

# Understanding Population Health Terminology

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*Population health* is a relatively new term, with no agreement about whether it refers to a concept of health or a field of study of health determinants. There is debate, sometimes heated, about whether population health and public health are identical or different. Discussions of population health involve many terms, such as *outcomes*, *disparities*, *determinants*, and *risk factors*, which may be used imprecisely, particularly across different disciplines, such as medicine, epidemiology, economics, and sociology. Nonetheless, thinking and communicating clearly about population health concepts are essential for public and private policymakers to improve the population's health and reduce disparities. This article defines and discusses many of the terms and concepts characterizing this emerging field.

**Keywords:** Population health, public health, health outcomes, health determinants, health production function.

**I**N MARCH 2004, THE EDITOR OF *THE MILBANK QUARTERLY* noted a subtle but important change in the journal's subtitle, from "A Journal of Public Health and Health Care Policy" to "A Multidisciplinary Journal of Population Health and Health Policy." In explaining this change, Gray noted,

The term *public health* has increasingly come to connote a relatively narrow, though vitally important, set of activities that are carried out by agencies with official functions. *The Milbank Quarterly* is concerned with a very broad range of topics affecting health, as this current issue

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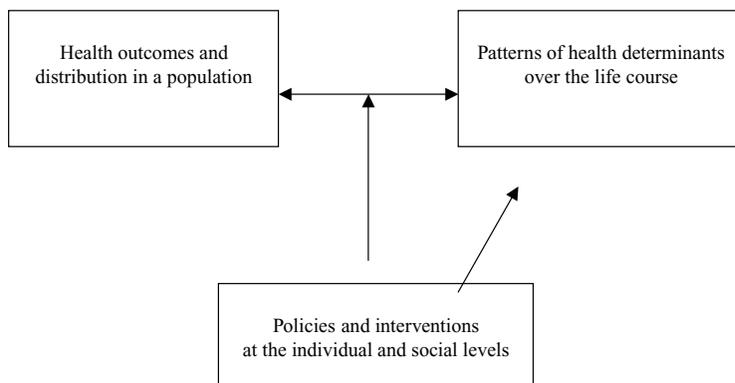
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well illustrates. The term *public health* has increasingly seemed too confining. . . . The term *population health* has been increasingly used in recent years, probably because it suggests a broad set of concerns—a particular perspective—rather than a specific set of activities, actors, or approaches. Thus, *population health* is more descriptive of the content to which the *Quarterly* aspires than *public health* is. (2004, 4)

*Population health*, however, is a relatively new term and does not yet have an agreed-upon definition. Whether population health refers to a concept of health or a field of study of health determinants is not clear, and there is debate, often heated, about whether population health and public health are identical or different. In addition, discussions of population health use many terms, such as *outcomes*, *disparities*, *determinants*, and *risk factors*. These terms are often used imprecisely, particularly when different disciplines, such as medicine, epidemiology, economics, and sociology, are involved. Although these are sometimes merely minor semantic differences, the meanings are often unclear and cause significant miscommunication. For example, a colleague and I have vigorously debated whether measures like community smoking rates are health outcomes, health determinants, risk factors, or even “intermediate health outcomes.” Similarly, the terms *inequality*, *inequity*, and *disparity* are sometimes used interchangeably. In addition, I include a few core methodological and statistical terms, which are used often enough to make clarification helpful to those not doing research.

The purpose of this article is to promote better understanding and communication among different stakeholders and disciplines working in the field of population health. It is not intended to be an extensive dictionary but, instead, a concise compellation of terms and concepts useful to public and private policymakers, beginning graduate students in population/public health and related fields, and scholars from other fields. It also is not intended to be prescriptive or constraining but to stimulate discussion and debate where differences remain. Language, particularly American English, continues to evolve, both leading and following what becomes contemporary use. This article intends to identify simultaneously both areas of actual or potential agreement and those for which more debate is needed and/or likely. The “struggle” among competing ideas and the words we use to represent them is not at the margin of policy debate but at the very center, often representing competing views and values.

To organize this article, I used the population health framework shown in figure 1, which was derived from the field model of Evans



*Note:* The field of population health investigates each of these components and their interactions.  
*Source:* Kindig and Stoddart 2003.

FIGURE 1. A Population Health Framework

and colleagues (Evans, Barer, and Marmour 1994). I discuss this choice in the next section. In this framework, population health is defined as health outcomes and their distribution in a population. These outcomes are achieved by patterns of health determinants (such as medical care, public health, socioeconomic status, physical environment, individual behavior, and genetics) over the life course produced by policies and interventions at the individual and population levels. Although some determinants are more amenable to change by policies and interventions, the model also allows for possibilities such as the future of genetic engineering.

The organization of this article follows this model, beginning with “Population and Health,” followed by “Population Health Outcomes,” “Determinants of Population Health Outcomes,” and “Policies and Interventions.” The last two sections focus on analytic terms used in establishing the causal relationships shown in the figure, as hypothesized by the arrows. Each section discusses terms that highlight particularly important issues or are controversial themselves, followed by the terms and definitions. Definitions from existing sources are referenced; where there is no reference I have defined the term myself.

## Population and Health

Although the term *population health* combines the concepts of both population and health, each term also has its own important meaning.

*Population* refers to a group of individuals, in contrast to the individuals themselves, organized into many different units of analysis, depending on the research or policy purpose. Whereas many interventions (e.g., much of medical care) focus exclusively on individuals, population health policy and research concentrate on the aggregate health of population groups like those in geographic units (cities, prisons) or other characteristics (ethnicity, religion, HMO membership). This focus is necessary because many determinants of health have their effect at a group level (air quality, education standards, Medicare policy, immunization) and because health differences across groups (men and women, rural and urban, black and white) are as important to population health outcomes and determinants as are differences between any two individuals. Therefore, population health research takes into account environmental and system variables that affect individuals, but it focuses on their impact on the health of the group, not the individuals themselves. According to Geoffrey Rose,

In order to grasp the principles of public health, one must understand that society is not merely a collection of individuals but is also a collectivity, and the behavior and health of its individual members are profoundly influenced by its collective characteristics and social norms. Given time, these collective and societal characteristics can be changed either by the behavior of individuals, such as opinion formers and health educators, or by the mass effects of changes in the economy, the environment, or technical developments. The efforts of individuals are only likely to be effective when they are working with the societal trends. (Rose 1992, 62)

Likewise, health itself has been described in many different ways, which is not surprising for such a fundamental concept. Several of the major ideas that *health* encompasses are listed in the terms following this section. While the general understanding of *health* often is negative, such as the absence of disease, the modern understanding of *health* also stresses its positive aspects, like wellness or well-being, and considers health in relation to all aspects of life in the environments in which we live. Our descriptions of health are complicated as well by the variations in individual preferences.

For the concept of population health itself, the primary definitional tension or confusion at present seems to be between defining population health as (1) a field of study of health determinants or (2) a concept

of broad health outcomes. Regarding these two rationales, the Group Health Community Foundation stated that

some observers see population health as a new term that highlights the influential role of social and economic forces in combination with biological and environmental factors, that shape the health of entire populations . . . others interpret population health primarily as a goal—a goal of achieving measurable improvements in the health of a defined population. (Kreuter and Lezin 2001, 5)

The first rationale seems to have evolved from the work of the Population Health Program of the Canadian Institute for Advanced Research (CIAR). Although their early discussions also considered the definition and measurement of health and the processes of health policymaking, the emphasis was on the determinants themselves and particularly the nonmedical determinants.

As I indicated earlier, I favor the second rationale, defining population health as “the health outcomes of a group of individuals, including the distribution of such outcomes within the group” (Kindig and Stoddart 2003, 381). These populations often are geographic regions like nations or communities but also can be other groups, like employees, specific ethnic groups, disabled persons, or prisoners. Such populations are relevant to public and private policymakers. In addition, Young indicates that in the past, the term *population health* was used as a “less cumbersome substitute for the health of populations,” which is, of course, its literal meaning (Young 1998, 4).

Although this definition of *population health* might be criticized as being too broad and covering almost all aspects of health, it can be argued that this concern is overridden by its primary focus on the measurement of health and health outcomes, which directs attention and research to the impact of each determinant (and their interactions) on an appropriate outcome. Including the distribution of outcomes also requires considering an unequal distribution of health across subpopulations, as well as the ethical and value considerations underpinning these issues. This perspective is similar to that of Dunn and Hayes, who define population health as “the health of a population as measured by health status indicators and as influenced by social, economic, and physical environments, personal health practices, individual capacity and coping skills, human biology, early childhood development, and health services” (Dunn and

Hayes 1999, S7). Their definition was used by Aday in her *Reinventing Public Health* (Aday 2005).

We might argue that both definitions are useful and that choosing the one concentrating on outcomes limits the inclusion or consideration of determinants and interventions. The framework of figure 1 speaks to this concern, as does the statement at the bottom of the figure, that the field of population health investigates the components and their interactions. In an earlier publication I defined population health as “the aggregate health outcome of health adjusted life expectancy of a group of individuals, in an economic framework that balances the relative marginal return from the multiple determinants of health” (Kindig 1997, 47). I do believe that accountability concerns argue strongly for emphasizing on an outcome concept, but not at the expense of understanding the importance of determinants in producing such outcomes. In this article, I offer several alternative definitions for these terms.

The distinction between public health and population health also deserves particular attention, since it has been, at the least, confusing and perhaps divisive regarding what should otherwise be one cohort of fellow travelers. For those who define *public health* as the “health of the public,” there is little difference from the definition of population health offered here and, in Frank’s words, the “shift in thinking entailed in population health should be a small one for public health workers . . . in fact it is not so much a shift as a return to our historical roots encompassing all the primary determinants of health in human populations” (Frank 1995, 163). However, much of governmental public health activity, in the United States at least, does not have such a broad mandate even in the “assurance” functions, since major determinants like medical care, education, and income remain outside public health authority and responsibility, and current resources do not even pay adequate attention to traditional and emerging public health functions. The broader definition of the public health system offered by the Institute of Medicine (IOM 2002) reaches beyond this narrow governmental view. Its report *The Future of the Public’s Health in the 21st Century* calls for significant movement in “building a new generation of intersectoral partnerships that draw on the perspectives and resources of diverse communities and actively engage them in health action” (IOM 2002, 4).

Definitions for a number of these and other population and health terms follow:

*Population:* The number of people in a given area. This can be defined geographically or politically, as in a country, although physical boundaries are not always necessary, as when referring to groups of people sharing common characteristics, for example, ethnicity, religion (Young 1998).

*Community:* (1) A group of people who have common characteristics; communities can be defined by location, race, ethnicity, age, occupation, interest in particular problems or outcomes, or other common bonds (Turnock 2004). (2) Individuals with a shared affinity, and perhaps geography, who organize around an issue, with collective discussion, decision making, and action (Labonte 1988).

*Health:* (1) The state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity (WHO 1994). (2) The extent to which an individual or group is able to realize aspirations and satisfy needs, and to change or cope with the environment. Health is a resource for everyday life, not the objective of living; it is a positive concept, emphasizing social and personal resources as well as physical capabilities (WHO 1984). (3) A state characterized by anatomical, physiological, and psychological integrity; an ability to perform personally valued family, work, and community roles; an ability to deal with physical, biological, and psychological stress; a feeling of well-being; and freedom from the risk of disease and untimely death (Stokes, Noren, and Shindell 1982). (4) A state of equilibrium between humans and the physical, biological, and social environment, compatible with full functional activity (Last 1997).

*Wellness:* Life satisfaction or gratification in living (Cowen 1991).

*Well-being:* Happiness and meaning and self-realization (Ryan and Deci 2001).

*Population health:* (1) A conceptual framework for thinking about why some populations are healthier than others, as well as the policy development, research agenda, and resource allocation that flow from it (Young 1998). (2) The health outcomes of a group of individuals, including the distribution of such outcomes within the group (Kindig and Stoddart 2003). (3) The health of a population as measured by health status indicators and as influenced by social, economic, and physical environments; personal health practices; individual capacity and coping skills; human biology; early childhood development; and health services (Dunn and Hayes 1999).

*Public health:* (1) Activities that a society undertakes to assure the conditions in which people can be healthy. These include organized community efforts to prevent, identify, and counter threats to the health of the public (Turnock 2004). (2) What we do as a society collectively to assure conditions in which people can be healthy (IOM 1988).

*Public health system:* Activities undertaken within the formal structure of government and the associated efforts of private and voluntary organizations and individuals (IOM 2002).

*Community health:* A perspective on public health that assumes community to be an essential determinant of health and the indispensable ingredient for effective public health practice. It takes into account the tangible and intangible characteristics of the community—its formal and informal networks and support systems, its norms and cultural nuances, and its institutions, politics, and belief systems (MAPP Glossary 2006).

## Population Health Outcomes

Next let us consider the terms and concepts for the box in figure 1 labeled “Health outcomes and distribution in a population,” because the ultimate purpose of population health policy is to improve the health of individuals and populations by investing in the determinants of health through policies and interventions that affect these determinants. Without careful attention to the outcomes we are trying to achieve, the determinants and policies could proceed without reference to the goal and become ends themselves instead of means to an end. Etches and colleagues provided a useful framework for considering indicators of population health measurement (Etches et al. 2006). Some conceptual frameworks for population health outcome measurement group outcomes and determinants components together, which can be confusing and misleading to both policymakers and researchers. The United Health Foundation has attempted to clarify this confusion by placing the nineteen components of its state health rankings (United Health Foundation 2005) into four categories, one of which is labeled “outcomes” (the others are “health policies,” “personal behaviors,” and “community environment”). Examples of outcomes are total mortality and limited activity days, and examples of determinants are smoking rates and adequacy of prenatal care. Even though the foundation still combines all four categories into

the ultimate ranking, the recognition that outcomes are different from determinants is important and welcomed.

This section distinguishes between the concepts of general population health outcomes and the different ways of measuring these outcomes. The idea of summary measures of population health is critical here because it highlights the importance of including both mortality and nonmortality components in a single outcome measure. While the data for the latter for different populations are still a challenge, we need to keep both conceptually in mind so that we do not lose sight of this important dimension because of data issues. The distinction between health outcomes and health status deserves clarification. The use of terminology is still evolving, but currently a *health state* or *health status* of an individual or population refers to health at a point or narrow period of time, usually measured as morbidity or some indicator of a health-related quality of life. When a measure of mortality or life expectancy is added to the measure, it produces a more expansive concept of population health outcome.

The last component covers terms dealing with health inequalities, since policymakers often frame outcomes as both increasing overall (population mean) health and reducing inequalities (population variance) across subpopulations. Whereas specific mortality reduction goals are often proposed for improvements in the mean, much less quantitative specificity is the norm for inequality goals. This is also important for policy purposes, since efforts to reduce the mean may be different from reducing inequality and, in fact, may be competing goals (Graham 2004). An important issue here is whether the most commonly used term, *disparity*, means just inequality or difference or whether it incorporates the ethical connotation of being unjust or unfair. While some have considered disparity as limited to inequality (Asada 2003), others have argued that disparity includes injustice and thus is more equivalent to inequity (Adler 2006; Braveman 2006). Similarly, it is important to identify which domains of inequality are being considered, for example, race/ethnicity, socioeconomic status or social class, geography, age, and gender.

We will wait to discuss reverse causality (when a determinant or risk factor can be an outcome; for example, morbidity can affect income or education) until determinants and risk factors have been covered.

Definitions for a number of these and other population health outcome terms follow:

### *General Population Health Outcome Terms*

*Outcomes:* All the possible results that may stem from exposure to a causal factor from preventive or therapeutic interventions; all identified changes in health status arising as a consequence of the handling of a health problem (Last 2001).

*Output:* The work done or amount produced by a person, machine, production line, or manufacturing plant especially over a period of time (Webster's 1980).

*Effect:* The result of a cause (Last 2001).

*Utility:* (1) A measure of happiness or satisfaction (Mankiw 2004).  
(2) A preference for, or desirability of, a particular outcome (Gold, Stevenson, and Fryback 2002).

*Welfare:* The state of being or doing well; the condition of health, happiness, and comfort (Webster's 1980).

### *Specific Population Health Outcome Measures*

*Mortality rate:* The number of deaths in a population within a prescribed time, expressed as either crude death rates or death rates specific to diseases and sometimes to age, sex, and other attributes (Turnock 2004).

*Morbidity:* Any departure, subjective or objective, from a state of physiological or psychological well-being. In this sense, *sickness*, *illness*, and *morbid condition* are similarly defined and synonymous (Last 2001).

*Disability:* Temporary or long-term reduction of a person's capacity to function in society (Last 2001).

*Health state/health status:* The health of an individual at any point in time (Gold, Stevenson, and Fryback 2002).

*Quality of life:* A broad construct reflecting a subjective or objective judgment concerning all aspects of an individual's existence, including health, economic, political, cultural, environmental, aesthetic, and spiritual aspects (Gold, Stevenson, and Fryback 2002).

*Health-related quality of life:* The impact of the health aspects of an individual's life on his or her quality of life or overall well-being (Gold et al. 1996).

*Summary measure of population health:* A measure of population health that allows the combined impact of death and morbidity to be considered simultaneously (Gold, Stevenson, and Fryback 2002).

*Quality-adjusted life year:* A measure of health outcome that assigns to each period of time a weight, ranging from 0 to 1, corresponding to the health-related quality of life during that period, in which a weight of 1 corresponds to optimal health and a weight of 0 corresponds to a health state judged equivalent to death; these are then aggregated across time periods (Gold et al. 1996).

### *Population Health Outcome Distribution Terms*

*Health inequality:* A generic term designating differences, variations, and disparities in the health of individuals and groups (Kawachi, Subramanian, and Almeida-Filho 2002).

*Disparity:* Inequality or difference, as in rank, amount, or quality (Adler 2006; Webster's 1980).

*Health inequity:* Those inequalities in health deemed to be unfair or to stem from some form of injustice. The dimensions of being avoidable or unnecessary have often been added to this concept (Kawachi, Subramanian, and Almeida-Filho 2002).

*Variance:* (1) Degree of change or difference (Webster's 1980). (2) A measure of the variation shown by a set of observations, defined by the sum of the squares of the deviation from the mean, divided by the number of degrees of freedom in the set of observations (Last 2001). Other measures are the range, skewness, or gini coefficient.

## Determinants of Population Health Outcomes

Even though Kindig and Stoddart believe that population health should be broadly defined as a health outcome concept, they also support the idea that a hallmark of the field of population health is attention to the multiple determinants of such health outcomes, however these outcomes are measured. These determinants include medical care, public health interventions, social environment (e.g., income, education, employment, social support, culture), physical environment (e.g., urban design, clean air and water), genetics, and individual behavior. In this section we look at terms and concepts relating to the box in figure 1 labeled "Patterns of health determinants over the life course." The figure shows that we

chose to use the term *determinant* rather than *risk factor* for this box. The definitions of these two terms are closely related, with *risk factor* having a strong tradition in epidemiology and *determinant* perhaps used more often in economics or sociology.

In recent population health writing, the term *determinant* appears more often, perhaps because of its use in the title of the influential book *Why Are Some People Healthy and Others Not? The Determinants of the Health of Populations* (Evans, Barer, and Marmour 1994). Although the formal definition of a risk factor includes a broad set of determinants, including environmental exposure (which could be interpreted to cover both the physical and social environments), risk factors have historically been commonly used in relation to behavior and lifestyle factors, which tend to focus on the individual rather than on population-level determinants or factors. In addition, it is not clear whether or not risk factors are causal, leaving Turnock to create the distinction of a “primary” risk factor being causal. Finally, the *Dictionary of Epidemiology* (Last 2001) introduces the idea of a “modifiable” risk factor as a “determinant” that can be modified by intervention; presumably this would exclude genetic determinants (before genetic engineering) as well as unmodifiable aspects of the physical environment.

For population health purposes, I prefer the use of the perhaps broader term *determinant*, which includes an established or hypothesized causal role. If risk factors are thought to be causal (Turnock’s “primary” risk factor), the two terms are probably synonymous. Risk factors that are not part of a causal chain have limited use in population health policy. In the following list of terms, I have accepted the categorization of determinants according to the Evans and Stoddart field model. Other categorizations are possible, of course, such as those for state health rankings (United Health Foundation 2005).

Is there a clear separation between outcomes and determinants or risk factors? Are there areas of overlap where a particular concept or measure can be both? In general, the separation seems clear and useful. The goal of population health policy is improving the level or distribution of certain outcome attributes, like mortality or health-related quality of life. It is important to keep in mind these outcome concepts and measures so that individual determinants or risk factors or specific policies (such as primary medical care or early childhood development or environmental programs) do not become ends in themselves instead of means to an end. Given our limited resources, the highest level of any individual

determinant or risk factor reduction may not be optimal, since a more balanced portfolio of investments (Kindig 1997; Kindig et al. 2003) may produce the greatest overall improvement or equitable distribution. However, the use of measures such as mortality or even many health-related quality of life measures is difficult, in that a long time is necessary to detect improvement or deterioration. These measures are therefore less useful for monitoring short-run changes in determinants or risk factors known or intended to improve such outcomes. Smoking rates, level of education, and air quality are examples of measures whose connection to ultimate outcomes is almost certain and therefore could be regarded as reasonable outcomes or outcome “proxies” themselves.

The problem with classifying such measures as outcomes in themselves is that they are not the ultimate outcome that population health improvement is seeking, and it is easy to slip into thinking and acting as though they are; that is, the means can easily become the end. Such a conclusion can be magnified in this era of interest groups, advocates, and silo bureaucracies, which make it hard to see beyond the risk factor or policy being advanced. As indicated earlier, such advocacy can lead to an environment in which the highest level of achievement for any given determinant is the guiding principle (zero smoking rates, no environmental exposure, or the best quality of medical care). This mind-set often may compete with a perspective that strives for the optimal balance of achievement across determinant categories or investments given limited resources.

The idea of a third category like “intermediate outcomes” may be appealing to some academics and policymakers. It would be applied to those determinants or risk factors, like smoking rates or primary medical care, that are certain (or almost certain) to improve broad outcomes significantly over time and are more useful for guiding policy in the short run. This is similar to the distinction proposed by Last between distal and proximal determinants: *distal determinants* are those remote enough from the outcome of interest to make it difficult to “discern or trace the causal pathway,” and *proximal determinants* are close enough in time or distance to “allow confident assertion of the linkage between the determinant and the outcome” (Last 2001 50, 51). While this has some appeal, it requires the additional step of establishing which determinants or risk factors would be considered proximal. This in turn means establishing criteria for how strong the causal evidence for each determinant or risk factor must be, which were proximal determinants

or intermediate outcomes, and which were other more distal determinants or risk factors that are hypothesized to be a part of the causal chain but for which the evidence is less certain. At the present time I am not aware of a proposal for such criteria, but if they could be established, they would help policymakers monitor population health and set investment priorities. Of course, the additional consideration of the relative cost-effectiveness of each determinant or risk factor adds another level of complexity to such a categorization scheme.

Definitions for a number of these and other population health determinant terms follow:

### *General Determinant Terms*

*Determinant*: (1) Any factor, whether event, characteristic, or other definable entity, that brings about change in a health condition or other defined characteristic (Last 2001). (2) A primary risk factor (causative factor) associated with the level of the health problem, that is, the level of determinant influences the level of the health problem (Turnock 2004).

*Cause*: Anything producing an effect or result (Webster's 1980) (also see *Causality* on page 156).

*Factor* (or *determinant*): (1) An event, characteristic, or other definable entity that brings about a change in a health condition or other defined outcome; a causal role may be implied (Last 2001).

*Risk factor*: An aspect of personal behavior or lifestyle, an environmental exposure, or an inborn or inherited characteristic that, on the basis of epidemiologic evidence, is known to be associated with health-related condition(s) considered important to prevent. The term *risk factor* is rather loosely used, with any of the following meanings: (1) An attribute or exposure that is associated with an increased probability of a specific outcome, not necessarily a causal factor. (2) An attribute or exposure that increases the probability of disease or other specified outcome, a determinant. (3) A determinant that can be modified by intervention, thereby reducing the probability of disease or other specified outcomes. To avoid confusion, it may be referred to as a *modifiable risk factor* (Last 2001).

*Input*: The amount of money, material, or effort put into a project or process; an investment (Webster's 1980).

### *Categories of Determinants*

The following categories of specific determinants follow the general field model of Evans and Stoddart (Evans, Barer, and Marmour 1994), but because the model offers no precise definitions, I have supplied them myself.

*Social determinant:* A proposed or established causal factor in the social environment that affects health outcomes (e.g., income, education, occupation, class, social support).

*Physical environmental determinant:* A proposed or established causal factor in the natural and built environment that affects health outcomes (e.g., air and water quality, lead exposure, the design of neighborhoods).

*Health care determinant:* A proposed or established causal factor in health care that affects health outcomes (e.g., access, quantity, and quality of health care services).

*Genetic determinant:* A proposed or established causal factor from the genetic composition of individuals or populations that affects health outcomes.

*Behavioral determinant:* A proposed or established causal factor based on individual personal choices of lifestyle or habits (either spontaneously or in response to incentives), such as diet, exercise, and substance abuse.

*Biological determinant:* Often, a biological mediator variable between a determinant and an outcome, such as the role of endocrine and immunologic processes in stress. In any case, all determinants must have biological mediator variables in order to affect the organism to produce the health outcomes.

### Policies and Interventions

The third concept in the population health framework is labeled “Policies and interventions at the individual and social levels,” indicating the mechanisms through which determinants can be altered (increased, improved, better balanced) to increase the outcomes and their distribution.

Both “policy” and “policymakers” are often narrowly conceptualized as the legislative output (policy) of the work of elected officials (policymakers), but a much wider range of decisions and decision makers affect

population health as well. Therefore, to define population health and public health, we must conceptualize policy more broadly to include codified decisions made in many governmental and nongovernmental settings. Just as policymakers, in the words of Dan Fox, are “people who run for office, meet payrolls, and treat patients” (Fox 1995, viii), *policy* refers to decisions made by different branches and levels of government (e.g., state court decisions, federal agency regulations, local office implementation processes), as well as the decisions about service delivery and program changes made by business and advocacy leaders. In addition, different policies are enacted or take effect at different geographic levels and for different determinant categories. For example, Medicare policy is federal; Medicaid is both federal and state; education is primarily local; and environmental policies are federal, state, and local.

Definitions for a number of these and other policy and intervention terms follow:

*Policy:* A guide to action to change what would otherwise occur, a decision about the amounts and allocation of resources; the overall amount is a statement of commitment to a certain area of concern; the distribution of the amount shows the priorities of decision makers. Policy sets priorities, and guides resource allocation (Milio 2001).

*Political strategy:* A plan to improve the chances of adopting and implementing a policy. It requires identifying and targeting policymakers, organizations, the media, and populations; using persuasive rationales for each audience; creating public debate to help “unfreeze” previously held opinions; using new and old methods of communication, persuasion, and mobilization; revising tactics as needed (Milio 2001).

*Intervention:* To come between as an influencing force (Webster’s 1980); a generic term used in public health to describe a policy or program designed to have an impact on a health problem. *Intervention* is essentially identical to *program*, a plan or procedure for dealing with some matter (Webster’s 1980).

*Policymakers:* Public or private leaders who make or influence the formation or implementation of policy decisions; those who run for office, meet payrolls, and care for patients (Fox 1995).

*Knowledge transfer:* The exchange, synthesis, and ethically sound application of knowledge within complex systems of relationships among researchers and users (CIHR 2004).

## Establishing Causal Relationships among Interventions, Determinants, and Population Health Outcomes

This section deals with some of the terms relating to the processes represented by the arrows in the figure, that is, the relationships among outcomes, determinants, and policies/interventions. Most of these are statistical concepts, of which only the most basic are defined here.

The ideal result of population health research is establishing clear and definitive causal relationships between broad determinant categories or specific programs and policies that predict with relative certainty their short- and long-term impacts on a variety of population health outcomes of interest. Most of our understanding of cause and effect comes from the biological or physical sciences, which, under fairly strict laboratory conditions, can obtain a relatively good claim for a precise relationship.

Much of the work in population health, however, is in the social sciences of sociology, economics, demography, public health, anthropology, and epidemiology, in which establishing causal relationships is very challenging and definitive conclusions require sophisticated methods and extreme care. Many of the reported data showing variables with a statistical association or correlation do not establish a causal relationship, and such associations from data sets recording a single point in time or comparing geographic entities can often be misleading. In the social sciences, which usually do not use controlled experimental methods, causality may be assessed by some of the following considerations: consistent results are obtained when the studies are replicated, the strength of the association, the precision or specificity with which one variable predicts another, the relationship between dose and response, the cause preceding the effect, biological plausibility, and the coherence with theory and with biological plausibility (Hill 1965; Susser 1991). In his useful "Glossary: Causality in Public Health Science," Susser states:

Some philosophers and epidemiologists drawing largely on experimental sciences require that causes be limited to well specified and active agents producing change. As by definition public health sciences entail an obligation to population health, among causes they must needs [*sic*] include contextual factors such as the more or less steady state conditions of sex or social position or climate or location,

which can seldom be structured experimentally to produce change. (Susser 2001, 376)

The complexity of establishing these relationships in population health led Stoddart (1995) to call models like figure 1 here or the Evans and Stoddart field model (Evans, Barer, and Marmour 1994) a “fantasy equation,” meaning that “at present we but vaguely understand the relative magnitude of the coefficients on the independent variables that would inform specific policies rather than broad directions, even if we are beginning to see the variables themselves more clearly” (Stoddart 1995, 7). But of course these relationships do exist, waiting to be discovered. Policymakers seldom require firm causal relationships for the decisions they make in the public or private sector, so the job of population health research is to get as close to causal understanding as is possible to guide their political or managerial efforts.

A final issue is reverse causality, which is why the arrow in figure 1 also goes from right to left. There exist some causal relationships in which what we have previously called an outcome (e.g., morbidity) can produce a change in a determinant or risk factor, such as a childhood illness being responsible for lower educational attainment. In this case, the definitions are reversed, depending on the direction of the proposed causal relationship. Here, morbidity would be the determinant, and educational attainment, the outcome. Separating the different directions of causality is an important and difficult research challenge.

Definitions for a number of these and other establishing causal relationship terms follow:

*Association (or correlation):* A statistical dependence between two or more events, characteristics, or other variables. The presence of an association does not necessarily imply a causal relationship (Last 2001). Last also defines *correlation* as the degree to which variables change together (2001).

*Causality:* The relationship of causes to the effects they produce (Last 2001).

*Dependent variable:* A variable whose value is dependent on the effect of other variable(s) (independent variable[s]) in the relationship under study (Last 2001).

*Independent (or predictor) variable:* The characteristic being observed or measured that is hypothesized to influence an event or manifestation

(the dependent variable) in the defined area of relationship under study (Last 2001).

*Regression analysis:* Regression analysis involves finding the best mathematical model to describe a dependent variable as a function of the independent variables or to predict the dependent variable from the independent variables (Last 2001).

## Balancing Investments: The Health Production Function

In the discussion of determinants, I observed that if establishing the effectiveness of any determinant or intervention is difficult, establishing the causal impact on population health outcomes per unit of resources expended is even more so. If resources were not limited, investment choices would not have to be made. But since they almost always are, policymakers need tools to be able to judge the relative cost-effectiveness of competing policies and programs across the multiple determinants. In the last several decades, the tools of cost-benefit and cost-effectiveness have been employed by economists to begin to develop, primarily in medical care, “league tables” that assess the relative cost-effectiveness of different programs or procedures. While there is no arbitrary level of optimal dollar investment per quality-adjusted life year saved, the relative ranking allows comparisons of high- and low-value interventions. Many of these assessments have been made in medical care, in which outcomes and costs are more easily measured, but such cost-effectiveness analysis needs to be extended to other determinants as well.

It has been said that it is important to define population health in the context of the increasingly accepted framework of the *health production function*, which is the econometric method whereby the independent contribution, or marginal product, of each proposed causal factor or determinant can be made. While policymakers usually make investment decisions one by one, increasingly they will be called on to demonstrate relative cost-effectiveness across competing interventions. I have included here the terms from health economics because I believe that a policy-relevant comparative economic analysis of the multiple determinants of health will be the most important task of population health research in the coming decades (Kindig et al. 2003).

Definitions for a number of these balancing investment terms follow:

*Health production function:* The relationship between the quantity of inputs used to make a good (health) and the quantity of output of that good (health) (Mankiw 2004).

*Marginal product:* The increase in output that arises from an additional unit of input (Mankiw 2004).

*Diminishing marginal product:* The parallel decline of the marginal product of an input with the increase in its quantity (Mankiw 2004).

*Opportunity cost:* The value of time or any other input in its most valuable use; the benefits lost because the next best alternative was not selected (Gold et al. 1996).

*Cost-benefit analysis:* A tool for estimating the net social benefit of a program or intervention as the incremental benefit of the program less the incremental cost, with all benefits and costs measured in dollars (Gold et al. 1996).

*Cost-effectiveness analysis:* An analytic tool in which the costs and effects of at least one alternative are calculated and presented as in a ratio of incremental cost to incremental effect. Effects are health outcomes, such as cases of disease prevented, years of life gained, or quality-adjusted life years, rather than monetary measures, as in cost-benefit analysis (Gold et al. 1996).

## Conclusion

I think that the overriding population health question is, What is the optimal balance of investments (e.g., dollars, time, policies) in the multiple determinants of health (e.g., behavior, environment, socioeconomic status, medical care, genetics) over the life course that will maximize overall health outcomes and minimize health inequities at the population level? This is a significant challenge that will require decades of attention by scholars and policymakers. It is possible that this “forest” can be lost among the “trees” of important but narrow research questions and policies advocated by different interest groups. I believe that thinking and communicating clearly about population health concepts are essential for public and private policymakers to address this question fully and to improve the overall population health and reduce disparities. My hope is that this article will contribute to better understanding, which in turn will help achieve this goal.

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