 13, 2004b. <http://www.cdc.gov/od/oc/media/pressrel/r040513.htm>.

Centers for Disease Control and Prevention. *CDC's futures initiative.* Public Health Training Network,2004c. Accessed April 12, at <http://www.cdc.gov/futures/satellite.htm>.

Centers for Disease Control and Prevention. *The Futures Initiative: creating the future of the CDC for the 21st century.* Centers for Disease Control and Prevention, 2004d. Accessed December 8, 2004 at <http://www.cdc.gov/futures/>.

Centers for Disease Control and Prevention. *National public health performance standards program.* Centers for Disease Control and Prevention, 2004e. Accessed November 11, 2004 at <http://www.phppo.cdc.gov/nphpsp/index.asp>.

Centers for Disease Control and Prevention. *CDC's health protection goals.* CDC, 2005a. Accessed August 25, 2005 at <http://www.cdc.gov/about/goals/default.htm>.

Centers for Disease Control and Prevention. *National diabetes fact sheet.* Atlanta, GA: Centers for Disease Control and Prevention; January 31, 2005b.<http://www.cdc.gov/diabetes/pubs/estimates.htm>.

Centers for Disease Control and Prevention, Merck Institute of Aging and Health. *The state of aging and health in America.* Atlanta, GA: Centers for Disease Control and Prevention 2004. <http://www.cdc.gov/aging/pdf/State_of_Aging_and_Health_in_America_2004.pdf>.

Centers for Disease Control and Prevention. Health-related quality of life: prevalence data. National Center for Chronic Disease Prevention and Health Promotion, 2007. Accessed October 23, 2007 at <http://apps.nccd.cdc.gov/HRQOL/index.asp>.

Chalmers AF. *What is this thing called science?* 3rd ed Indianapolis, IN: Hackett Pub., 1999.

Chambers ET, Cowan MA. *Roots for radicals: organizing for power, action, and justice*. New York, NY: Continuum, 2003.

Chambers LW. The new public health: do local public health agencies need a booster (or organizational "fix") to combat the diseases of disarray? *Canadian Journal of Public Health* 1992;83(5):326-8.

Chaskin RJ. *Defining community capacity: a framework and implications from a comprehensive community initiative*. Chicago Ill: The Chapin Hall Center for Children at the University of Chicago, 1999.

Chaskin RJ. *Building community capacity.* New York, NY: A. de Gruyter, 2001.

Churchman CW. Operations research as a profession. *Management Science* 1970;17:B37-53.

Cirincione J, Wolfsthal JB, Rajkumar M. *Deadly arsenals: tracking weapons of mass destruction.* Washington, DC: Carnegie Endowment for International Peace, 2002.

Clifton E. *Climate change hits African Americans harder.* Washington, DC: Inter Press Service News Agency; July 23, 2004. <http://www.ipsnews.net/interna.asp?idnews=24763>.

Colorado P. Wayfinding and the new sun: indigenous science in the modern world. *Noetic Sciences Review* 1992;Summer(22):19-23.

Cooperrider DL, Sorensen PF, Whitney D, Yaeger TF. *Appreciative inquiry: rethinking human organization toward a positive theory of change.* Champaign, IL: Stipes Pub., 2000.

Corning PA. The synergism hypothesis: on the concept of synergy and it's role in the evolution of complex systems. Journal of *Social and Evolutionary Systems* 1998;21(2):133-72.

Corning PA. *Presidential speech: the systems sciences in the year 3000.* International Society of the Systems Sciences, 2000. Accessed April 23, 2002 at <http://www.complexsystems.org/commentaries/jul00.html>.

Corning PA. *Nature's magic: synergy in evolution and the fate of humankind.* New York, NY: Cambridge University Press, 2003.

Corso LC, Wiesner PJ, Halverson PK, Brown CK. Using the essential services as a foundation for performance measurement and assessment of local public health systems. *Journal of Public Health Management and Practice* 2000;6(5):1-18.

Cortes E. *Reweaving the fabric: the iron rule and the IAF strategy for dealing with poverty through power and politics.* Piscataway, NJ: Center for Urban Policy Research, Rutgers University, 1993.

Creative Learning Exchange. *About the Creative Learning Exchange.* Creative Learning Exchange, 2002. Accessed January 14, 2002 at <http://www.clexchange.org/about/>.

Crick BR. *In defense of politics.* 4th ed Chicago, IL: University of Chicago Press, 1993.

Dangerfield BC, Fang Y, Roberts C. Model-based scenarios for the epidemiology of HIV/AIDS: the consequences of highly active antiretroviral therapy. *System Dynamics Review* 2001;17(2):119-50.

Daniels N. Toward ethical review of health system transformations. *American Journal of Public Health* 2006;96(3):447-451.

Davenport C, Mathers J, Parry J. Use of health impact assessment in incorporating health considerations in decision making. *Journal of Epidemiology and Community Health* 2006;60(3):196-201.

DeBusk RF. The role of the health care system in primordial prevention. *Preventive Medicine* 1999;29 (6 Pt 2):S59-65.

Dent E. The interactional model: an alternative to the direct cause and effect construct for mutually causalorganizational phenomena. *Foundations of Science* 2003;8(3):20.

Dewey J, Hickman L, Alexander TM. *The essential Dewey.* Bloomington: Indiana University Press, 1998.

Dewey J, Sidorsky D. *John Dewey: the essential writings.* New York, NY: Harper & Row, 1977.

Diez-Roux AV. Multilevel analysis in public health research. *Annual Reviews of Public Health* 2000;21(1):171-192.

Doncaster P. *Timetable of human evolution and cultural development.* University of Southampton, 2001. Accessed December 26, 2002 at <http://www.soton.ac.uk/~cpd/history.html>.

Doyle JK, Ford DN. Mental models concepts for system dynamics research. *System Dynamics Review* 1998;14(1):3-29.

Dubos RJ, Escande J-P. *Quest: reflections on medicine, science, and humanity.* New York, NY: Harcourt Brace Jovanovich, 1979.

Dudley MK, Agard KK. *A Hawaiian nation II: a call for Hawaiian sovereignty.* Honolulu, HI: Na Kane O Ka Malo Press, 1990.

Dudley MK, Agard KK. *A call for Hawaiian sovereignty.* Centennial commemoration ed Honolulu, HI: Na Kane O Ka Malo Press, 1993.

Duffy J. *The sanitarians: a history of American public health.* Urbana, IL: University of Illinois Press, 1990.

Duhl LJ. *The social entrepreneurship of change.* 2nd ed Putnam Valley NY: Cogent Pub., 2000.

Dunn FL. Re: "Who made John Snow a hero?" *American Journal of Epidemiology* 1992;135(4):451.

Edelman R. *Vermont's experience with diabetes system modeling.* Diabetes and Obesity Conference; Denver, CO: Centers for Disease Control and Prevention; May 16-19, 2006.

Elliot G. *Twentieth century book of the dead.* New York, NY: C. Scribner, 1972.

Emirbayer M. Manifesto for a relational sociology. *American Journal of Sociology* 1997;103(2):281-317.

Eng E, Parker E. Measuring community competence in the Mississippi Delta: the interface between program evaluation and empowerment. *Health Education Quarterly* 1994;21(2):199-220.

Eoyang G. *Public health and human systems dynamics: what can we learn from each other?* Complexity Science in Practice: Understanding & Acting to Improve Health and Healthcare; Allentown, NJ: Plexus Institute; May 1, 2003.

Eoyang GH. *Conditions for self-organizing in human systems.* Cincinnati, OH: Union Institute and University; 2001.

Etzioni A. *A responsive society: collected essays on guiding deliberate social change.* San Francisco: Jossey-Bass Publishers, 1991a.

Etzioni A. A theory of social guidance. In: Etzioni A, editor. *A responsive society: collected essays on guiding deliberate social change.* San Francisco: Jossey-Bass Publishers; 1991b. p. 23-42.

Evans AS. Causation and disease: the Henle-Koch postulates revisisted. *Yale Journal of Biology and Medicine* 1976;49:175-95.

Evans AS. *Causation and disease: a chronological journey.* New York, NY: Plenum Medical Book Co., 1993.

Evans RG, Barer ML, Marmot TR. *Why are some people healthy and others not?: the determinants of health of populations.* New York, NY: A. de Gruyter, 1994.

Evans T. *Challenging inequities in health: from ethics to action.* New York, NY: Oxford University Press, 2001.

Evenari G, Aginsky Y, Dorsky N, Cassidy N. *Wayfinders: a Pacific odyssey.* [videorecording] Charlotte, NC: Maiden Voyage Productions. and PBS Home Video; 1999.

Evenari GK, Thompson N. *In the wake of our ancestors.* [videorecording] Half Moon Bay, CA: Evenari Media Productions; 1992.

Ewald PW. The evolution of virulence. *Scientific American* 1993;268(4):86-93.

Ewald PW. The evolution of virulence and emerging diseases. *Journal of Urban Health* 1998;75(3):480- 91.

Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Follow-up report on the diagnosis of diabetes mellitus. *Diabetes Care* 2003;26(11):3160-3167.

Ezzati M, Hoorn SV, Rodgers A, Lopez AD, Mathers CD, Murray CJ. Estimates of global and regional potential health gains from reducing multiple major risk factors. *Lancet.* 2003;362(9380):271-80.

Farmer P. *Pathologies of power: health, human rights, and the new war on the poor.* Berkeley, CA: University of California Press, 2003.

Farquhar JW. Primordial prevention: the path from Victoria to Catalonia. *Preventive Medicine* 1999;29(6 Pt 2):S3-8.

Fawcett S, Francisco V, Hyra D, Paine-Andrews A, Schultz J, Russos S, Fisher J, Evensen P. Building healthy communities. In: Tarlov A, St. Peter R, editors. *The society and population health reader: a state and community perspective.* New York, NY: New Press; 2000. p. 75-93.

Fawcett SB. Some values guiding community research and action. *Journal of Applied Behavior Analysis* 1991;24(4):621-636.

Fawcett SB. Evaluating comprehensive community initiatives: a bill of rights and responsibilities. In: Isaacs S, editor. *Improving Population Health: The California Wellness Foundation's Health Improvement Initiative.* San Francisco, CA: Social Policy Press; 2002. p. 229-233.

Fawcett SB, Paine-Andrews A, Francisco VT, Schultz J, Richter KP, Berkley-Patton J, Fisher JL, Lewis RK, Lopez CM, Russos S, Williams EL, Harris KJ, Evensen P. Evaluating community initiatives for health and development. *WHO Reg Publ Eur Ser* 2001;92:241-70.

Fawcett SB, Paine-Andrews A, Francisco VT, Schultz JA, Richter KP, Lewis RK, Williams EL, Harris KJ, Berkley JY, Fisher JL, Lopez CM. Using empowerment theory in collaborative partnerships for community health and development. *American Journal of Community Psychology* 1995;23(5):677- 697.

Fee E, Acheson RM. *A history of education in* public health: health that mocks the doctors' rules. New York, NY: Oxford University Press, 1991.

Felitti VJ, Anda RF, Nordenberg D, Williamson DF, Spitz AM, Edwards V, Koss MP, Marks JS. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *American Journal of Preventive Medicine* 1998;14(4):245-58.

Fenner F. *Smallpox and its eradication.* Geneva: World Health Organization, 1988.

Fett MJ. Computer modelling of the Swedish two county trial of mammographic screening and trade offs between participation and screening interval. *Journal of Medical Screening* 2001;8(1):39-45.

Field MJ, Gold MR, Institute of Medicine (U.S.). Committee on Summary Measures of Population Health. *Summarizing population health: directions for the development and application of population metrics.* Washington, DC: National Academy Press, 1998

Fielding JE. Public health in the twentieth century: advances and challenges. *Annual Reviews of Public Health* 1999;20:xiii-xxx.

Fields BS, Benson RF, Besser RE. Legionella and Legionnaires' disease: 25 years of investigation. *Clinical Microbiology Review* 2002;15(3):506-26.

Finney BR. *Pacific navigation and voyaging.* Wellington: Polynesian Society, 1976.

Finney BR. *From sea to space.* Palmerston North NZ: University Press of Hawaii, 1992.

Finney BR. *Voyage of rediscovery: a cultural odyssey through Polynesia.* Berkeley, CA: University of California Press, 1994.

Fisher NI. *Statistical analysis of circular data.* Cambridge, England: Cambridge University Press, 1993.

Flood RL, Jackson MC. *Creative problem solving: total systems intervention.* New York, NY: Wiley, 1991.

Foege W. *Social DNA.* Annual Meeting of the Prevention Research Centers; Atlanta, GA; 2000.

Foege WH. Public health: moving from debt to legacy. *American Journal of Public Health* 1987;77(10):1276-8.

Foege WH. Confronting emerging infections: lessons from the smallpox eradication campaign. *Emerging Infectious Diseases* 1998;4(3):412-3.

Ford *A. Modeling the environment: an introduction to system dynamics models of environmental systems.* Washington, DC: Island Press, 1999.

Foresight and Governance Project. *Serious games: improving public policy through game-based learningand simulation.* Washington, DC: Woodrow Wilson International Center for Scholars 2002. <http://wwics.si.edu/subsites/game/index.htm>.

Forrester JW. *Industrial dynamics.* Cambridge, MA: MIT Press, 1961.

Forrester JW. *Urban dynamics.* Cambridge, MA.: MIT Press, 1969.

Forrester JW. Counterintuitive behavior of social systems. *Technology Review* 1971;73(3):53-68.

Forrester JW. *The beginning of system dynamics.* International Conference of the System Dynamics Society; Stuttgart, Germany; July 13, 1989. Available at <http://sysdyn.clexchange.org/sdep/papers/D-4165-1.pdf>.

Forrester JW. *System dynamics and the lessons of 35 years:* MIT System Dynamics in Education Project; D-4224-4; April 29, 1991. <http://sysdyn.clexchange.org/sdep/papers/D-4224-4.pdf>.

Forrester JW. *Learning through system dynamics as preparation for the 21st century.* Keynote Address for Systems Thinking and Dynamic Modeling Conference for K-12 Education; Concord, MA; October 13, 1994. Available at <http://sysdyn.clexchange.org/sdep/papers/D-4434-3.pdf>.

Fortun M, Bernstein HJ. *Muddling through: pursuing science and truths in the 21st century.* Washington, DC: Counterpoint, 1998.

Foucault M. *Power/knowledge: selected interviews and other writings,* 1972-1977. 5th ed.Gordon C, Marshall L, Mephan J, Soper K. New York, NY: Pantheon Books, 1980.

Freeman J, Johnson VL. *Waves of protest: social movements since the sixties.* Lanham, MD: Rowman & Littlefield Publishers, 1999.

Freire P. *Pedagogy of the oppressed.* 30th anniversary ed New York, NY: Continuum, 2000.

Frerichs RR. *John Snow.* University of Southern California, 2004. Accessed September 25, 2004 at <http://www.ph.ucla.edu/epi/snow.html>.

Freudenberg N. Shaping the future of health education: from behavior change to social change. *Health Education Monographs* 1978;6(4):372-377.

Freudenberg N. Health education for social change: a strategy for public health in the US. *International Journal of Health Education* 1982;24(3):138-45.

Freudenberg N. Public health advocacy to change corporate practices: implications for health education practice and research. *Health Education and Behavior* 2005;32(3):298-319; discussion 355-362.

Freudenberg N, Eng E, Flay B, Parcel G, Rogers T, Wallerstein N. Strengthening individual and community capacity to prevent disease and promote health: in search of relevant theories and principles. *Health Education Quarterly* 1995;22(3):290-306.

Frumkin H, Frank LD, Jackson R. *Urban sprawl and public health: designing, planning, and building for healthy communities.* Washington, DC: Island Press, 2004.

Galea S, Freudenberg N, Vlahov D. Cities and population health. *Social Science and Medicine* 2005;60(5):1017-1033.

Gandhi, Fischer L. *The essential Gandhi: his life, work, and ideas: an anthology.* Vintage Books ed New York, NY: Vintage Books, 1983.

Gardner H, Csikszentmihalyi M, Damon W. *Good work: when excellence and ethics meet.* New York, NY: Basic Books, 2001.

Garrett MJ. *Health futures: a handbook for health professionals.* Geneva: World Health Organization, 1999.

Gecan M. *Going public.* Boston: Beacon Press, 2002.

Gibbs D, Brown B. *Community-level indicators for understanding health and human services issues: a compendium of selected indicator systems and resource organizations.* Washington, DC: Office Of The Assistant Secretary For Planning And Evaluation, U.S. Department Of Health And Human Services; September 2000, 2000. <http://aspe.hhs.gov/progsys/Community/>.

Ginter PM, Duncan WJ, Capper SA. *Strategic planning for public health practice using macroenvironmental analysis. Public Health Reports* 1991;106(2):134-41.

Gold MR, Stevenson D, Fryback DG. HALYS and QALYS and DALYS, oh my: similarities and differences in summary measures of population health. *Annual Reviews of Public Health* 2002;23:115-34.

Goodman RM. Principals and tools for evaluating community-based prevention and health promotion programs. *Journal of Public Health Management and Practice* 1998;4(2):37-47.

Goodman RM. Community-based participatory research: questions and challenges to an essential approach. *Journal of Public Health Management and Practice* 2001a;7(5):v-vi.

Goodman RM. Evaluation of community-based programs: an alternative perspective. In: Schneiderman N, editor. *Integrating Behavioral and Social Sciences with Public Health.* Washington, DC: American Psychological Association; 2001b.

Goodman RM, McLeroy KR, Steckler AB, Hoyle RH. Development of level of institutionalization scales for health promotion programs. *Health Education Quarterly* 1993;20(2):161-78.

Goodman RM, Speers MA, McLeroy K, Fawcett S, Kegler M, Parker E, Smith SR, Sterling TD, Wallerstein N. Identifying and defining the dimensions of community capacity to provide a basis for measurement. *Health Education and Behavior* 1998;25(3):258-78.

Goodwin J, Jasper JM. *Rethinking social movements: structure, meaning, and emotion.* Lanham, MD: Rowman & Littlefield Publishers, 2004.

Gori GB. Individualized or population risks: what is the argument? *American Journal of Public Health* 2001;91(12):1919-.

Gostin LO, Boufford JI, Martinez RM. The future of the public's health: vision, values, and strategies. *Health Affairs* 2004;23(4):96-107.

Green LW. Health education planning: a diagnostic approach. 1st ed Palo Alto Calif: Mayfield Pub. Co., 1980.

Green LW. Health education's contributions to public health in the twentieth century: a glimpse through health promotion's rear- view mirror. *Annual Reviews of Public Health* 1999;20:67-88.

Green LW. Public health asks of systems science: to advance our evidence-based practice, can you help us get more practice-based evidence? *American Journal of Public Health* 2006;96(3):406-409.

Green LW, Johnson JL. Dissemination and utilization of health promotion and disease prevention knowledge: theory, research and experience. *Canadian Journal of Public Health-Revue Canadienne de Sante Publique* 1996;87:S11-S17.

Green LW, Kreuter MW. *Health promotion planning: an educational and environmental approach*. 2nd ed Mountain View CA: Mayfield Pub. Co., 1991.

Green LW, Kreuter MW. *Health promotion planning: an educational and ecological approach.* 3rd ed Mountain View, CA: Mayfield Pub. Co., 1999.

Green LW, Kreuter MW. *Health program planning: an educational and ecological approach*. 4th ed New York, NY: McGraw-Hill, 2004.

Green LW, Richard L, Potvin L. Ecological foundations of health promotion. *American Journal of Health Promotion* 1996;10(4):270-281.

Gregg EW, Cadwell BL, Cheng YJ, Cowie CC, Williams DE, Geiss L, Engelgau MM, Vinicor F. Trends in the prevalence and ratio of diagnosed to undiagnosed diabetes according to obesity levels in the *U.S. Diabetes Care* 2004;27(12):2806-2812.

Gutman M, Clayton R. Treatment and prevention of use and abuse of illegal drugs: progress on interventions and future directions. *American Journal of Health Promotion* 1999;14(2):92-7.

Guynup S. *Cholera: tracking the first truly global epidemic.* Washington, DC: National Geographic; June 14, 2004. <http://news.nationalgeographic.com/news/2004/06/0614_040614_tvcholera.html>.

Gwatkin DR. Health inequalities and the health of the poor: what do we know? what can we do? *Bulletin of the World Health Organization* 2000;78(1):3-18.

Haas M. *Institutional racism: the case of Hawai'i.* Westport, CT: Praeger, 1992.

Hahn R, Vesely S, Chang M-H. Health risk aversion, health risk affinity, and socio-economic position in the USA: the demographics of multiple risk. *Health, Risk & Society* 2000;2(3):295-314.

Hahn RA. Anthropology and epidemiology: one logic or two? In: *Sickness and healing: an anthropological perspective.* New Haven, CT: Yale University Press; 1995. p. 99-130.

Hancock L, Sanson Fisher RW, Redman S, Burton R, Burton L, Butler J, Girgis A, Gibberd R, Hensley M, McClintock A, Reid A, Schofield M, Tripodi T, Walsh R. Community action for health promotion: a review of methods and outcomes 1990-1995. *American Journal of Preventive Medicine* 1997;13(4):229-239.

Hancock T. The evolution, impact and significance of the healthy cities/healthy communities movement. *Journal of Public Health Policy* 1993;14(1):5-18.

Hancock T. Healthy communities must also be sustainable communities. *Public Health Reports* 2000;115(2-3):151-6.

Hancock T, Bezold C. Possible futures, preferable futures. *Healthcare Forum Journal* 1994;37(2):23-9.

Harden MJ, Brinkman S. *Voices of wisdom: Hawaiian elders speak.* Kula HI: Aka Press, 1999.

Hargrove JL. *Dynamic modeling in the health sciences.* New York, NY: Springer, 1998.

Hassmiller S. Turning point: the Robert Wood Johnson Foundation's effort to revitalize public health at the state level. *Journal of Public Health Management and Practice* 2002;8(1):1-5.

Hawaii Community Services Council. *Ke Ala Hoku critical indicators report.* Honolulu: Hawaii Community Services Council, 1999.

Hawaii Health Information Corporation. *Health trends in Hawaii: a profile of the health care system.* 5th ed Honolulu: Hawaii Health Information Corporation, 2001.

Hawaii State Legislature. SCR-12: *Adopting key community outcomes of well-being for the people of the state of Hawaii.* Honolulu, HI; January 25, 2000. <http://www.capitol.hawaii.gov/session2000/bills/scr12_.htm>.

Hawken P, Ogilvy JA, Schwartz P. *Seven tomorrows: toward a voluntary history.* New York, NY: Bantam Books, 1982.

Hayes MV, Willms SM. *Healthy community indicators: the perils of the search and the paucity of the find.* Vancouver B C: Health Policy Research, Unit University of British Columbia, 1990.

Heffler S, Smith S, Keehan S, Clemens MK, Zezza M, Truffer C. Health spending projections through 2013. *Health Affairs* 2004;Suppl:W3-54-65.

Heirich M. *Rethinking health care: innovation and change in America.* Boulder, CO: Westview Press, 1999.

Henle J. *On miasmata and contagia* (1840).Translated by George Rosen. Baltimore, MD: Johns Hopkins Press, 1938.

Higginbotham HN, Albrecht G, Connor L. *Health social science: a transdisciplinary and complexity perspective.* New York, NY: Oxford University Press, 2001.

Hildreth R. *Building worlds, transforming lives, making history: a coach's guide for public achievement.* 2nd ed Minneapolis, MN: Center for Democracy and Citizenship, 1998.

Hildreth RW. Theorizing citizenship and evaluating Public Achievement. PS: *Political Science & Politics* 2000;33(3):8-18.

Hinton AL. *Genocide: an anthropological reader.* Malden, MA: Blackwell, 2002.

Hirsch G. *Modeling the consequences of major incidents for health care systems.* 22nd International Conference of the System Dynamics Society; Oxford, England; July 25-29, 2004. Available at <http://cgi.albany.edu/~sdsweb/sdsweb.cgi?P121>.

Hirsch G, Homer J, McDonnell G, Milstein B. *Achieving health care reform in the United States: toward a whole-system understanding.* 23rd International Conference of the System Dynamics Society; Boston, MA; July 17-21, 2005. Available at <http://www.systemdynamics.org/conf2005/proceed/papers/HIRSC406.pdf>.

Hirsch G, Immediato CS. Microworlds and generic structures as resources for integrating care and improving health. *System Dynamics Review* 1999;15(3):16.

Hirsch G, Killingsworth W. A new framework for projecting dental manpower requirements. *Inquiry* 1975(June).

Hirsch G, Miller S. Evaluating HMO policies with a computer simulation model. *Medical Care* 1974;12(8):668-81.

Hirsch G, Wils W. *Cardiovascular disease in the Dutch population: a model-based approach to scenarios.* Ministry of Health: Conference on Health Care Scenarios; The Hague, Netherlands: Ministry of Health; August, 1984.

Hirsch GB, Immediato CS. *Design of simulators to enhance learning: examples from a health care microworld.* International System Dynamics Conference; Quebec City; July, 1998.

Hoard M, Homer J, Manley W, Furbee P, Haque A, Helmkamp J. Systems modeling in support of evidence-based disaster planning for rural areas. *International Journal of Hygiene and Environmental Health* 2005;208:117-125.

Hodge T. *Assessing progress toward sustainability: development of a systemic framework and reporting structure.* Ottawa: National Library of Canada, 1996.

Hofrichter R, editor. *Health and social justice: politics, ideology, and inequity in the distribution of disease.* San Francisco, CA: Jossey-Bass; 2003.

Homer J. *Reference guide for the CDC Diabetes System Model.* Atlanta, GA: Division of Diabetes Translation, Centers for Disease Control and Prevention; August, 2006. <<http://sustainer.org/pubs/diabetessystemreference.pdf>.

Homer J, Hirsch G, Minniti M, Pierson M. Models for collaboration: how system dynamics helped a community organize cost-effective care for chronic illness. *System Dynamics Review* 2004;20(3):199- 222.

Homer J, Hirsch G, Milstein B. *Chronic illness in a complex health economy: the perils and promises of downstream and upstream reforms.* System Dynamics Review 2007;23(2/3):313—343.

Homer J, Jones A, Seville D, Essien J, Milstein B, Murphy D. *The CDC diabetes system modeling project: developing a new tool for chronic disease prevention and control.* 22nd International Conference of the System Dynamics Society; Oxford, England; July 25-29, 2004. Available at <http://cgi.albany.edu/~sdsweb/sdsweb.cgi?P254>.

Homer J, Milstein B. *Communities with multiple afflictions: a system dynamics approach to the study and prevention of syndemics.* 20th International Conference of the System Dynamics Society; Palermo,Italy; July, 2002a. Available at <http://www.systemdynamics.org/publications.htm>.

Homer J, Milstein B. *Syndemic simulation.* Forio Business Simulations, 2002b. Accessed January 7, 2002 at <http://broadcast.forio.com/sims/syndemic/>.

Homer J, Milstein B. *Planning comprehensive public health programs: an opportunity for system dynamics.* System Dynamics Winter Camp; Austin, TX; January 9-10, 2003a. Available at <http://www2.cdc.gov/syndemics/Presentations.htm>.

Homer J, Milstein B. *Syndemic simulation.* Forio Business Simulations, 2003b. Accessed June 1, 2003 at <http://broadcast.forio.com/sims/syndemic2003/>.

Homer J, Milstein B. *Optimal decision making in a dynamic model of poor community health.* 37th Hawaii International Conference on System Science; Big Island, HI; January 5-8, 2004. Available at <http://csdl.computer.org/comp/proceedings/hicss/2004/2056/03/205630085a.pdf>.

Homer J, Milstein B, Dietz W, Buchner D, Majestic D. *Obesity population dynamics: exploring historical growth and plausible futures in the U.S.* 24th International System Dynamics Conference; Nijmegen, The Netherlands; July 26, 2006. Available at <http://cgi.albany.edu/~sdsweb/sds2006.cgi?P141>.

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 in press.

Homer J, Ritchie-Dunham J, Rabbino H, Puente LM, Jorgensen J, Hendricks K. Toward a dynamic theory of antibiotic resistance. *System Dynamics Review* 2000;16(4):287-319.

Homer J, St. Clair C. A model of HIV transmission through needle sharing. *Interfaces* 1991;21:26-49.

Homer JB. A system dynamics model for cocaine prevalence estimation and trend projection. *Journal of Drug Issues* 1993;23(2):251-279.

Homer JB. Why we iterate: scientific modeling in theory and practice. *System Dynamics Review* 1996;12(1):1-19.

Homer JB, Hirsch GB. System dynamics modeling for public health: background and opportunities. *American Journal of Public Health* 2006;96(3):452-458.

Homer JB, Oliva R. Maps and models in system dynamics: a response to Coyle. *System Dynamics Review* 2001;17(4):347-355.

Honeycutt A, Boyle J, Broglio K, Thompson T, Hoerger T, Geiss L, Narayan K. A dynamic Markov model for forecasting diabetes prevalence in the United States through 2050. *Health Care Management Science* 2003;6:155-164.

Horton M, Freire P. *We make the road by walking: conversations on education and social change.* Philadelphia: Temple University Press, 1990.

Horton R. Rediscovering human dignity. *The Lancet* 2004;364(9439):1081-1085.

Hubbard BM. *Conscious evolution: awakening the power of our social potential.* Novato, CA: New World Library, 1998.

Hudson RP. *Disease and its control: the shaping of modern thought.* Westport, CT: Greenwood Press, 1983.

Human Systems Dynamics Institute. *Human systems dynamics: the research and practice landscape.* Minneapolis, MN: Human Systems Dynamics Institute; May, 2003.

Huxley A. Ends and means: an inquiry into the nature of ideals and into methods employed for their realization. New York, NY: Harper, 1937.

Illich I. *Disabling professions.* London: M. Boyars, 1977.

Illich I. *Medical nemesis: the expropriation of health.* New York, NY: Pantheon Books, 1982.

Industrial Areas Foundation. *Organizing for change, power, action, justice: IAF standing for the whole.* Chicago, IL: Industrial Areas Foundation 1990.

Innovation Associates, New England Health Care Assembly. *Creating integrated care and healthiercommunities: microworld learning experience.* Cambridge, MA: American Hospital AssociationCenter for Health Care Leadership 1997.

Institute of Medicine. *The future of public health.* Washington, DC: National Academy Press, 1988.

Institute of Medicine. *Linking research and public health practice: a review of CDC's program of centers for research and demonstration of health promotion and disease prevention.* Washington, DC: National Academy Press, 1997.

Institute of Medicine. *The future of the public's health in the 21th century.* Washington, DC: National Academy Press, 2002a.

Institute of Medicine. *Unequal treatment: confronting racial and ethnic disparities in healthcare.* Washington, DC: National Academy Press, 2002b.

Institute of Medicine. *Who will keep the public healthy?: educating public health professionals for the 21st century.* Washington, DC: National Academy Press, 2002c.

International Healthy Cities Foundation. *What is the Healthy Cities movement?* International Healthy Cities Foundation, 2002. Accessed October 5, 2004 at <http://www.healthycities.org/>.

International Institute for Sustainable Development. *Ke Ala Hoku: initiative details.* International Institute for Sustainable Development, 2004. Accessed October 8, 2004 at <http://www.iisd.org/measure/compendium/DisplayInitiative.aspx?id=1149>.

Isee Systems. *Stella/iThink.* 2004. Accessed December 30, 2004 at <http://www.iseesystems.com>.

Israel BA, Checkoway B, Schulz A, Zimmerman M. Health education and community empowerment:conceptualizing and measuring perceptions of individual, organizational, and community control.*Health Education Quarterly* 1994;21(2):149-70.

Israel BA, Schulz AJ, Parker EA, Becker AB. Review of community-based research: assessing partnership approaches to improve public health. *Annual Reviews of Public Health* 1998;19:173-202.

Jackson DJ, Valdesseri R, CDC Health Systems Work Group. *Health systems work group report.* Atlanta, GA: Centers for Disease Control and Prevention, Office of Strategy and Innovation; January 6, 2004.

Jackson R, Locke P, Pirkle J, Thompson FE, Sussman D. Will biomonitoring change how we regulate toxic chemicals? *Journal of Law, Medicine, and Ethics* 2002;30(3 Suppl):177-83.

Jackson RJ. The impact of the built environment on health: an emerging field. *American Journal of Public Health* 2003;93(9):1382-1384.

James SA. Primordial prevention of cardiovascular disease among African-Americans: a social epidemiological perspective. *Preventive Medicine* 1999;29(6 Pt 2):S84-9.

Jammalamadaka SR, Sengupta A. *Topics in circular statistics.* River Edge, NJ.: World Scientific, 2001.

Janes CR, Stall R, Gifford SM. *Anthropology and epidemiology: interdisciplinary approaches to the study of health and diseases.* Boston, MA: Kluwer Academic Publishers, 1986.

Jennings B, Hanson MJ. *Commodity or public work?* two perspectives on health care. Waltham, MA:Civic Practices Network 1995a. <http://www.cpn.org/topics/health/commodity.html>.

Jennings B, Hanson MJ. Commodity or public work? two perspectives on health care. *Bioethics Forum* 1995b(Fall):3-11.

Jones AP, Homer JB, Murphy DL, Essien JDK, Milstein B, Seville DA. Understanding diabetes population dynamics through simulation modeling and experimentation. *American Journal of Public Health* 2006;96(3):488-494.

Kahane A. *The victory of the open heart: solving tough problems through talking and listening.* San Francisco, CA, 2004.

Kanahele GS. *Hawaiian renaissance.* Honolulu, HI: Project WAIAHA, 1982.

Kari NN, Boyte HC, Jennings B. *Health as a civic question.* Civic Practices Network, 1994. Accessed December 1, 2002 at <http://www.cpn.org/topics/health/healthquestion.html>.

Kawachi I, Subramanian SV, Almeida-Filho N. A glossary for health inequalities. *Journal of Epidemiology and Community Health* 2002;56(9):647-652.

Kenny S, Aubert R, Geiss L. Prevalence and incidence of non-insulin-dependent diabetes. In: Harris M, Cowie C, Reiber G, Boyko E, Stern M, Bennett P, editors. *Diabetes in America.* 2nd ed. Washington, DC: US Government Printing Office; 1995. p. 47-68.

Kibel BM. *Success stories as hard data: an introduction to results mapping.* New York, NY: Kluwer Academic/Plenum Publishers, 1999.

Kibel BM. *Journey mapping: an overview.* Pacific Institute for Research and Evaluation, 2001. Accessed January 14, 2002 at <http://www.pire.org/resultmapping/previewafs.htm>.

Kidder T. *Mountains beyond mountains.* New York, NY: Random House Trade Paperbacks, 2004.

King ML. *Where do we go from here: chaos or community?* New York, NY: Harper & Row, 1967.

King ML, Jr. *Speeches of Dr. Martin Luther King, Jr.* (1944-68). Martin Luther King, Jr., National Historic Site, 2002. Accessed June 24, 2002 at <http://www.nps.gov/malu/documents/king_speeches.htm>.

Kirby S, Taylor M, Freimuth V, Parvanta C. Identity building and branding at CDC: a case study. *Social Marketing Quarterly* 2001;VII(2):16-35.

Kleinbaum DG, Kupper LL, Muller KE. *Applied regression analysis and other multivariable methods.* 2nd ed Boston, MA: PWS-Kent Pub. Co., 1988.

Kline SJ. *Conceptual foundations for multidisciplinary thinking.* Stanford Calif: Stanford University Press, 1995.

Klinenberg E. *Heat wave: a social autopsy of disaster in Chicago.* Chicago: University of Chicago Press, 2002.

Kohn LT, Corrigan J, Donaldson MS. *To err is human: building a safer health system.* Washington, DC: National Academy Press, 2000.

Kooiman J. *Governing as governance*. Thousand Oaks, CA: Sage, 2003.

Koopman JS, Lynch JW. Individual causal models and population system models in epidemiology. *American Journal of Public Health* 1999;89(8):1170-4.

Koplan J. CDC sets millennium priorities. *US Medicine* 1999:4-7.

Kretzmann JP, McKnight J. *Building communities from the inside out: a path toward finding and mobilizing a community's assets.* Chicago, IL: Northwestern University, Distributed by ACTA Publications, 1993.

Kreuter MW. PATCH: its origin, basic concepts, and links to contemporary public health policy. *Journal of Health Education* 1992;23(3):135-9.

Kreuter MW. *Community health promotion ideas that work.* 2nd ed Sudbury, MA: Jones and Bartlett, 2003.

Krieger N. Re: "Who made John Snow a hero?" *American Journal of Epidemiology* 1992;135(4):450-1.

Krieger N. Epidemiology and the web of causation: has anyone seen the spider? *Social Science and Medicine* 1994;39(7):887-903.

Krieger N. A glossary for social epidemiology. *Journal of Epidemiology and Community Health* 2001a;55(10):693-700.

Krieger N. Theories for social epidemiology in the 21st century: an ecosocial perspective. *International Journal of Epidemiology* 2001b;30(4):668-77.

Krieger N, Birn AE. A vision of social justice as the foundation of public health: commemorating 150 years of the spirit of 1848. *American Journal of Public Health* 1998;88(11):1603-6.

Krieger N, Northridge M, Gruskin S, Quinn M, Kriebel D, Davey Smith G, Bassett M, Rehkopf DH, Miller C. Assessing health impact assessment: multidisciplinary and international perspectives. *Journal of Epidemiology and Community Health* 2003;57(9):659-662.

Krieger N, Zierler S. What explains the public's health? --a call for epidemiologic theory. *Epidemiology* 1996;7(1):107-9.

Krug EG, editor. *World report on violence and health.* Geneva: World Health Organization; 2002.

Kunitz SJ. *Disease and social diversity: the European impact on the health of non-Europeans.* New York, NY: Oxford University Press, 1994.

Kyselka W. *An ocean in mind.* Honolulu, HI: University of Hawaii Press, 1987.

Lamprecht F, Sack M. Vulnerability and salutogenesis in health and disease. *Public Health Review* 2003;31(1):7-21.

Landau J. *Natural change agents and their potential to promote family and community connectedness: a discussion of pilot programs on sexual behavior, HIV/AIDS, and substance abuse.* CDC Division of Reproductive Health Science Seminar; Atlanta, GA; February 4, 1997.

Landau-Stanton J. Issues and methods of treatment for families in cultural transition. In: Mirkins M, editor. *The Social and Political Contexts of Family Therapy.* MA: Allyn and Bacon; 1990.

Lane D, Monefeldt C, Rosenhead JV. Looking in the wrong place for healthcare improvements: a system dynamics study of an accident and emergency department. *Journal of the Operational Research Society* 2000;51:518-531.

Lasker RD, Weiss ES. Broadening participation in community problem solving: a multidisciplinary model to support collaborative practice and research. *Journal of Urban Health* 2003;80(1):14-47; discussion 48-60.

Lasker RD, Weiss ES, Miller R. *Partnership synergy: a practical framework for studying and strengthening the collaborative advantage.* In. New York, NY; 2001.

Laszlo E. *Macroshift: navigating the transformation to a sustainable world.* San Francisco, CA: Berrett- Koehler Publishers, 2001.

Laverack G, Wallerstein N. Measuring community empowerment: a fresh look at organizational domains. *Health Promotion International* 2001;16(2):179-85.

Leischow SJ, Milstein B. Systems thinking and modeling for public health practice. *American Journal of Public Health* 2006;96(3):403-405.

Leon DA, Walt G. *Poverty, inequality and health: an international perspective.* New York, NY: Oxford University Press, 2001.

Levin G, Roberts EB. *The dynamics of human service delivery.* Cambridge, MA: Ballinger Pub., 1976.

Levin G, Roberts EB, Hirsch GB. *The persistent poppy: a computer-aided search for heroin policy.* Cambridge, MA: Ballinger Pub. Co., 1975.

Levins R. Preparing for uncertainty. *Ecosystem Health* 1995;1(1):47-57.

Levins R, Lopez C. Toward an ecosocial view of health. *International Journal of Health Services* 1999;29(2):261-93.

Levy BS, Sidel VW. *War and public health.* Updated ed Washington, DC: American Public Health Association, 2000.

Lewis D. *We, the navigators: the ancient art of landfinding in the Pacific.* 2nd ed Honolulu, HI:University of Hawaii Press, 1994.

Light DW. Professionalism as a countervailing power. *Journal of Health Politics, Policy and Law* 1991;16(3):499-506.

Light DW. The rhetorics and realities of community health care: the limits of countervailing powers to meet the health care needs of the twenty-first century. *Journal of Health Politics, Policy, and Law* 1997;22(1):105-45.

Lilienfeld DE. John Snow: the first hired gun? *American Journal of Epidemiology* 2000;152(1):4-9.

Lincoln A. *Second annual message to Congress.* Washington, DC; December 1, 1862. Available at <http://www.quotationreference.com/quotefinder.php?byax=1&strt=1&subj=Abraham+Lincoln>.

Lindblom CE. The science of "muddling through". *Public Administration Review* 1959;19(Spring):79-88.

Loeb PR. *Soul of a citizen: living with conviction in a cynical time.* New York, NY: St. Martin's Griffin, 1999.

Loeb PR. *The impossible will take a little while: a citizen's guide to hope in a time of fear.* New York, NY: Basic Books, 2004.

Lord J. Really *MADD: looking back at 20 years. Mothers Against Drunk Driving,* 2000. Accessed December 2, 2004 at <http://www.madd.org/aboutus/0,1056,1686,00.html>.

Luginbuhl W, Hirsch G. Prevention and rehabilitation as a means of cost containment: the example of myocardial infarction. *Journal of Public Health Policy* 1981;2(2):103-115.

Lukes S. *Individualism.* New York, NY: Harper & Row, 1973.

MacQueen KM. Anthropology in public health. In: Breslow L, Green LW, Keck W, Last J, McGinnis M,editors. *Encyclopedia of Public Health.* New York, NY: Macmillan; 2002..

Magnussen L, Ehiri J, Jolly P. Comprehensive versus selective primary health care: lessons for global health policy. *Health Affairs* 2004;23(3):167-176.

Maier FH, Grossler A. What are we talking about? -- a taxonomy of computer simulations to support learning. *System Dynamics Review* 2000;16(2):14.

Malama Hawaii. *Vision, mission, and guiding values.* Malama Hawaii, 2003. Accessed July 28, 2003 at <http://www.malamahawaii.org/about_us.html>.

Mann JM. *Health and human rights: a reader.* New York, NY: Routledge, 1999.

Mann JM, Tarantola D, Netter TW. *AIDS in the world.* Cambridge, MA: Harvard University Press, 1992.

Manuel DG, Schultz SE, Kopec JA. Measuring the health burden of chronic disease and injury using health adjusted life expectancy and the Health Utilities Index. *Journal of Epidemiology and Community Health* 2002;56(11):843-850.

Marmot M. Dignity and inequality. *The Lancet* 2004;364(9439):1019-1021.

Mayer B, Brown P, Linder M. Moving further upstream: from toxics reduction to the precautionary principle. *Public Health Reports* 2002;117(6):574-86.

Mayors' Institute on City Design. *About the Mayors' Institute on City Design*. Mayors' Institute on City Design, 2002. Accessed July 22, 2002 at <http://www.archfoundation.org/micd/about/index.htm>.

McAdam D, Tarrow SG, Tilly C. *Dynamics of contention.* New York, NY: Cambridge University Press, 2001.

McAlister A, Puska P, Salonen JT, Tuomilehto J, Koskela K. Theory and action for health promotion illustrations from the North Karelia Project. *American Journal of Public Health* 1982;72(1):43-50.

McDonnell G, Heffernan M, Faulkner A. *Using system dynamics to analyse health system performance within the WHO framework.* 22nd International Conference of the System Dynamics Society; Oxford, England; July 25-29, 2004. Available at <http://cgi.albany.edu/~sdsweb/sdsweb.cgi?P337>.

McDowell I, Spasoff RA, Kristjansson B. On the classification of population health measurements. *American Journal of Public Health* 2004;94(3):388-393.

McGinnis JM. Setting nationwide objectives in disease prevention and health promotion: the United States experience. In: Holland WW, Detels R, Knox G, editors. *Oxford textbook of public health.* Oxford: Oxford University Press; 1985.

McKinlay JB. A case for refocusing upstream: the political economy of illness. In: Jaco EG, editor. *Patients, Physicians, and Illness: a Sourcebook in Behavioral Science and Health.* 3rd ed. New York, NY: Free Press; 1979. p. 9-25.

McKinlay JB. The promotion of health through planned sociopolitical change: challenges for research and policy. *Social Science and Medicine* 1993;36(2):109-117.

McKinlay JB, Marceau LD. To boldly go... *American Journal of Public Health* 2000a;90(1):25-33.

McKinlay JB, Marceau LD. Upstream healthy public policy: lessons from the battle of tobacco. *International Journal of Health Services* 2000b;30(1):49 - 69.

McKinlay JB, Marceau LD. US public health and the 21st century: diabetes mellitus. *Lancet* 2000c;356(9231):757-61.

McKnight J. *Politicizing health care.* Civic Practices Network, 1978. Accessed June 8, 2004 at <http://www.cpn.org/topics/health/politicizing.html>.

McKnight JL, Kretzmann J. *Mapping community capacity.* Evanston, IL: Center for Urban Affairs and Policy Research Northwestern University, 1990.

McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Education Quarterly* 1988;15(4):351-77.

McMichael AJ. The urban environment and health in a world of increasing globalization: issues for developing countries. *Bulletin of the World Health Organization* 2000;78(9):1117-1126.

McMichael AJ. Global environmental change as "risk factor": can epidemiology cope? *American Journal of Public Health* 2001;91(8):1172-1174.

McMichael AJ, Smith KR, Corvalan CF. The sustainability transition: a new challenge. *Bulletin of the World Health Organization* 2000;78(9):1067.

McNeill JR. *Something new under the sun: an environmental history of the twentieth-century world.* 1st ed New York, NY: W.W. Norton & Company, 2000.

Meadows DH. *The global citizen.* Washington, DC: Island Press, 1991.

Meadows DH, Meadows DL, Randers J. *Beyond the limits: confronting global collapse, envisioning a sustainable future.* Mills, VT.: Chelsea Green Pub., 1992.

Meadows DH, Randers J, Meadows DL. *The limits to growth: the 30-year update.* White River Junction, VT: Chelsea Green Pub., 2004.

Meadows DH, Richardson J, *Bruckmann G. Groping in the dark: the first decade of global modelling.* New York, NY: Wiley, 1982.

Meadows DH, Robinson JM. *The electronic oracle: computer models and social decisions.* New York, NY: Wiley, 1985.

Memmi A. *The colonizer and the colonized.* Boston, MA: Beacon Press, 1970.

Mendez D, Warner KE. Smoking prevalence in 2010: why the healthy people goal is unattainable. *American Journal of Public Health* 2000;90(3):401-3.

Midgley G. *Systemic intervention: philosophy, methodology, and practice*. New York, NY: Kluwer Academic/Plenum Publishers, 2000.

Midgley G. *Systems thinking.* Thousand Oaks, CA: Sage, 2003.

Midgley G. Systemic intervention for public health. *American Journal of Public Health* 2006;96(3):466- 472.

Milio N. *Promoting health through public policy.* Philadelphia: F. A. Davis Co., 1981.

Milio N. Evaluation of health promotion policies: tracking a moving target. In: Irving R, editor. *Evaluation in health promotion: principles and perspectives.* Copenhagen: World Health Organization Europe; 2001. p. xxvi, 533.

Milstein B. *Exploring foundations.* Syndemics Prevention Network, Centers for Disease Control and Prevention, 2002a. Accessed December 20, 2004 at <http://www.cdc.gov/syndemics/foundations.htm>.

Milstein B. *Introduction to the Syndemics Prevention Network.* Centers for Disease Control and Prevention, 2002b. Accessed January 9, 2002 at <http://www.cdc.gov/syndemics/pdfs/networkintro. pdf>.

Milstein B. *Seeing syndemics: thoughts on improving public health in communities with multiple afflictions.* CDC Work in Progress Seminar, Emerging Investigations and Analytic Methods Branch; Atlanta, GA.; July 18, 2002c. Available at <http://www2.cdc.gov/syndemics/Presentations.htm>.

Milstein B. *Using a syndemic orientation to explore evaluation design options for community health improvement initiatives.* 16th National Conference on Chronic Disease Prevention and Control; Atlanta, GA; March 1, 2002, 2002d. Available at <http://www2.cdc.gov/syndemics/Presentations.htm>.

Milstein B. *Exploring interfaces between public health and democracy.* Humphrey Institute for Public Affairs and the Jane Addams School for Democracy; Minneapolis, MN; December 17, 2003a. Available at <http://www2.cdc.gov/syndemics/Presentations.htm>.

Milstein B. *Possibilities for better integrating system dynamics into public health.* Roundtable Meeting of the Health Policy Special Interest Group, 21st International Conference of the System Dynamics Society; New York, NY; 2003b. Available at <http://www2.cdc.gov/syndemics/Presentations.htm>.

Milstein B. *Force health protection under a syndemic orientation: from force health protection to forces for protecting health.* 7th Annual Force Health Protection Conference; Albuquerque, NM; August 10, 2004a. Available at <http://www2.cdc.gov/syndemics/Presentations.htm>.

Milstein B. Syndemic. In: Mathison S, editor. *Encyclopedia of Evaluation.* Thousand Oaks, CA: Sage Publications; 2004b. p. 404-405.

Milstein B. *Transforming health evaluation: possibilities for a dynamic and democratic approach.* 4th Annual CDC Evaluation Summer Institute; Atlanta, GA: Centers for Disease Control and Prevention; June 9, 2004c. Available at <http://www.chronicdisease.org/SEpresentations/MILSTEIN-- Slides.ppt>.

Milstein B. *Sparking interest in syndemics.* Atlanta, GA: Centers for Disease Control and Prevention; May 13, 2005.

Milstein B. *Navigating health system change: combining innovations from public health, systems science, and social navigation.* Edinburgh Evaluation Summer School; Edinburgh, Scotland: University of Edinburgh and Health Scotland; June 6, 2006. Available at <http://www.chs.med.ed.ac.uk/ruhbc/summerschool/handouts/6th/navigating%20health%20system%20change.pdf>.

Milstein B, Homer J. *The dynamics of upstream and downstream: why is so hard for the health system to work upstream, and what can be done about it?* CDC Futures Health Systems Work Group; Atlanta, GA; December 3, 2003. Available at <http://www2.cdc.gov/syndemics/Presentations.htm>.

Milstein B, Homer J. *Directing change and charting progress toward health: roles for system dynamics and social navigation. E*valuation 2004: Annual Meeting of the American Evaluation Association; Atlanta, GA; November 5, 2004. Available at <http://www2.cdc.gov/syndemics/Presentations.htm>.

Milstein B, Homer J. *Background on system dynamics simulation modeling, with a summary of major public health studies.* Atlanta, GA: Syndemics Prevention Network, Centers for Disease Control and Prevention; April 8, 2005. <http://www.hpsig.com/images/f/f5/SD_background_for_public_health_%284.11.05%29.pdf>.

Milstein B, Jones A, Homer J, Murphy D, Essien J, Seville D. Charting plausible futures for diabetes prevalence: a role for system dynamics simulation modeling. Preventing Chronic Disease 2007;4(3):1-8. Available at <http://www.cdc.gov/pcd/issues/2007/jul/06_0070.htm>.

Milstein B, Seville D. *Navigating health futures: innovations in planning and evaluating system change ventures.* Maine Center for Public Health Evaluation Forum; Portland, ME; July 22, 2005. Available at <http://www2.cdc.gov/syndemics/Presentations.htm>.

Mindell J, Ison E, Joffe M. A glossary for health impact assessment. *Journal of Epidemiology and Community Health* 2003;57(9):647-651.

Mingers J, Gill A. *Multimethodology: the theory and practice of combining management science methodologies.* New York, NY: Wiley, 1997.

Minkler M. Ethical issues in community organization. *Health Education Monographs* 1978;6(2):198-210.

Minkler M. Health education, health promotion and the open society: an historical perspective. *Health Education Quarterly* 1989;16(1):17-30.

Minkler M. Challenges for health promotion in the 1990s: social inequities, empowerment, negative consequences, and the common good. *American Journal of Health Promotion* 1994;8(6):403-13.

Minkler M. Using participatory action research to build healthy communities. *Public Health Reports* 2000;115(2-3):191-7.

Minkler M, Wallerstein N, editors. *Community-based participatory research for health.* San Francisco, CA: Josey-Bass; 2003.

Minnich EK. Arendt, Heidegger, Eichmann: thinking in and for the world. *Soundings* 2003;86(1-2):103- 117.

Molla MT, Wagener DK, Madans JH. Summary measures of population health: methods for calculating healthy life expectancy. *Healthy People 2010 Stat Notes* 2001(21):1-11.

Morris AD, Mueller CM. *Frontiers in social movement theory.* New Haven, CT: Yale University Press, 1992.

Moyer B. *Doing democracy: the MAP model for organizing social movements.* Gabriola Island, BC: New Society Publishers, 2001.

Moynihan DP. *The politics of a guaranteed income; the Nixon administration and the Family assistance plan.* New York, NY: Random House, 1973.

Mukhtar Q, Jack L, Jr., Martin M, Murphy D, Rivera M. Evaluating progress toward Healthy People 2010 national diabetes objectives. *Preventing Chronic Disease* 2006;3(1):A11.

Mullan F. *Plagues and politics: the story of the United States Public Health Service.* New York, NY: Basic Books, 1989.

Muntaner C. Power, politics, and social class. Journal of Epidemiology and Community Health 2002;56(8):562-a-.

Murphy D, Chapel T, Clark C. Moving diabetes care from science to practice: the evolution of the National Diabetes Prevention and Control Program. *Annals of Internal Medicine* 2004;140(11):978-984.

Murphy D, Homer J, Nanavati P, Daves S. *Modeling population dynamics: diabetes.* Diabetes and Obesity Conference; Denver, CO: Centers for Disease Control and Prevention; May 16-19, 2006. Available at <http://www.cdc.gov/diabetes/conferences/conf2006/index.htm#theme>.

Murray CJL, Lopez AD, Harvard School of Public Health., World Health Organization., World Bank. T*he global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020.* Cambridge, MA: Published by the Harvard School of Public Health on behalf of the World Health Organization and the World Bank; Distributed by Harvard University Press, 1996.

Murray CJL, Lopez AD, Salomon JA, Mathers CD. *Summary measures of population health: concepts, ethics, measurement and applications.* Geneva: WHO, 2002.

National Cancer Institute. *Integrating science and practice: systems thinking in tobacco control.* Bethesda, MD: National Cancer Institute (Initiative on the Study and Implementation of Systems); January, 2005.

National Center for Health Statistics. *Healthy people 2000 final review: national health promotion and disease prevention objectives.* Hyattsville, MD: Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, 2001.

National Center for Health Statistics. *National Health Interview Survey (NHIS).* Centers for Disease Control and Prevention, 2004. Accessed September 16, 2004 at <http://www.cdc.gov/nchs/nhis.htm>.

National Center for Health Statistics. *Health, United States, 2006: with chartbook on trends in the health of Americans.* Hyattsville, MD: Department of Health and Human Services 2006. Available at <http://www.cdc.gov/nchs/data/hus/hus06.pdf>.

National Commission on Civic Renewal. *A nation of spectators: how civic disengagement weakens America and what we can do about it.* College Park, MD: University of Maryland, 1998.

National Public Health Institute. *North Karelia international visitor's programme.* National Public Health Institute, 2003. Accessed May 30, 2004 at <http://www.ktl.fi/eteo/cindi/northkarelia.html>.

National Research Council. *Preparing for an aging world: the case for cross-national research.* Washington, DC: National Academy Press, 2001.

Navarro V. *Dangerous to your health: capitalism in health care.* New York, NY: Monthly Review Press, 1993.

Navarro V. *The political economy of social inequalities: consequences for health and quality of life.* Amityville, NY: Baywood Pub. Co., 2002.

Nellis K, Birch K. *Mission ready 2004: this is a test.* CDC Connects, Centers for Disease Control and Prevention, 2004. Accessed May 3, 2004 at <http://intranet.cdc.gov/ecp/insidestory/missionready.html>.

Nordyke EC. *The peopling of Hawai'i.* 2nd ed Honolulu, HI: University of Hawaii Press, 1989.

Norris T, Pittman M. The healthy communities movement and the coalition for healthier cities and communities. *Public Health Reports* 2000;115(2-3):118-24.

Northridge ME, Stover GN, Rosenthal JE, Sherard D. Environmental equity and health: understanding complexity and moving forward. *American Journal of Public Health* 2003;93(2):209-214.

Norton BL, McLeroy KR, Burdine JM, Felix MR, Dorsey AM. Community capacity: concept, theory, and methods. In: DiClemente RJ, Crosby RA, Kegler MC, editors. *Emerging Theories in Health Promotion: Practice and Research Strategies for Improving Public Health.* San Francisco: Jossey- Bass; 2002. p. 194-227.

Nye JS, Donahue JD. *Governance in a globalizing world.* Washington, DC: Brookings Institution Press, 2000.

O'Donnell MP. Definition of health promotion. *American Journal of Health Promotion* 1986a;1(1):4-5.

O'Donnell MP. Definition of health promotion: part II: levels of programs. *American Journal of Health Promotion* 1986b;1(2):6-9.

O'Donnell MP. Definition of health promotion: part III: expanding the definition. *American Journal of Health Promotion* 1989;3(3):5.

Office of the Surgeon General. *The health consequences of smoking: a report of the Surgeon General.* Washington, DC: Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office of Smoking and Health, 2004.

Olshansky SJ, Ault AB. The fourth stage of the epidemiologic transition: the age of delayed degenerative diseases. *Milbank Quarterly* 1986;64(3):355-91.

Olson E. U.S. lengthens the list of diseases linked to smoking. *The New York Times* 2004 May 28. <http://www.nytimes.com/2004/05/28/politics/28smoke.html?pagewanted=print&position=>

Olson EE, Eoyang GH. *Facilitating organization change: lessons from complexity science.* San Francisco, CA: Jossey-Bass/Pfeiffer, 2001.

Omran AR. The epidemiologic transition. a theory of the epidemiology of population change. *Milbank Quarterly* 1971;49(4):509-38.

Ong P, Graham M, Houston D. Policy and programmatic importance of spatial alignment of data sources. *American Journal of Public Health* 2006;96(3):499-504.

Opdycke S. *The community indicator movement and social reporting: a working paper.* New York, NY: Fordham Institute for Innovation in Social Policy, 2001.

Osterman P. *Gathering power: the future of progressive politics in America.* Boston, MA: Beacon Press, 2002.

Papa Ola Lokahi. *Ka uhane lokahi: 1998 Native Hawaiian health and wellness summit and island aha.* Honolulu, HI: Papa Ola Lokahi, 1998.

Park A. Time 100: the people who shape our world. *Time Magazine* 2004 April 26.

Parkin J. E*pidemiology; or the remote cause of epidemic diseases in the animal and the vegetable creation.* London: J and A Churchill, 1873.

Pearce N. Epidemiology as a population science. *International Journal of Epidemiology* 1999;28(5):S1015-1018.

People's Health Movement. *People's charter for health.* People's Health Movement, 2004. Accessed February 27, 2004 at <http://www.phmovement.org/charter/index.html>.

Pidd M. *Tools for thinking: modelling in management science.* New York, NY: Wiley, 1996.

Polsky AJ. *The rise of the therapeutic state.* Princeton NJ: Princeton University Press, 1991.

Polynesian Voyaging Society. *Our vision, mission, and guiding values.* Polynesian Voyaging Soceity, 2002. Accessed September 6, 2004 at <http://www.pvs-hawaii.com/about.htm>.

Polynesian Voyaging Society. *History of the Polynesian Voyaging Society:* 1973 - 1998. 2004. Accessed November 19, 2004 at <http://www.pvs-hawaii.com/about.htm>.

Potter WC. *Nuclear power and nonproliferation: an interdisciplinary perspective.* Cambridge, MA: Oelgeschlager, Gunn & Hain, 1982.

Powers RS, Vogele WB, Kruegler C, McCarthy RM. *Protest, power, and change: an encyclopedia of nonviolent action from ACT-UP to women's suffrage.* New York, NY: Garland Pub., 1997.

Public Achievement. *About us.* Center for Democracy and Citizenship, 2004. Accessed September 15, 2004 at <http://www.publicachievement.org/1_about.html>.

Public Health Functions Steering Committee. T*he public health workforce an agenda for the 21st century: a report of the Public Health Functions Project.* Washington, DC: U.S. Department of Health and Human Services, Public Health Service 1997. <http://www.health.gov/phfunctions/pubhlth.pdf>.

Public Health Functions Steering Committee. *Public health in America.* U.S. Department of Health and Human Services, 1999. Accessed November 11, 2004 at <http://www.health.gov/phfunctions/public.htm>.

Puska P. *The North Karelia Project: 20 year results and experiences.* Helsinki: National Public Health Institute, 1995.

Puska P. Successful prevention of non-communicable diseases: 25 year experiences with North Karelia Project in Finland. *Public Health Medicine* 2002;4(1):5-7.

Quigley R, Keville J, Taylor L. *Health impact assessment gateway.* Health Development Agency, 2005 Accessed at <http://www.hiagateway.org.uk/>.

Rahmandad H, Sterman J. *Heterogeneity and network structure in the dynamics of diffusion: comparing agent-based and differential equation models.* Cambridge, MA: MIT Sloan School of Management 2005.

Randers J. *Elements of the system dynamics method.* Cambridge, MA: MIT Press, 1980.

Raphael D. *Social justice is good for our hearts: why societal factors—not lifestyles—are major causes of heart disease in Canada and elsewhere.* Toronto, Canada: CSJ Foundation for Research and Education, 2002.

Rhodes R. *The making of the atomic bomb.* New York, NY: Simon & Schuster, 1986.

Rhodes R. *What can we say about the world we are now making?* Living with the Genie: Governing Science and Technology in the 21st Century; New York, NY: Center for Science, Policy, and Outcomes; 2002.

Richardson GP. *Feedback thought in social science and systems theory.* Philadelphia, PA: University of Pennsylvania Press, 1991.

Richardson GP, Andersen DF. Teamwork in group model-building. *System Dynamics Review* 1995;11(2):113-137.

Richmond B. Systems thinking: critical thinking skills for the 1990s and beyond. *System Dynamics Review* 1993;9(2):113-134.

Richmond B. *The "thinking" in systems thinking: seven essential skills.* Waltham, MA: Pegasus Communications, 2000.

Richmond B. *In search of a unifying picture.* Systems Thinking and Dynamic Modeling in K-12 Education; Durham, NH: Creative Learning Exchange; July 1, 2002.

Richmond B, Peterson S. *An introduction to systems thinking.* Hanover, NH: High Performance Systems, 1997.

Richmond J. Vermont Commons School: developing systems citizens. The Connector 2003;1(5).

Richter ED, Laster R. The precautionary principle, epidemiology, and the ethics of delay. *International Journal of Occupational Medicine and Environmental Health* 2004;17(1):9-16.

Rissel C. Empowerment: the holy-grail of health promotion. *Health Promotion International* 1994;9(1):39-47.

Ritchie-Dunham JL, Mendez Galvan JF. Evaluating epidemic intervention policies with systems thinking: a case study of dengue fever in Mexico. *System Dynamics Review* 1999;15(2):20.

Rittel HWJ, Webber MM. *Dilemmas in a general theory of planning*. Berkeley: University of California, Berkeley, 1972.

Roberts C, Dangerfield B. Modelling the epidemio-logical consequences of HIV infection and AIDS: a contribution from operational research. *Journal of the Operational Research Society* 1990;41(4):273- 89.

Roberts EB. *Managerial applications of system dynamics*. 2nd ed Waltham, MA: Pegasus Communications, 1999a.

Roberts EB. Some insights into implementation. In: Roberts EB, editor. *Managerial applications of system dynamics*. 2nd ed. Waltham, MA: Pegasus Communications; 1999b. p. 155-161.

Roberts EB, Homer J, Kasabian A, Varrel M. A systems view of the smoking problem. *International Journal of Biomedical Computing* 1982;13:69-86.

Rogers MB. *Cold anger: a story of faith and power politics*. Denton, TX: University of North Texas Press, 1990.

Rogers RG, Hackenberg R. Extending epidemiologic transition theory: a new stage. *Social Biology* 1987;34(3-4):234-43.

Rose GA. *The strategy of preventive medicine*. New York, NY: Oxford University Press, 1992.

Rosen G. *A history of public health*. Expanded ed Baltimore: Johns Hopkins University Press, 1993.

Rosenberg CE. *The origins of specialization in American medicine: an anthology of sources*. New York, NY: Garland Pub., 1989.

Rosenberg T. What the world needs now is DDT. *New York Times Magazine* 2004 April 11:38-43.

Rosenfield PL. The potential of transdisciplinary research for sustaining and extending linkages between the health and social sciences. *Social Science and Medicine* 1992;35(11):1343-57.

Rosnay Jd. *The macroscope: a new world scientific system*. New York, NY: Harper & Row, 1979.

Rothman KJ, Adami HO, Trichopoulos D. Should the mission of epidemiology include the eradication of poverty? *Lancet*. 1998;352(9130):810-3.

Rothman KJ, Poole C. Science and policy making. *American Journal of Public Health* 1985;75(4):340-1.

Royston G, Dost A, Townshend J, Turner H. Using system dynamics to help develop and implement policies and programmes in health care in England. *System Dynamics Review* 1999;15(3):293-313.

Ruger JP. Health and social justice. *The Lancet* 2004;364(9439):1075-1080.

Salk J. *The survival of the wisest*. New York, NY: Harper & Row, 1973.

Sampson RJ, Raudenbush SW, Earls F. Neighborhoods and violent crime: a multilevel study of collective efficacy. *Science* 1997;277(5328):918-24.

Saposnick K. The systems thinker in every student: an interview with Mary Sheetz. *Leverage Points* 2004(46).

Scholl J. *Action research and system dynamics: can they benefit from each other?* Proceedings of the 37th Hawaii International Conference on System Science; Big Island, HI; January 5-8, 2004. Available at <http://csdl.computer.org/comp/proceedings/hicss/2004/2056/03/205630086c.pdf>.

Schon DA. *The reflective practitioner: how professionals think in action*. New York, NY: Basic Books 1983.

Schon DA, Rein M. *Frame reflection: toward the resolution of intractable policy controversies*. New York, NY: BasicBooks, 1994.

Schorr LB. *Common purpose: strengthening families and neighborhoods to rebuild America*. New York, NY: Anchor Books, Doubleday, 1997.

Schrage M. *Serious play: how the world's best companies simulate to innovate*. Boston, MA: Harvard Business School Press, 2000.

Scott J. *Social network analysis: a handbook*. 2nd ed Thousands Oaks, CA: Sage Publications, 2000.

Scott JC. *Seeing like a state: how certain schemes to improve the human condition have failed*. New Haven, CT: Yale University Press, 1999.

Scutchfield FD, Ireson C, Hall L. The voice of the public in public health policy and planning: the role of public judgment. *Journal of Public Health Policy* 2004;25(2):197-205; discussion 206-10.

Seaburn D, Landau-Stanton J, Horowitz S. Core techniques in family therapy. In: Richard H. Mikesell, Lusterman D-D, Susan HM, editors. *Integrating family therapy: handbook of family psychology and systems theory.* 1st ed. Washington, DC: American Psychological Association; 1995. p. 5-26.

Sedgwick WT. *Principles of sanitary science and the public health with special reference to the causation and prevention of infectious diseases.* New York, NY: Macmillan, 1902.

Sen AK. *Development as freedom.* New York, NY: Anchor Books, 1999.

Senge PM. Creating desired futures in a global society. *Reflections* 2003;5(1):1-12.

Seward JE. *A kingdom lost: the U.S. annexation of Hawaii.* Carlisle Barracks, PA: U.S. Army War College, 2001.

Sharp G. *Creative conflict in politics.* London: Housmans, 1962.

Sharp G. *The dynamics of nonviolent action.* Boston: P. Sargent, 1973a.

Sharp G. *Power and struggle.* Boston: P. Sargent, 1973b.

Sharp G. *The role of power in nonviolent struggle.* Cambridge, MA: Albert Einstein Institution, 1990.

Sharp G. *There are realistic alternatives.* Boston Mass: Albert Einstein Institution; 1880813122 2003. <http://65.109.42.80/organizations/org/TARA.pdf>.

Sharp G. *Social power and political freedom.* Boston, MA: P. Sargent Publishers, 1980.

Sharp G. *Waging nonviolent struggle: 20th century practice and 21st century potential.* Boston, MA: Porter Sargent Publishers, 2005.

Sheller M. *The mechanisms of mobility and liquidity: re-thinking the movement in social movements.* Lancaster University, 2001. Accessed January 7, 2003 at <http://www.comp.lancs.ac.uk/sociology/papers/sheller-mechanisms-of-mobility-and-liquidity.pdf>.

Shilts R. *And the band played on : politics, people, and the AIDS epidemic.* New York, NY: St. Martin's Press, 1987.

Sidel VW, Levy BS. War, terrorism, and public health. *Journal of Law, Medicine, and Ethics* 2003;31:516-523.

Sigerist HE. *Civilization and disease.* Ithaca, NY: Cornell University Press, 1943.

Sigerist HE. Health. *Journal of Public Health Policy.* 1996;17(2):204-234.

Singer M. AIDS and the health crisis of the U S urban poor; the perspective of critical medical anthropology. *Social Science and Medicine* 1994;39(7):931.

Singer M. A dose of drugs, a touch of violence, a case of AIDS: conceptualizing the SAVA syndemic. *Free Inquiry in Creative Sociology* 1996;24(2):99-110.

Singer M. *The political economy of AIDS.* Amityville, NY: Baywood Pub., 1998.

Singer M. Toward a critical biocultural model of drug use and health risk. In: Marshall PL, Singer M,

Clatts MC, editors. *Integrating Cultural, Observational, and Epidemiological Approaches in the Prevention of Drug Abuse and HIV/AIDS.* Washington, DC: National Institute on Drug Abuse,; 1999. p. 26-49.

Singer M. Toward a bio-cultural and political economic integration of alcohol, tobacco and drug studies in the coming century. *Social Science and Medicine* 2001;53(2):16.

Singer M. Critical medical anthropology. In: Ember CR, Ember M, editors. *Encyclopedia of Medical Anthropology: Health and Illness in the World's Cultures.* New York, NY: Kluwer Academic/Plenum Publishers; 2004. p. 23-30.

Singer M, Clair S. Syndemics and public health: reconceptualizing disease in bio-social context. *Medical Anthropology Quarterly* 2003;17(4):423-441.

Singer M, Romero-Daza N. *A notable connection between substance abuse, violence, and AIDS: initial findings from research in the Puerto Rican community of Hartford.* Hartford, CT.: Hispanic Health Council 1997. <http://www.medanthro.net/research/adsg/newsletters/singer2.pdf>.

Singer M, Snipes C. Generations of suffering: experiences of a treatment program for substance abuse during pregnancy. *Journal of Health Care for the Poor and Underserved* 1992;3(1):222-34.

Sirianni C, Friedland L. *Civic innovation in America: community empowerment, public policy, and the movement for civic renewal.* Berkeley: University of California Press, 2001a.

Sirianni C, Friedland L. Community health and civic organizing. In: *Civic Innovation in America: Community Empowerment, Public Policy, and the Movement for Civic Renewal.* Berkeley: University of California Press; 2001b. p. 138-185.

Smith G, Wolstenholme EF, McKelvie D, Monk D. *Using system dynamics in modeling mental health issues in the UK.* 22nd International Conference of the System Dynamics Society; Oxford, England; July 25-29, 2004. Available at <http://cgi.albany.edu/~sdsweb/sdsweb.cgi?P120>.

Snyder RC. *Shutting the public out of politics: civic republicanism, professional politics, and the eclipse of civil society.* Dayton, OH: Charles F. Kettering Foundation, 1999.

Social Marketing Institute. *Success stories: Florida "truth" campaign.* Social Marketing Institute, 2004. Accessed December 3, 2004 at <http://www.social-marketing.org/success/cs-floridatruth.html>.

Sontag S. *Illness as metaphor & AIDS and its metaphors.* London: Penguin, 2002.

Spivak H, Prothrow-Stith D, Hausman AJ. Dying is no accident. adolescents, violence, and intentional injury. *Pediatric Clinics of North America* 1988;35(6):1339-47.

Stannard DE. *Before the horror: the population of Hawai'i on the eve of Western contact.* Honolulu, HI: Social Science Research Institute University of Hawaii, 1989.

Starr P. *The social transformation of American medicine.* New York, NY: Basic Books, 1982.

Sterman JD. Misperceptions of feedback in dynamic decision making. *Organizational Behavior and Human Decision Processes* 1998;43(3):301-335.

Sterman JD. *Business dynamics: systems thinking and modeling for a complex world.* Boston, MA: Irwin McGraw-Hill, 2000.

Sterman JD. System dynamics modeling: tools for learning in a complex world. *California Management Review* 2001;43(4):8-25.

Sterman JD. All models are wrong: reflections on becoming a systems scientist. *System Dynamics Review* 2002;18(4):501-531.

Sterman JD. Learning from evidence in a complex world. *American Journal of Public Health* 2006;96(3):505-514.

Stokols D. Establishing and maintaining healthy environments: toward a social ecology of health promotion. *American Psychologist* 1992;47(1):6-22.

Stokols D. Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion* 1996;10(4):282-298.

Stokols D, Allen J, Bellingham RL. The social ecology of health promotion: implications for research and practice. *American Journal of Health Promotion* 1996;10(4):247-251.

Stokols D, Grzywacz JG, McMahan S, Phillips K. Increasing the health promotive capacity of human environments. *American Journal of Health Promotion* 2003;18(1):4-13.

Summers J. *Soho: a history of London's most colourful neighborhood.* Bloomsbury, London, 1989.

Surowiecki J. The financial page, no profit, no cure. *New Yorker* 2001 November 5:46.

Susser M. Disease, illness, sickness; impairment, disability and handicap. *Psychological Medicine* 1990;20(3):471-3.

Susser M. *Causal thinking in the health sciences: concepts and strategies of epidemiology.* New York, NY: Oxford University Press, 1973.

Susser M. What is a cause and how do we know one? a grammar for pragmatic epidemiology. *American Journal of Epidemiology* 1991;133(7):635-48.

Susser M. Glossary: causality in public health science. *Journal of Epidemiology and Community Health* 2001;55(6):376-378.

Susser M, Susser E. Choosing a future for epidemiology: II. from black box to Chinese boxes and ecoepidemiology. *American Journal of Public Health* 1996;86(5):674-7.

Syme SL. Strategies for health promotion. *Preventive Medicine* 1986;15(5):492-507.

Syme SL. The social environment and health. *Daedalus* 1994;123(4):79.

Syme SL. Rethinking disease: where do we go from here? *Annals of Epidemiology.* 1996;6(5):463-8.

Syme SL. *Social determinants of health: the community as an empowered partner.* In: Preventing Chronic Disease: Public Health Research, Practice, and Policy; 2004. <http://www.cdc.gov/pcd/issues/2004/jan/syme.htm>.

Syme SL. The social determinants of disease: some roots of the movement. *Epidemiologic Perspectives & Innovations* 2005;2(1):1-2.

Syme SL, Frohlich KL. The contribution of social epidemiology: ten new books. *Epidemiology* 2002;13(1):3.

System Dynamics Society. *What is system dynamics?* System Dynamics Society, 2002. Accessed December 19, 2002 at <http://www.systemdynamics.org/>.

Szreter S. Rethinking McKeown: the relationship between public health and social change. *American Journal of Public Health* 2002;92(5):722-725.

Tan J, Wen HJ, Awad N. Health care and service delivery systems as complex adaptive systems: examining chaos theory in action. *Communications of the ACM* 2005;48(5):36-44.

Tarrow SG. *Power in movement: social movements and contentious politics.* 2nd ed New York, NY: Cambridge University Press, 1998.

Taylor K, Lane D. Simulation applied to health services: opportunities for applying the system dynamics approach. *Journal of Health Services Research and Policy* 1998;3(4):226-32.

Taylor L, Quigley R. *Health impact assessment: a review of reviews.* London: Health Development Agency; October, 2002. <http://www.who.int/hia/evidence/en/hia_review.pdf>.

Tengs TO, Ahmad S, Savage JM, Moore R, Gage E. The AMA proposal to mandate nicotine reduction in cigarettes: a simulation of the population health impacts. *Preventive Medicine* 2005;40(2):170-80.

Tengs TO, Osgood ND, Chen LL. The cost-effectiveness of intensive national school-based anti-tobacco education: results from the tobacco policy model. *Preventive Medicine* 2001;33(6):558-70.

Tengs TO, Osgood ND, Lin TH. Public health impact of changes in smoking behavior: results from the Tobacco Policy Model. *Medical Care* 2001;39(10):1131-41.

Tesh SN. *Hidden arguments: political ideology and disease prevention policy.* New Brunswick, N.J.: Rutgers University Press, 1988.

The GoodWork Project. *The Goodwork project.* 2002. Accessed March 30, 2004 at <http://www.goodworkproject.org/Papers/gwpressrelease.pdf>.

The Lancet. Population health looking upstream. *Lancet* 1994;343(8895):429-30.

The Native Hawaiian Health Research Consortium. *E Ola Mau: the Native Hawaiian health needs study — historical/cultural task force report.* Honolulu, HI: Alu Like, Inc; December, 1985.

The Sentencing Project. *New prison figures demonstrate need for comprehensive reform.* Washington, DC: The Sentencing Project 2004. <http://www.sentencingproject.org/pdfs/1044.pdf>.

Thomas SD. *The last navigator: a young man, an ancient mariner, the secrets of the sea.* Camden, ME: International Marine, 1997.

Thompson N. *Hawai`iloa,* 1990-1995. Polynesian Voyaging Society, 1995. Accessed December 18, 2004 at <http://www.pvs-hawaii.com/newsletters/nl_hawaiiloa_1995.htm>.

Thompson N. *The Hokule'a voyages: what can evaluators learn from the renaissance of Polynesian voyaging?* Annual Meeting of the American Evaluation Association; Honolulu, HI; 2000a.

Thompson N. *Reflections on voyaging and home.* Polynesian Voyaging Society, 2000b. Accessed July 18, 2002 at <http://pvs.kcc.hawaii.edu/malama/voyaginghome.html>.

Thompson N. *Finding a way.* Polynesian Voyaging Society, 2005. Accessed March 16, 2005 at <http://www.pvs-hawaii.com/newsletters/nl_finding_a_way.htm>.

Tilson H, Gebbie KM. The public health workforce. *Annual Reviews of Public Health* 2004;25:341-56.

Townshend JRP, Turner HS. Analysing the effectiveness of Chlamydia screening. *Journal of the Operational Research Society* 2000;51(7):812-824.

Trask H-K, NetLibrary Inc. *From a native daughter: colonialism and sovereignty in Hawaiì.* Rev. ed Honolulu, HI: University of Hawaiì Press, 1999.

Trostle JA, Sommerfeld J. Medical anthropology and epidemiology. *Annual Review of Anthropology* 1996;25:253-274.

Turning Point National Program Office., Turning Point Performance Management Collaborative., Public Health Foundation (U.S.). *From silos to systems: using performance management to improve the public health.* Seattle, WA: University of Washington Turning Point National Program Office, 2003.

Ulrich W. *Critical heuristics of social planning: a new approach to practical philosophy.* Bern: Haupt, 1983.

Ulrich W. *Systems thinking as if people mattered: critical systems thinking for citizens and managers.* Lincoln, United Kingdom: Lincoln School of Management; Working Paper No. 23 1998. <http://www.geocities.com/csh_home/downloads/ulrich_1998c.pdf>.

Ulrich W. Reflective practice in the civil society: the contribution of critically systemic thinking. *Reflective Practice* 2000;1(2):247-268.

Ulrich W. Boundary critique. In: Daellenbach HG, Flood RL, editors. *The Informed Student Guide to Management Science.* London: Thomson; 2002. p. 41-42. <http://www.geocities.com/csh_home/downloads/ulrich_2002a.pdf>.

Ulrich W. *Pragmatizing critical systems thinking for professionals and citizens.* 2003. Accessed June 2, 2005 at <http://www.geocities.com/csh_home/cst_pragmatizing.html>.

United Nations. *The rights of indigenous peoples.* United Nations Office of the High Commissioner for Human Rights, 1997. Accessed December 27, 2002 at <http://193.194.138.190/html/menu6/2/fs9.htm>.

United Nations. *World urbanization prospects: the 2001 revision*. New York, NY: United Nations, 2002.

United Nations Development Programme. *What is human development?* United Nations, 2004. Accessed June 6, 2004 at <http://hdr.undp.org/hd/default.cfm

http://hdr.undp.org/reports/view_reports.cfm?type=1>.

United States Public Health Service. *Promoting health, preventing disease: objectives for the nation.* Washington, DC: Department of Health and Human Services, Public Health Service, 1980.

United States Public Health Service. *Healthy people 2000: national health promotion and disease prevention objectives.* Washington, DC: Department of Health and Human Services, 1990.

United States Public Health Service. *Healthy people 2010.* Washington, DC: U.S. Department of Health and Human Services 2000. <http://www.healthypeople.gov>.

United States. National Archives and Records Administration., Schamel CE. *Petition against the annexation of Hawaii submitted to the U.S. Senate in 1897 by the Hawaiian Patriotic League of the Hawaiian Islands.* Washington, DC: National Archives and Records Administration, 1999.

United States. Office of Disease Prevention and Health Promotion. *Healthy people midcourse review.* Office of Disease Prevention and Health Promotion, U.S. Department of Health and Human Services, 2006. Accessed August 27, at <http://www.healthypeople.gov/data/midcourse/default.asp>.

University of California Berkeley. School of Public Health., University of California San Francisco. Institute for Health Policy Studies., Centers for Disease Control and Prevention. *Public health impact of needle exchange programs in the United States and abroad.* Berkeley, CA: University of California Berkeley School of Public Health 1993. <http://www.caps.ucsf.edu/publications/needlereport.html>.

Valdez A, Kaplan CD, Curtis RL, Jr., Yin Z. Illegal drug use, alcohol and aggressive crime among Mexican-American and white male arrestees in San Antonio. *Journal of Psychoactive Drugs* 1995;27(2):135-43.

Vandenbroucke JP, Eelkman Rooda HM, Beukers H. Who made John Snow a hero? *American Journal of Epidemiology* 1991;133(10):967-73.

Vartiainen E, Jousilahti P, Alfthan G, Sundvall J, Pietinen P, Puska P. Cardiovascular risk factor changes in Finland, 1972-1997. *International Journal of Epidemiology* 2000;29(1):49-56.

Veerman JL, Barendregt JJ, Mackenbach JP. Quantitative health impact assessment: current practice and future directions. *Journal of Epidemiology and Community Health* 2005;59(5):361-370.

Vennix JAM. *Group model building: facilitating team learning using system dynamics.* New York, NY: J. Wiley, 1996.

Vennix JAM, Andersen DF, Richardson GP. Group model building, art, and science - Foreword. *System Dynamics Review* 1997;13(2):103-106.

Ventana Systems. *Vensim.* 2004. Accessed December 30, 2004 at <http://www.vensim.com/>.

Virchow RLK, Rather LJ. *Collected essays on public health and epidemiology.* Canton, MA: Science History Publications U.S.A., 1985.

von Bertalanffy L. *General system theory: a new approach to unity of science.* Baltimore, MD: John Hopkins Press, 1951.

von Bertalanffy L, LaViolette PA. *A systems view of man.* Boulder, CO: Westview Press, 1981.

Wachter RM, Shojania KG. *Internal bleeding: the truth behind America's terrifying epidemic of medical mistakes.* New York, NY: RuggedLand, 2004.

Wallace D, Wallace R. *A plague on your houses: how New York was burned down and national public health crumbled.* New York, NY: Verso, 1998.

Wallace R. A synergism of plagues: planned shrinkage, contagious housing destruction, and AIDS in the Bronx. *Environmental Research* 1988;47(1):1-33.

Wallace R, Wallace D. Resilience and persistence of the synergism of plagues: stochastic resonance and the ecology of disease, disorder and disinvestment in US urban neighborhoods. *Environment and Planning A* 1997;29(5):789-804.

Wallerstein N. Powerlessness, empowerment, and health: implications for health promotion programs. *American Journal of Health Promotion* 1992;6(3):197-205.

Wallerstein N, Bernstein E. Introduction to community empowerment, participatory education, and health. *Health Education Quarterly* 1994;21(2):141-8.

Walt G. *Health policy: an introduction to process and power.* Atlantic Highlands, NJ: Zed Books, 1994.

Warren MR. *Dry bones rattling: community building to revitalize American democracy.* Princeton, N.J.: Princeton University Press, 2001.

Wasserman S, Faust K. *Social network analysis: methods and applications.* Cambridge, England: Cambridge University Press, 1994.

Watkins LO. Coronary heart disease and coronary disease risk factors in black populations in underdeveloped countries: the case for primordial prevention. *American Heart Journal* 1984;108(3 Pt 2):850-62.

Weber M. Bureaucracy. In: Gerth HH, Mills CW, editors. Max Weber: Essays in Sociology. New Tork, NY: Oxford University Press; 1946.

Weitz ED. *A century of genocide: utopias of race and nation.* Princeton, NJ: Princeton University Press, 2003.

West C. T*he American evasion of philosophy: a genealogy of pragmatism.* Madison, WI: University of Wisconsin Press, 1989.

White F. *The overview effect: space exploration and human evolution.* 2nd ed Reston, VA: American Institute of Aeronautics and Astronautics, 1998.

Wiesner PJ. Four diseases of disarray in public health. *Annals of Epidemiology* 1993;3(2):196-198.

Wilkinson RG. *Unhealthy societies: the afflictions of inequality.* New York, NY: Routledge, 1996.

Wilkinson RG, Marmot MG, editors. *The solid facts: social determinants of health.* 2nd ed. Copenhagen: Centre for Urban Health, World Health Organization; 2003.

Wilson WJ. *The truly disadvantaged: the inner city, the underclass, and public policy.* Chicago: University of Chicago Press, 1990.

Winslow CEA. *The conquest of epidemic disease: a chapter in the history of ideas.* Princeton, N.J.: Princeton University Press, 1943.

Wolstenholme EF. A management flight simulator for community care. In: S C, editor. *Enhancing Decision Making in the NHS.* Milton Keynes, UK: Open University Press; 1996.

Wolstenholme EF. A patient flow perspective of UK health services: exploring the case for new "intermediate care" initiatives. *System Dynamics Review* 1999;15(3):253-271.

Wood RL. *Faith in action: religion, race, and democratic organizing in America.* Chicago: University of Chicago Press, 2002.

Woodward A, Hales S, Litidamu N, Phillips D, Martin J. Protecting human health in a changing world: the role of social and economic development. *Bulletin of the World Health Organization* 2000;78(9):1148-55.

World Commission on Environment and Development. *Our common future.* Geneva: Centre for Our Common Future, 1992.

World Health Organization. *Ottawa charter for health promotion.* International Conference on Health Promotion: The Move Towards a New Public Health, November 17-21, 1986 Ottawa, Ontario, Canada, 1986. Accessed July 12, 2002 at <http://www.who.int/hpr/NPH/docs/ottawa_charter_hp.pdf>.

World Health Organization. *Health promotion glossary.* World Health Organization, 1998. Accessed July 15, 2002 at <http://www.who.int/hpr/NPH/docs/hp_glossary_en.pdf>.

World Health Organization. *Health: a precious asset: accelerating follow-up to the World Summit for Social Development.* Geneva: Department of Health in Sustainable Development World Health Organization, 2000.

World Health Organization. *Health impact assessment methods and strategies.* WHO Regional Office for Europe, 2004a. Accessed at <http://www.euro.who.int/healthimpact>.

World Health Organization. *The world health report 2004: changing history.* Geneva: World Health Organization 2004b. <http://www.who.int/whr/en/>.

World Health Organization. C*ommission on social determinants of health.* WHO, 2005a. Accessed March 18, 2005 at <http://www.who.int/social_determinants/en/>.

World Health Organization. *Public health impact assessment.* WHO, 2005b. Accessed March 29, 2005 at <http://www.who.int/hia/en/>.

Yankelovich D. *Coming to public judgment: making democracy work in a complex world.* 1st ed Syracuse, NY: Syracuse University Press, 1991.

York Zimmerman Inc., WETA-TV. *A force more powerful: a century of nonviolent conflict.* PBS Online, 2000. Accessed November 18, 2002 at <http://www.pbs.org/weta/forcemorepowerful/>.

Zack MM, Moriarty DG, Stroup DF, Ford ES, Mokdad AH. Worsening trends in adult health-related quality of life and self-rated health—United States, 1993-2001. *Public Health Reports* 2004;119(5):493-505.

Zahran HS, Kobau R, Moriarty DG, Zack MM, Holt J, Donehoo R. Health-related quality of life surveillance--United States, 1993-2002. *MMWR Surveillance Summaries* 2005;54(SS-4):1-35.

Zinn H. *A people's history of the United States: 1492-present.* 20th anniversary ed New York, NY: Harper Collins, 1999.

ABOUT THE AUTHOR

Bobby Milstein, PhD, MPH, works at the Centers for Disease Control and Prevention where he leads the Syndemics Prevention Network and also coordinates planning and evaluation activities for emerging investigations and policy initiatives in chronic disease, environmental health, emergency preparedness, and health system improvement. He specializes in understanding transformations of public health work that arise in situations where there are multiple interacting epidemics, or syndemics. This work involves a close analysis of the concepts, methods, and moral considerations that guide health protection ventures, along with a synthesis of techniques from other areas of applied science such as dynamic modeling, democratic organizing, and social navigation.

With an academic background that combines cultural anthropology, behavioral science, and systems science, he has guided the development of CDC's framework for program evaluation and often consults on the role of dynamic, democratic processes in improving health and health equity.

Hygeia's Constellation

Navigating Health Futures in a Dynamic and Democratic World

6811