Social Ecology of Health

TOWARD AN ECOSOCIAL VIEW OF HEALTH

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The changing patterns of health in the United States justify both celebration and dismay. We can celebrate declining mortality rates, increased life expectancy, and improvements in diagnostic and therapeutic technologies. But public health was caught by surprise by the return of infectious disease; the gap in health outcomes between rich and poor and between whites and blacks increases; there is a growing discrepancy between what is technically possible and the actual health status; and despite its greater expenditures on health, the United States lags behind the other developed countries in health outcomes. The authors examine four reasons for this: we do not buy more health care, only pay more for it; we receive more health care, but much of it inappropriate, ineffective, or harmful; only some of us get more health care; and we have created a way of life that makes us sick, then spend more to repair the damage. Major failures arise when problems are understood too narrowly. An ecosocial perspective attempts to look at the whole. It rejects as false the dichotomies social/biological, physical/psychological, genetic/environmental, lifestyle/environment, examining their interrelations rather than assigning them relative weights. In addition to looking at average differences among populations, the authors examine patterns of variability in health outcomes.

An examination of the changing health patterns in this century justifies both celebration and dismay. We can celebrate the increase in life expectancy at birth, the disappearance of smallpox, and the decline of other diseases. We can marvel at technical advances such as the development of reliable heart surgery, molecular methods for diagnosis, sophisticated electronic imaging. But we also have to recognize that diseases we thought were on their way out have returned with a vengeance (tuberculosis, cholera, malaria), that apparently new diseases have arisen (AIDS, Legionnaires' disease, ebola, hepatitis C, cryptosporidiosis, *E. coli* 0157, Lassa fever, hanta virus), while microorganisms have shown remarkable

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flexibility in thwarting our therapies. Agricultural productivity has risen greatly, but without eliminating hunger. The gap between rich and poor in life expectancy and morbidity has remained robust for more than a century despite changes in the details of class structure and substitutions of specific causes of death.

When we examine the pattern of success and failure, it seems as if the successes occur in the solution of narrow, highly specific problems (smallpox) amenable to molecular and technical solutions, while the dramatic failures (wide disparities in health) appear at the level of whole systems, where factors that were not taken into account can overwhelm the expected results deduced from simple logic.

Solutions designed to solve isolated problems can exacerbate or give rise to new ones. Pesticides can increase pest problems and poison people, antibiotics give rise to new pathogens, hospitals are a focus of infection, agricultural development can lead to hunger, and flood control may make us more vulnerable to floods. Therefore a public health community better prepared for surprise has to include the perspectives of evolution, biogeography, and ecology as well as social science, and deal not only with current problems but also with those that might arise.

FOUR HYPOTHESES

The U.S. paradox is that although we spend more on health care than any other country we rank in the lowest quartile among the 25 industrialized countries for infant mortality, life expectancy, and other health indicators. We offer four hypotheses for this dismal datum:

1. *We do not get more health care, it only costs more* (Figures 1 and 2).
2. *We do get more health care, but a significant fraction of it is inappropriate, ineffective, or even harmful.*
   - 120,000 deaths per year are caused by medical error (including iatrogenic disease, nosocomial infection, and unnecessary medical intervention).
   - 80 percent of cases referred for second opinion on cardiac bypass do not need the surgery.
3. *Only some of us get more health care.* Inequalities along class, race, and geographic lines in access to health care result in neglect of many and overtreatment of the few.
   - Black women are 35 percent less likely than white women to receive a mammogram.
   - White seniors are 2.5 times more likely to receive bypass surgery and 2.2 times more likely to receive angioplasty than black seniors.
   - The uninsured poor are twice as likely as those with private insurance to report a delay of hospital care. Among those whose care is delayed, hospital stays are longer and death rates higher (1).
4. *Our way of life makes us sick, and then we invest more in repairing the damage.*

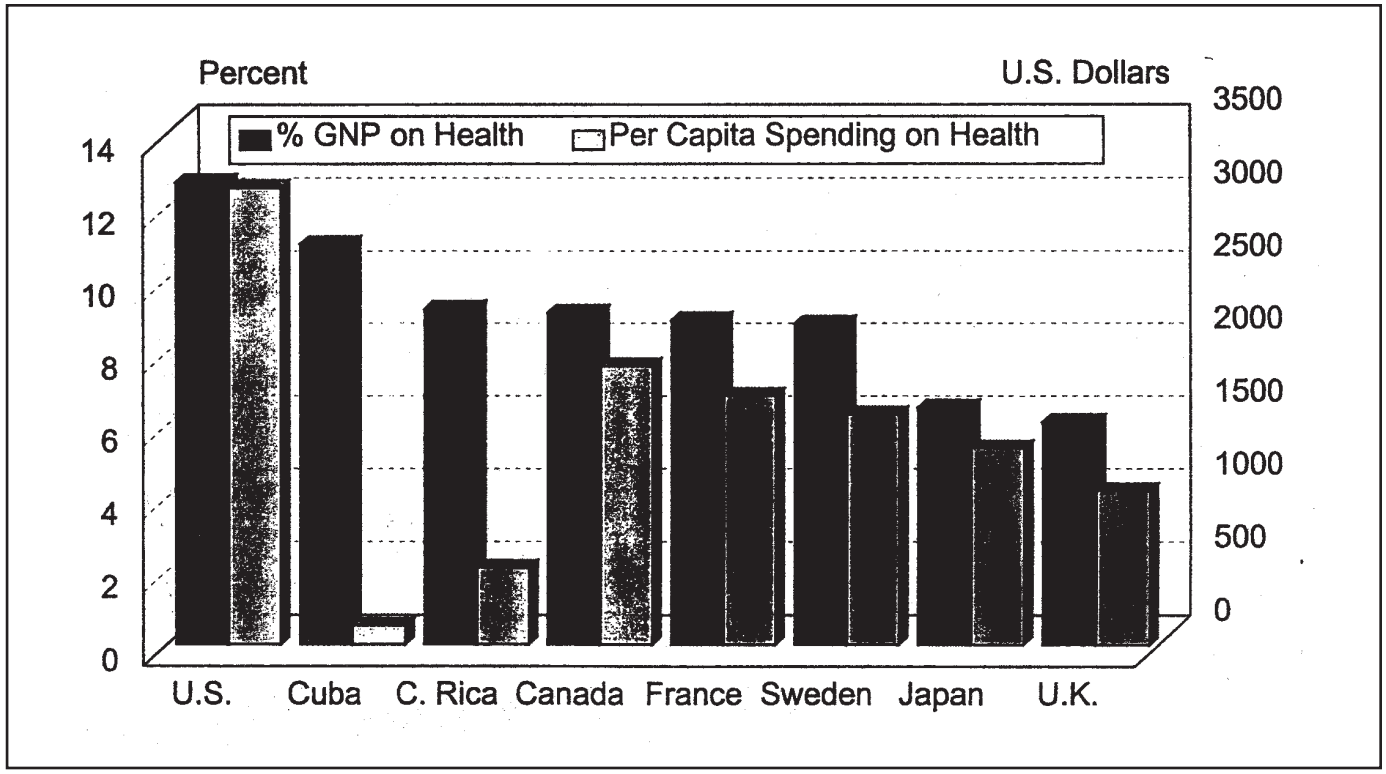

Figure 1. Spending on health care in various countries: of all nations, the United States spends the most. Data from the United Nations and national ministries.

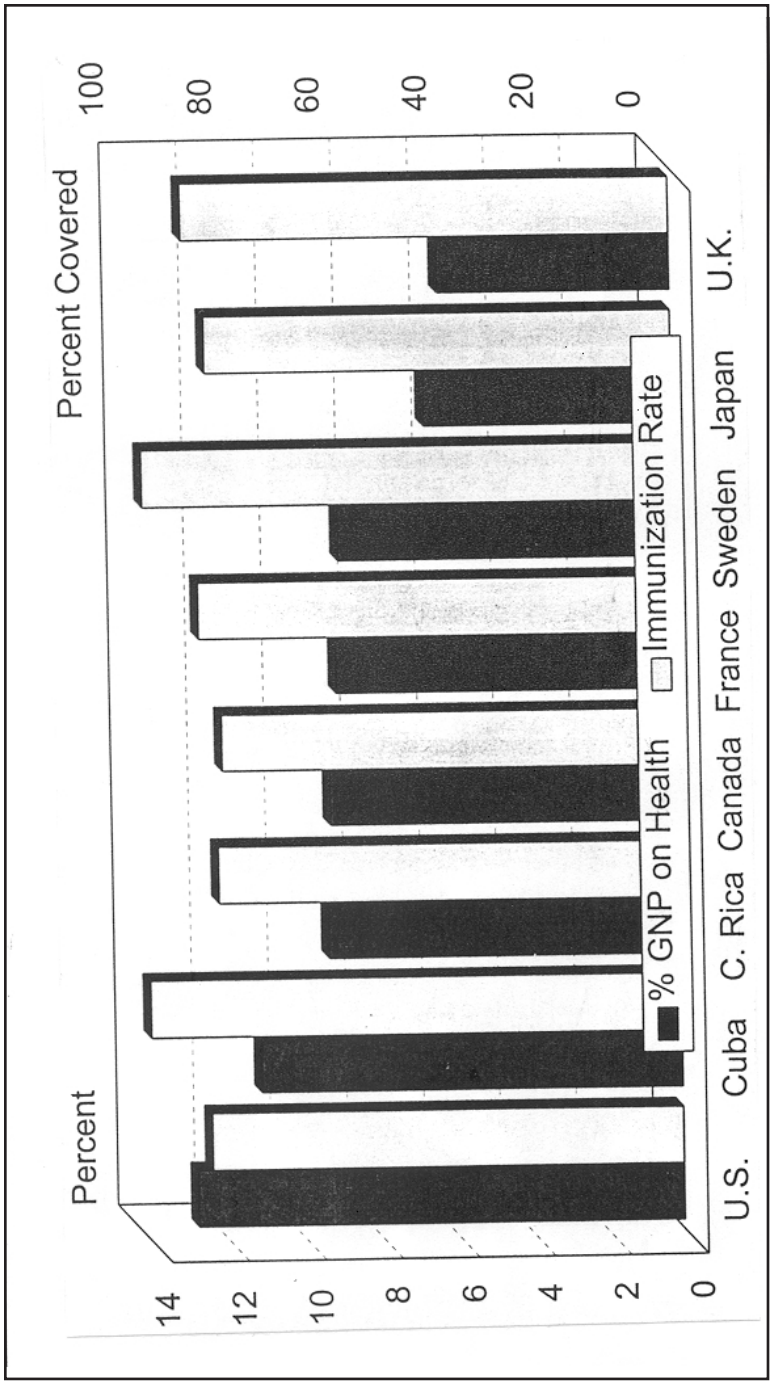

Figure 2. Spending on health care compared with immunization rate: the United States does not get better coverage for the extra paid for health care. Data from the United Nations and national ministries.

Our research program examines each of these not mutually exclusive hypotheses, but with emphasis on the last because the others are more familiar.

It is at the level of complex interactions that our science has been least successful. Fragmentation of knowledge prevents us from seeing the whole, and methodologies encourage explanations within the confines of single disciplines, assigning relative weights to "factors" rather than elucidating their interactions.

Several important movements and intellectual currents have arisen that together offer a more holistic view of the complexities of health at the population level. They include: Ecosystem Health, Environmental Justice, Social Determination, and Health Care for All. Each of these four currents is on the cutting edge of a breakaway from the classical microbiological or single-factor epidemiology that has proven so vulnerable to surprises.

Ecosystem Health sees the human species as one among many in an environment that is changing as a result of human activity: land use patterns, climate change, population growth, resource depletion, pollution, urbanization, loss of biodiversity, and other local and global processes all disrupt the natural self-regulation of the biosphere. These changes harm people, domestic animals, wildlife, the oceans, and the forests. The crucial response has to be to redesign our relations with the rest of nature.

Environmental Justice points out that "we" are not undifferentiated "we." Polluters pour thousands of kinds of historically new organic compounds into our rivers, clear cut our forests, dirty our skies, and protect these activities from criticism. Environmental destruction, internationally and domestically within countries, often imposes health burdens unevenly, as the environmental justice movement points out: with greater exposure at home and at work, the less well-off suffer higher disease rates as a consequence. The priorities have to be: stop spoiling the environment, minimize the trade-offs between economic development and toxicity, and eliminate the differential exposure of population subgroups to environmental hazards.

The Social Determination Movement studies the inequality of health within a nation or among nations. It sees steep gradients of education, income, and social position as adversely affecting the health of a population, not only at the bottom but throughout the entire range of the social structure, from the bottom throughout the middle and into the upper, even of people who are far removed from the abject poverty of Calcutta. This field holds that inequality per se rather than absolute privation in developed economies undermines the capacity of people to resist disease. The psychological concomitants of steep social positioning are emphasized both at the individual (self-esteem, hopefulness) and collective (community efficacy, social capital) levels (3, 4).

The Health Care for All Movement focuses on the inequality of access to health care as a major deterrent to health improvement. This movement advocates universal access to health care as a basic right of membership in the human species. It evaluates the quality of health care only insofar as it is unequal and

therefore does not touch on fundamental questions of the generation of health and disease.

Each of these four intellectual currents opens up areas that have been ignored by traditional epidemiology. Each is supported by both theory and observation. And each, in emphasizing the importance of ignored phenomena in its field, tends to ignore the advantages of including perspectives from other fields.

But these four currents should not be intellectual competitors. When we move from a model that assigns relative weights to isolable influences ("factors" or "independent variables") to a model of whole-system determination, we can see the absolute importance of each of them because:

- All theory is wrong that limits concern to just our species and pushes the rest of nature into the background.
- All theory is flawed that sees our species as an undifferentiated whole and ignores injustice that we inflict upon each other.
- All theory is too narrow that looks only at the individual confronting an "environment" and fails to see that individual as a unique "particle" formed in an ecosocial field.
- All theory is wrong that separates mind from body, that sees the psychological impact of social location but dismisses the intricate, criss-crossing pathways by which a hierarchical society creates adverse health outcomes and undermines people's capacity to prevent or ameliorate them.
- All methodology is wrong that pits quantitative against qualitative methods or looks only at undirectional causation from "independent" to "dependent" variables without taking into account the feedbacks between them.
- Finally, all policy derived from theory is hopelessly biased if "policy" is seen as the allocation of resources and the drafting of regulations by those who control the resources and make the regulations; if real conflict of interest is denied and the boundary conditions within which policy is formed are simply accepted as "life"; and if researchers are not at the disposal of all affected parties.

Our task, then, is to integrate the insights of these most perceptive efforts and to confront health, society, and habitat as a whole, in their full complexity.

THE PRODUCTION OF KNOWLEDGE ABOUT HEALTH

Gaining an understanding of the health of even a single region is a daunting task. We have adopted an approach to health in Kansas that depends on the convergence of three sources of knowledge: theoretical, data-driven, and experiential. Our strategy is to integrate these three sources of knowledge and understanding, each with its particular insights, gaps, and biases. A starting point is to recognize the strengths and weaknesses of each.

1. *A general theoretical framework.* We apply to public health problems the theoretical perspectives from ecology, geography, systems theory, philosophy of science, policy studies, and various social sciences. Our emphasis is on wholeness and process in complexly connected networks of causes that cross the boundaries of disciplines. This demands a critical stance toward the familiar dichotomies—such as social/biological, environment/lifestyle, physical/ psychological, individual responsibility/social determination of health—that have fragmented our discipline and pitted half-truths against half-truths. We are actively interested in a number of policy questions that lie outside the normal domain of public health, in fields such as environmental protection and agriculture.

We also use a comparative approach. If Kansas comparisons are made to fairly similar places such as neighboring states, it is easier to explain any observed differences against a background of shared conditions. When we compare very different places, the explanation for observed differences may be less accessible. But by showing that patterns that hold in one place are not necessarily universal, the comparisons broaden the range of possible alternatives. When very different conditions show similar patterns we are identifying robust properties of human health. We try to work with both kinds of comparisons, selected in part for degrees of difference and similarity, and partly through chance access to information.[1]

2. *Kansas public and private health research and data.* A great wealth of data has been collected by a number of Kansas agencies at the statewide and county level, which provide the core material for our analysis.

3. *Interviews with Kansans outside the formal public health system who have special insights into a particular kind of phenomenon or local conditions.* Here we have made use of informal contacts through our associates, the children of one of us, friends of friends, and people we meet after we lecture on various topics around the state. They help us interpret anomalies in the data, call our attention to very local situations that do not affect county-level data, and provide historical background.

The approach to knowledge production outlined above is supported by past experience and also reflects two theoretical commitments on our part: the need for a self-reflective looking at our own scientific practice as a social process, and the democratic commitment that makes research a community effort combining professional and nonprofessional inputs.

[1] In the full study we are using comparisons with selected Canadian provinces, Mexican and Brazilian states, Israeli health districts, and Cuban provinces. At the time of this writing, only the Cuban data were available.

WHOLENESS: A WHOLE-SYSTEM APPROACH

Hegel warned that the truth is the whole (5). Of course we cannot really see "The Whole." But we can recognize the following.

1. *A problem has to be posed big enough to accommodate an answer.* In an atomic world, the laws of conservation of matter and conservation of energy are too small and have to be united in the larger conservation of matter/energy. If we fail to define the problem big enough, then many important impacts on a variable come from outside the domain of the problem and are treated as "random" or "error." When we control away the heterogeneity of social life in order to plot levels of cholesterol against rates of heart disease, we have lost most of the determinations and are left with a statistically significant but weak explanation. Contrary to common sense, big problems are often more soluble than small ones.

2. *The relevant systems are bigger and more complex than our tradition acknowledges.* In order to understand the upsurge in infectious disease we cannot limit ourselves to diseases of humans. Similar patterns of resurgent and emerging diseases can be seen in wild and domestic animals and in crop plants. When we include them, we can begin to see parasitism as a universal phenomenon of evolutionary ecology and can pose questions such as, How wide a host range do diseases have? Do they mostly affect similar hosts? When do pathogens extend their host range? Are diseases with many hosts more or less severe than those with few hosts? How do nutrition and environmental stress affect vulnerability to disease? Most infections fail to take, so what makes some successful?

3. *There will always be an "outside."* After we have expanded our model to include much more than was formerly included, there is still an outside impinging on the system and capable of overwhelming the processes on which we have chosen to focus.

The systems are bigger than we expected in another sense: the objects of analysis are not individuals but populations. Concepts such as vulnerability or health apply also to population subgroups such as classes, occupations, communities, genders, races, and ethnic groups. Health is generated in households, neighborhoods, workplaces, communities, nations, and the whole world. Individuals are imbedded in several kinds of larger units, each with its own unique impact on health. Within the same community, people may breathe the same air and drink the same water but experience different environments at work or school and while going to and from work or school; may walk the same pot-holed streets and swelter in the same heatwaves, but some have and others lack air conditioning; may fear the same dangers but have different histories of knowledge about facing them. They may be immersed in different cultural and

dietary and religious worlds, and may be represented quite differently by the same elected representatives.

From the perspective of an organized community, the people are simply who they are, the givens to be taken into account in any effort at change. From the perspective of individuals, their overlapping communities (home, neighborhood, workplace, town) are the givens within which life unfolds and health is created and undermined. When we study the community, we see a collection of individuals and treat their uniqueness statistically to identify community characteristics or structurally to understand and influence community processes of change. When we work with individuals, we have to see each one as a special point of intersection of many current and past influences. Units at different levels determine each other mutually, and a reliable theory cannot reduce one to the other or rank them in a hierarchy of relative fundamentalness. After emphasizing the unique properties of each community, we then have to recognize their connectedness. Although each subpopulation has its unique health problems, these cannot be contained just within its boundaries, but spill over to other populations and become problems of the whole society (6).

Therefore, programs aimed at helping individuals to escape from their communities while leaving the impoverishment intact do not really address the problem: if every person earned a Ph.D. we would hear great seminars at the soup kitchens unless homelessness was also addressed. In the long run our "patient" is the species, suffering from an ecosocial distress syndrome that links the daunting problems of resource depletion, resurgent disease, pollution, inequality, oppression, climate change, and alienation.

Once we argue the need for a more inclusive, complex frame of reference for the study of health, we have to confront an awesome, daunting complexity that can overwhelm us. How is it possible to face such complexity?

We claim that the study of complexity is not so much difficult as unfamiliar, and that the task of theoretical work is to make obvious what is initially obscure. This has happened in the past. For example, while medieval monks could add, subtract, and even multiply, division remained a mystery that required specialists. The simple shift from Roman to Arabic numbers made division accessible to all literate people. Now we have to shift from the reductionist notion that to understand the world it is sufficient to study its smallest pieces. Instead, we must adopt a holistic dynamic approach informed by philosophy and systems theory that can reeducate our intuitions until such notions as feedback, interpenetration, sinks and sources, connectivity, bifurcations and phase transitions, self-damping and system memory become as familiar to us as the independent variable, correlation coefficient, or regression line. Below are three principles for taking a more complex whole-system view of health problems.

1. *Challenge the false dichotomies that plague science.* Replace these by the principles that human biology is a socialized biology, that we can choose to

change our environments, but recognize that all our choices are constrained choices; that our beliefs and feelings affect our immune, detoxification, and endocrine systems, while the state of our bodies affects our thinking and feeling; and that genes may influence how we relate to our environments, while society can determine which environments we face, and these environments can then determine which genetic differences are trivial and which are significant. A particularly important dichotomy is that between individual responsibility and social determination of health.

Separately false, jointly true: Consider the two propositions (*a*) we are each responsible for our own health, and (*b*) health is socially determined. Both are claims about reality, and about the causes of disease. Both are also normative: each person should take responsibility for her or his own health, or our society should take collective responsibility for the health of all of us. Each proposition is separately false, but together they are jointly true.

When stated by policymakers, the first proposition blames the sick (or their parents) for being sick and justifies the denial of public resources for health improvement. The second, accepting social responsibility, would propose actions to improve health care, make it more available, or reduce environmental insults to our health such as pollution, but it leaves the individual out of the equation or as a passive onlooker.

When the sick (or the potentially sick) receive these propositions, the impact depends upon these people's power to act. If someone is without the resources, knowledge, skill, and energy to act, the first proposition leads to guilt and makes health problems worse. The second proposition also leads to helplessness: "this world is making me sick and I can't help it no matter what I do."

But when stated by someone able to act, the first proposition can be interpreted to mean "I have been harmed, but I won't let it defeat me." The individual can become better informed, make decisions about lifestyle within the limits of his or her social location, and demand the necessary care. The second proposition would lead to collective action such as identification and publication of pollution sources, demands for health insurance or free care, or introduction of health-protective measures into collective agreements. In the long run, individual action can achieve significant but still limited results, while action at the community level may reduce future damage but perhaps not help the actors themselves very much.

Therefore, taken separately each proposition is false and harmful, but taken together they are true and can be empowering.

2. *Respect the spontaneous activity of nature.* Organisms—and infectious agents are organisms—evolve in response to their own circumstances and to our attempts to control them. Pathogens are always navigating among opposing demands of natural selection for a good meal, protection from the body's defenses, and an exit to new hospitable hosts. They change when they encounter

the new environments we create for them or when our therapies make drug resistance an overwhelming survival requirement.

Species are always probing the boundaries of their ecological niches and geographic extensions, and invading new territories when opportunities permit. We sometimes create the opportunities. *Legionella* is a bacterium found all over the world, but rarely and in small numbers. These bacteria are poor competitors and have finicky nutritional requirements, but they do tolerate higher temperatures than most bacteria and can resist chlorine. Therefore, when we remove the natural enemies of the *Legionella* bacteria by our usually effective purification techniques, they will thrive in the heated and chlorinated water pipes of hotels and conference centers. Lately several cases of Legionnaires' disease have occurred among truck drivers who have used the showers at truck-stops on the interstate highways.

If climate fluctuations increase natural production of mouse food, or if we clear the natural vegetation to plant grain while the harvest is left in the field or barn when prices are too low, and if we kill the predators of mice—the coyotes, snakes, and owls—mouse populations will explode on the newly available food and, according to the location, offer us hanta virus or plague. These diseases are current threats in the southwestern United States. In other countries current threats include Venezuelan hemorrhagic fever, Bolivian hemorrhagic fever, and other novelties.

If malaria spreads in the United States it will be a result not so much of invasion by exotic mosquitoes as of economic hardship that forces people to sleep outdoors without protection from mosquitoes. If global temperature continues to rise we can expect heat waves. Those who lack access to air conditioning and who are elderly or already sick will be most vulnerable to heat death. If *Salmonella* or *Cryptosporidium* contaminate our food or water, it will be because technical changes in industry have not been matched by corresponding changes in our surveillance and regulation, or because we fail to know that all systems, no matter how up-to-date, break down sometimes.

It may seem too much to ask that we put effort into studying diseases that have not happened yet when there is enough to do with present health problems, but unless we prepare for change and uncertainty we will face many unpleasant surprises.

A seeming detour is needed here to examine how other organisms confront uncertain environments. There are really only four modalities available: detection and response, long- and short-range prediction, tolerance of a broad range of conditions, and prevention.

Of course these are not mutually exclusive modalities and must be combined. Even after we have done our best guessing what might happen and have made our best preparations, we have to accept that the world still can surprise us, and we always have to ask the questions, "but what if we're wrong?" Here is where we need to combine the most promising approaches selected by scientific consensus

with some proportion of unpopular ideas that may seem way out, just in case these ideas prove correct (7).

3. *Respect the systemic nature of health-related phenomena.* The variables that affect our health are linked in reciprocal feedback loops rather than by one-way causal chains separating independent from dependent variables. The causal pathways cross disciplinary boundaries and loop back and forth in positive and negative feedbacks (Figure 3).

Negative feedback loops can be protective: an outbreak of a disease can lead to immunization programs that reduce that disease. An uncomfortably high temperature can increase sweating or the use of air conditioning, in either case reducing the discomfort. An infection may call forth the macrophages and other anti-infection responses. But negative feedback can also thwart interventions. Antibiotics result in drug resistance. Pesticides lead to pesticide resistance. Increased policing can lead to increased alienation. Food distribution may lower the price of food to the point where farmers stop producing food. Too much health-promoting exhortation can provoke boredom, resentment, disconnection, and reduced effectiveness of health promotion.

Negative feedbacks may lead to either positive or negative correlations among the variables that are linked, depending on whether outside influences spread along the positive or negative branch of the loop. Since they may spread along both pathways, this can give rise to inconsistency across epidemiological studies. Carcinogens in the blood can lead to tumors, generating a positive correlation between these two variables. But tumors have a higher affinity for carcinogens, removing them from the blood and generating a negative correlation. Doctors treat disease, creating a negative correlation between medical service and disease prevalence. But high disease rates among insured populations attract doctors, creating a positive correlation.

Positive feedbacks reinforce any initial deviation of a variable. If a child is held back from her or his studies by the sequelae of poverty, that child may be labeled a poor learner and tracked toward dead-end occupations and more poverty; a child in an enriched program will be offered more opportunity. A youngster's first foray into petty crime may be greeted by rejection in the home, expulsion from school, and harassment by the police, but may be praised and supported by gang brothers and guided toward further crime in the subculture that is welcoming. Thus positive feedbacks can create the illusion of irreversible determination at an early age (Figure 3).

When multiple causes affect health, the same variable may produce opposite effects by different pathways that may cancel each other. For example, crowding is harmful to us because of increased contagion, but multi-generational households, particularly in immigrant or marginalized populations, provide support. This paradox can cause us to underestimate the negative effects of crowding and isolation, and the positive effects of family support. Our task then is not to

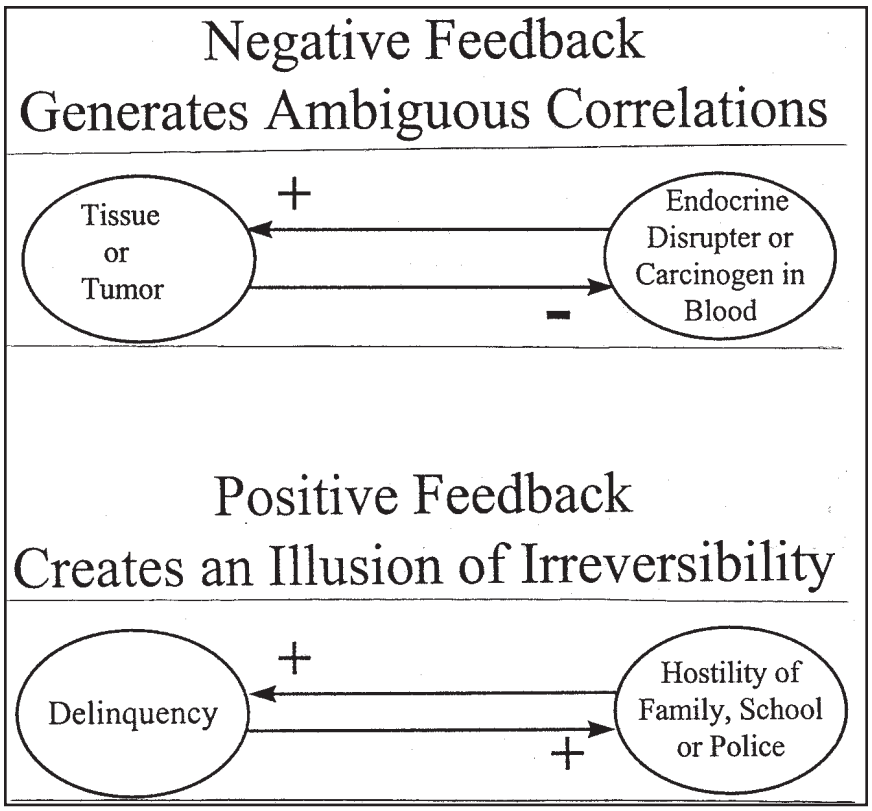

Figure 3. Feedback loops: negative and positive.

choose some optimum density, but to ask what arrangements would permit the transmission of support without the transmission of infection.

One way that poverty is harmful is through insufficient access to medical care, but the affluent might be unnecessarily exposed to excessive and costly interventions. In a statistical analysis of the health impact of access to medical care, a gradient by income would obscure the harmfulness of both unavailable and excessive medical intervention. Our task is not to give everyone the care the affluent get but to improve the quality of care, eliminate clinical decisions made for nonmedical reasons, and make the improved care equitably available to all.

Unemployment can undermine health. Unemployment reduces access to medical treatment and sometimes to potable water, disrupts social networks, can cause depression and excessive alcohol consumption with attendant cirrhosis, and forces skimping on food or home heating. But Singh and colleagues (8) found that Kansas counties with high unemployment rates showed lower overall crude

death rates and rates of death from cancer and heart disease. Unemployment is bad for your health, but under certain conditions so is working. The death rates from cancer and heart disease are higher in some occupational groupings. For example, "Kansas farmers are at a significantly elevated risk of death for non-Hodgkin's lymphoma, leukemia, and cancers of the prostate and brain" (9). There is a positive association between counties with a large amount of agricultural activity and the cancer death rate for all residents; and in industries such as meat packing more than one worker in four is injured or made ill each year from work-related causes. Once again, an aggregated comparison of the health of employed and unemployed would obscure the health impacts of both conditions. Reducing unemployment would not improve health unless jobs are also made safer. Table 1 shows the differential effects on health of being in counties in the highest or lowest quartiles for some social indicators.

Note that above 75 years of age, the social indicators have less effect on the death rate than for the general population or youth. This does not mean that older people are insensitive to social conditions. Across counties, the range for death rate of the over 75 group is 43 percent of the mean, only slightly less than the 56 percent for the general population. The appreciable variation across counties, although not across the selected indicators, suggests that elders are sensitive to different aspects of their social environment that were not captured in

Table 1

Ratio of outcomes of lowest to highest quartiles for social indicators across Kansas counties, 1988–1993[a,b]

Social indicator	CDR	Deaths >75	Deaths 15–24	IHD	Cancer	COPD	Cirr.	Inf.	P & I
High school	1.83	1.03	1.62	1.67	1.40	1.38	1.39	1.41	1.65
Median income	1.89	1.02	1.40	2.38	1.68	1.73	1.29	1.21	2.31
Poverty rate	1.23	1.02	1.25	1.28	1.17	1.14	1.34	1.27	1.26
200% Poverty rate	1.36	1.02	1.22	1.63	1.24	1.23	1.18	0.97	1.65
Medicaid card	1.68	1.06	1.99	1.85	1.52	1.66	1.88	1.66	1.71
Unemployment	0.80	1.08	0.89	0.79	0.83	0.84	2.04	1.08	0.64
No car	1.37	1.06	1.37	1.42	1.26	1.38	1.82	1.61	1.48
Average	1.41	1.04	1.39	1.57	1.30	1.34	1.56	1.32	1.53

[a]Source: computed from reference 8.

[b]The *social indicators* are proportion of the population with at least a high school diploma, median income, poverty rate, 200 percent of poverty rate, a Medicaid card, unemployment rate, and households without a vehicle. The *numbers in the table* are the ratio of outcomes in the first to last quartile of Kansas counties for percentage having at least a high school education, median household income, poverty rate, 200 percent of poverty rate, absence of Medicaid card, and households with no vehicle. The *outcomes* are crude death rate (CDR), death rate for people 75 and older, deaths for ages 15–24, and deaths from ischemic heart disease (IHD), cancer, chronic obstructive pulmonary disease (COPD), cirrhosis of the liver (Cirr.), infectious diseases (Inf.), pneumonia and influenza (P & I).

the indicators used. Median household income and percentage with available health care (Medicaid card) seem to be the best predictors of outcome disparities. For all indicators, heart disease is more responsive than cancer, but the two show a nearly perfect correlation of more than .97 over indicators. This suggests that they are sensitive to identical social conditions, but that heart disease is more sensitive than cancer to these factors. Both chronic obstructive pulmonary disease and pneumonia/influenza are strongly correlated with heart disease and cancer, and this whole cluster is less strongly responsive to the same indicators as cirrhosis, infectious disease, or motor vehicle accidents.

Table 2 shows the correlations among the highest to lowest quartiles of social indicator ratios of the causes of death, indicating the similarity of their responses to different indicators. The nearly perfect correlation between cirrhosis deaths and deaths over age 75 is not remarkable since cirrhosis deaths do tend to occur late in life. But the nearly perfect correlations among heart disease, cancer, chronic pulmonary obstruction, and pneumonia and influenza show their very similar sensitivities to the indicated social factors. The social indicators themselves are also intercorrelated as manifestations of undesirable conditions, but all social indicators do not create their health effects in exactly the same way.

The Importance of Variability

Traditional public health is interested in estimating the average effect of something, and treats the variance as noise, to be reduced to a minimum by skillful

Table 2

Correlations among causes of death over socioeconomic quartiles[a]

	Deaths >75	Deaths 15–24	IHD	Cancer	COPD	Cirr.	Inf.	P & I
Deaths >75	1	–.09	–.56	–.49	–.32	.99	.32	–.62
Deaths 15–24		1	.61	.75	.79	.00	.76	.58
IHD			1	.97	.93	–.51	.20	.99
Cancer				1	.98	–.42	.40	.96
COPD					1	–.25	.53	.92
Cirr.						1	.43	–.58
Inf.							1	.20
P & I								1

[a]The strong correlation between death rate for people over 75 and cirrhosis (Cirr.) reflects the fact that cirrhosis deaths usually occur at a more advanced age than deaths from the other causes. All the causes of death respond to social conditions prevailing in the different counties, but heart disease (IHD), cancer, chronic obstructive pulmonary disease (COPD), and pneumonia and influenza (P & I) show an almost perfect correlation among themselves, while cirrhosis and infectious disease (Inf.) are more loosely connected to the others.

selection of data sets so as to minimize the confidence interval. An ecologically informed approach would examine the variabilities of phenomena as objects of interest in their own right.

For example, the stability of physiological measures such as blood pressure indicate the effectiveness of homeostasis, while increasing variability with age or deprivation attests to its erosion. We have found (10) that the variance of blood pressure and some other traits increases with age, decreases with income, and is greater for African Americans than for whites. Here we do not see age as a "risk factor" but rather see homeostasis being undermined at different rates according to people's life situations. Thus African Americans age faster than whites, and the variance of their blood pressure is greater.

Schmalhausen's law generalizes the undermining of homeostasis under stress. It states that a system at the boundary of its tolerance along any dimension of its existence is more vulnerable to small differences of circumstance along any dimension. Thus, under conditions of poverty, individual differences in shopping skill can have a big effect on well-being. Someone who clips all the coupons, saves all the green stamps, and takes the time to track down bargains and preserve left-overs may get by where someone who does not have the available time, child care, mobility, energy, or skill would suffer from malnutrition. But in an affluent household these differences will have trivial effects. A child with poor visual acuity in a crowded classroom with overworked teachers may be shunted out of academic study as a slow learner, but in a better school system might simply get eye glasses.

Suppose that a person is subject to many life circumstances that could cause illness or injury, but has defenses that buffer their effects. Suppose that the probability of successful protection is p, which is close to 1 (after all, most people do not get sick with every exposure to pathogens and most cancerous cells do not develop into cancer). By and large our defenses are pretty effective. So, if p is equal to .99 (or 99 percent), 1 percent of the time the defenses will fail and we will see harmful outcomes. Now suppose that in another community or household or subgroup p is equal to .98 (or 98 percent). This reflects only a 1 percent change in the defenses, but the rate of harmful outcome has doubled to 2 percent. The big differences in outcome among individuals or households could be associated with changes in their parameters (behavioral, physical, skills, history) that are too small to measure.

We can ask the question, why is it that not everyone in a poor community loses children, or turns to crime, or is frequently ill? When we observe that misfortunes tend to cluster, it is often more important to ask why some people are so vulnerable in that circumstance, rather than attempt to identify the particular precipitating factors in each case that make for heightened vulnerability in those circumstances.

Variability in Space

The differential variability of health outcomes across regions is also rich in information and is a research tool imported from our ecological work. Those causes of death or morbidity that vary geographically are by definition sensitive to conditions, and therefore more likely to be amenable to change. We can use the pattern of variation to set ameliorative goals, for instance raising the life expectancy of all districts at least to the state average or to that of its top five counties.

Geographic variation takes place on different scales, and we can use this to interpret the pattern. First, suppose that the variation is caused by some geographic gradient, say elevation or rainfall. Since the midpoints of states are farther apart than those of counties or zip codes, there should be more variation among states than within them.

On the other hand, suppose that very local conditions determine the local health outcomes. Then the variation among different localities within a state would tend to cancel out. The variance among states would be local variance divided by the number of counties. Now suppose that local outcomes are not independent, that affluence leads to affluence and attracts doctors, and rich areas create adjacent poor ones to serve them. Then there would be large local variance and smaller county or regional variances. But if deliberate efforts were made to equalize conditions, the variances might be much smaller and decrease over time.

Unemployment in Kansas counties is usually in the single digit range. It varied by less than 20 percent among the three metropolitan areas, about 142 percent across counties, but as much as threefold from zip code to zip code within Wichita alone.

For Kansan African Americans the unemployment rate was 12.3 percent in 1996. For zip code regions in northeast Wichita, composed predominantly of an African American population, the rate was 36 percent. The range of personal income is 30 percent of the average across states in the United States, 70 percent across counties in Kansas, and much higher (but not easily calculated) across zip codes. From the 12 counties with more than 200 African Americans, per capita income was 53 percent of that of whites. In those same counties, African Americans were only 38 percent as likely as whites to own their own homes; the same income does not go as far for blacks as for whites. Health outcomes show a similar pattern. Thus, in Sedgwick County total infant mortality was 10.9 deaths per 1,000 live births, compared to 7 per 1,000 for the state as a whole. For African Americans, infant mortality is about double that of whites, as are the rates of perinatal death and low birth weight. The county infant mortality rates are higher for African Americans than for whites (28.6 and 10.9 per 1,000 live births, respectively). Both these rates are above Havana's rate of 7.9 per 1,000 (11). The rate for the whole county is slightly above that of Isla de la Juventud (Cuba's

worst province). In 1994, African American men died an average of 14.1 years earlier than whites, and African American women died 10.3 years earlier. African Americans are the largest minority in Kansas, and therefore the easiest to study, but we have the impression that similar patterns occur for Hispanic, Native American, and some of the Asian populations. Minorities suffer from a systematic structure of unequal power and disadvantage in addition to prejudice. These discrepancies then remain a problem in Kansas, as well as in the rest of the United States.

In the course of travel in Kansas we were sometimes told of local disease clusters such as multiple sclerosis or cancer that were discovered when old friends got together and discussed "whatever happened to . . . ?" Although clusters may sometimes be the random events that inevitably show up in small samples, a pattern of local clustering may indicate the focal distribution of insults and therefore has to be examined as a pattern rather than case by case. In this work, nonprofessional neighborhood groups are especially important in observing anomalies and tracing their sources.

Different diseases show different degrees of variability. Consider the major causes of death across counties in Kansas and provinces in Cuba (Table 3). Heart disease varies geographically more than does cancer in both countries. This difference also is seen in comparing the responsiveness of the two diseases to socioeconomic indicators (Table 2) and even over time. In Cuba, the economy experienced abrupt changes in the late 1980s with the sudden loss of favorable and stable prices and long-term trade relations with the Soviet bloc. This affected all health indicators, but particularly heart disease, and diabetes more than cancer.

Table 3

Mean values and range/mean for causes of death over Kansas counties, 1988–1993, and Cuban provinces, 1995[a,b]

	Kansas		Cuba	
Cause of death	Mean	Range/mean	Mean	Range/mean
IHD	208.3	2.19	200.9	0.63
Cancer	203	1.35	132.9	0.51
COPD	40	2.37	9[c]	1.57
Cirr.	6.6	4.09	8.2	0.95
Inf.	14.4	3.40	13.4	0.83
P & I	36.6	4.29	34.1	1.21

[a]Source: data for Cuba from reference 11.
[b]The death rates in Kansas and Cuba are comparable except for a lower cancer rate in Cuba, but the variabilities differ. Abbreviations as in Table 1.
[c]The Cuban data are for bronchitis, emphysema, and asthma.

The average values of the death rates are comparable for the two countries except for cancer, but the variabilities are strikingly different. Until we have obtained the data for other states and nations we are unable to assign the differences in variability to general economic and social conditions or the uniform availability of health care in Cuba.

A second aspect of geographic variation is the correlations of disease prevalences among Kansas counties across regions. Gopal Singh and colleagues (8) have found that the major causes of death showed positive correlations among them, averaging .47 (Table 4). The same thing holds for hospital admissions for different causes. There are counties where the risk of hospitalization is consistently above that for the state for almost all causes of admission. These are diseases that are not closely related in terms of medical "cause." The correlation may have two explanations. First, the precipitating factors may be correlated. For instance, poor household water sources may both be contaminated with pesticides and carry intestinal bacteria. The second explanation is that despite a large number of possible insults to the body, we confront them with relatively few kinds of defenses: the integrity of the epithelium of the digestive, reproductive, and respiratory systems; cellular and humoral immunity; sympathetic/ parasympathetic balance; the inflammation response; perhaps half a dozen pathways of detoxification in the liver; excretion by the kidneys of solubilized toxins. Social-environmental factors concentrated by poverty, relative privation, or other conditions that undermine any of these defenses will make people more vulnerable to different kinds of precipitating factors, whether infectious or not. Then diseases might be classified by the bodily defenses required to fight an insult rather than by the precipitating agent or the organ affected.

Table 4

Correlations matrix for major causes of death, Kansas[a,b]

	IHD	Cancer	COPD	Cirr.	Inf.	P & I
IHD		.86	.70	.27	.13	.79
Cancer			.77	.34	.37	.77
COPD				.36	.34	.65
Cirr.					.44	.29
Inf.						.26
Average	.55	.62	.57	.34	.30	.55

[a]Source: Singh (1997, unpublished data).
[b]The average is the average correlation between a given disease and all the others. Infectious diseases are least correlated with the other diseases, and cancer is most strongly connected to the others. Abbreviations as in Table 1.

Consider the correlations among causes of death across Kansas counties and Cuban provinces (Table 5). The correlations look remarkably similar for heart disease with cancer, respiratory disease, and cirrhosis and for cancer with respiratory disease, but correlations with influenza are strikingly different. Kansas partakes of the U.S. influenza immunization program, while Cuba has no such program. Therefore any correlations that depend on uneven medical access, with more flu shots in the same counties having more available treatment of other diseases, would disappear in Cuba. We do not yet know why the correlation between cancer and liver disease is different in the two countries. One possibility is that in Kansas, evangelical Christian churches that prohibit smoking also prohibit drinking alcohol, risk factors for cancer and liver disease, respectively. This connection may be weaker in Cuba.

As the social determinants of disease are likely to have different patterns in the two countries (for instance, education is less linked to income and varies much less in Cuba than in Kansas) (12), this would lead us to expect different correlations among diseases although some correlations are similar. The close correlations among heart disease and cancer also hold up across social indicators in Kansas and over time in Cuba. This finding may give support to the idea that

Table 5

Correlations among causes of death across Kansas counties and Cuban provinces[a]

	Kansas	Cuba
Heart/cancer	.86	.65
Heart/respiratory	.70	.58
Heart/liver	.27	.28
Heart/influenza	.79	.04
Cancer/respiratory	.77	.78
Cancer/liver	.34	.07
Cancer/influenza	.77	0.0
Respiratory/liver	.36	.78
Respiratory/influenza	.65	.08

[a]The association between diseases that are not medically related indicates either a social correlation of the exposures or that our body depends on similar defenses to confront both. Heart disease, cancer, and respiratory disease form one cluster in both Kansas and Cuba, and the other conditions (liver disease, influenza) are more loosely associated with these. The big discrepancy between Kansas and Cuba in the correlations of influenza with other diseases may reflect the absence of an annual flu immunization program in Cuba.

certain social circumstances undermine the same defense systems even for very different diseases in quite different societies. At this stage, we have only the first hints derived from this new research tool analyzing multiple disease rates and correlations in widely disparate societies.

The Reality of History

People, like all systems, respond to their experiences and are changed thereby. But these changes take place at different rates. We are familiar with the use of a child's weight-for-height to measure acute malnutrition because this measure changes on a scale of weeks to months, whereas height-for-age measures the accumulated nutrition over a life time. The risk of lung cancer responds over months to years when someone stops smoking. People's situations therefore reflect different aspects of their past with different rates of erasure.

If history is important in determining health, then the direction and amount of change in a county should be relevant for predicting outcomes as well as the present state. In collaboration with Gopal Singh at the Kansas Health Institute, we have prepared an index of decline which measures the loss of population and farms, growing poverty, increased school dropout rate, and other aspects of a region in decline. The health implications of this index have not yet been analyzed, but the index identifies counties mostly in the southeastern and central parts of Kansas that are in serious decline. We hypothesize that high rates of decline are correlated with high prevalence of disease.

For behavior too, we should look not only at someone's present social location but also whether that person is moving upward or downward or sideways. Behavior depends on different time horizons. Only when people have had the experience that what they do now affects what happens to them later can they make long-term health-promoting decisions. But this time horizon of efficacy is itself socially influenced, linked to socioeconomic position, gender, and race. If we aim to affect health behavior, we have to examine the circumstances that generate behavior and understand the relation of choice to non-choice. Choices are always made from among alternatives presented by the social environment, or by circumstances that were themselves not chosen. Choice depends on the tools for making choices, the outer edge of people's aspirations as they have been encouraged or dampened by past experience. When we recognize the elements of non-choice in choice, we can escape from the contradiction between social causation and individual responsibility and understand the interactiveness of the two, and thus see the individual as a unique particle in a social field.

The Significance of the Material Environment

While emphasizing the neglected domain of social determination of health, we do not reject or ignore ecological and physical factors that interpenetrate

with them. It is necessary to restate that health is created and eroded in an ecosocial/physical world, and that the artificial separation of "environmental" from social aspects of these processes can only weaken our understanding and interfere with efforts to reduce health-undermining conditions in our lives.

In this context, we mean by "environment" all conditions that arise outside the body, whether these reach us inadvertently, despite our efforts, or through choices we or others make. At the most elementary level, the case for environmental determination of health and disease includes the following observations.

1. *The geography of cancer, as related to the location of industry and agriculture.* The highest rates of cancer mortality in the United States are in the "rust belt" of the midwest, the lower Mississippi valley, and the northeast. The high rates of cancer mortality occur across all age groups. In Kansas, cancer rates tend to be higher in counties with more agricultural activity. Other studies have shown that farmers exposed to the herbicide atrazine suffer elevated rates of several cancers. These geographic areas are not distinguishable from the rest of the country in their degree of social inequality, poverty levels, or less tangible indicators.

2. *The history of disease, with cancer rates following industrialization and the chemicalization of agriculture.* The increases in cancer occur across all age groups.

3. *Changes in disease rates among immigrant groups in the generations following immigration.* The changes are shifts from the rates in the country of origin toward the rates in the immigrants' new locations.

4. *The association of diseases with occupations as well as with ranks within an occupation.*

5. *The distribution of cancer across species:*

- Geographically, concentrating in areas where human cancers are most common.
- Across ecological guilds, with bottom-feeding fish and predators (eating the detritus where the pollutants concentrate or prey that have already concentrated pollutants) showing higher rates than open ocean feeders.
- In laboratory studies with animals exposed to specific chemicals. Although all species have their own unique sensitivities, which may prevent us from attributing specific cancers in humans to specific chemicals, the fact of differential sensitivity among species does not make us systematically less vulnerable than others. The case for chemical carcinogenesis is strong even where a direct one-to-one linking of specific chemical concentrations to disease prevalence is not possible.

Water quality is the primary environmental threat to Kansas health. Almost half the private drinking water wells are contaminated with coliform bacteria, and 17 percent with the herbicide atrazine (13) which is associated with non-Hodgkin's lymphoma in farmers (14). Atrazine is also suspected of disrupting the human endocrine system.

Despite a strong inferential case for the role of the environment in causing major diseases, classical epidemiological studies are inconsistent with each other or often inconclusive. This paradox is not a good reason to dismiss environmental causation but rather urges us to examine why epidemiological studies are so often inconsistent or inconclusive. Among the problems are the failure to take feedback into account in the modeling, frequent omission of women and minorities in the studies, and the inability to disentangle multiple causes and their interactions in causing illness.

But the recognition of physical environmental factors does not detract in any way from the importance of social determination. The outstanding conclusion of this area of study is that social stratification, by education and income, and injustice are the critical factors that detract from the health of our population. Variations in health within a population are an epidemiological issue. When we look more closely we see that the relationship between the social and physical environments has several nuances:

(*a*) Populations that are poor, marginalized and discriminated against have higher exposures to pollutants, lower-quality food, and more dangerous jobs. The regulatory agencies are slower to identify the exposures in these communities and are more tolerant in the corrective measures they impose (15).

(*b*) Poor people are already more vulnerable to disease due to marginal diets, higher stress, hopelessness, the anxiety of dangerous neighborhood, the basic insecurity of life. Those of us who have never lived in marginal circumstances, or have forgotten the experience after escaping, often oversimplify the pervasiveness of deprived and subordinate social condition. At the margin of their tolerance, all species are more vulnerable to almost all perturbations.

(*c*) Cigarettes, alcohol, fatty and sweet foods, and sedentary activities are embedded in our culture and aggressively promoted by advertising so that they become powerful "environmental" factors. Stressful circumstances make these habits attractive for short-term relief.

(*d*) Diet is "chosen." But the choice is constrained by prices, availability in neighborhoods, the shortage of time for food preparation or for meals, and the shortened time horizon of control over one's life that poor people experience. The distancing from dietary health information is a response to just one more exhortation to do something additional that is difficult.

(*e*) Attitudes of hopelessness, anxiety, a short time horizon, and so forth, are derived from real experience, including the experience of frequent illness, chronic poor health, and little power to plan what happens later. Although not everybody in adverse circumstances exhibits these characteristics, they are

stronger if reinforced by experience. Focusing on why some individuals respond to adversity in more productive or less productive ways can divert us from asking the bigger question about the adversity itself and ways to change it.

(*f*) Collective action could and sometimes does remedy environmental exposures, but disadvantaged neighborhoods also have less political influence and fewer resources for organizing (15).

None of these nuances negates the importance of social factors. Society creates the exposures to physical factors both by producing them and by directing them at particular populations. Social conditions produce the differential vulnerability of communities and provide the resources, knowledge, and confidence to affect exposures. In run-down neighborhoods, the ugliness, noise, and smell affect people's sense of well-being, which in turn affects health and creates a consciousness of despair, irrelevance, and impotence.

Organisms select, transform, and define their environments; the environments thus created form the organisms and therefore the next round of selecting, transforming, and defining processes. The inseparability of social, ecological, physical, chemical, and biotic environments is a crucial framework for a whole-system approach to health.

Looking Critically at Our Own Science

Public health is a historically evolving system with its own agenda and preferred solutions to problems. The principle that things are the way they are because they got that way has to be applied to public health as well. Then we can see the ways in which the present pattern of knowledge and ignorance is not a spontaneous consequence of some problems being harder than others, but rather a consequence of intellectual choices encouraged by the fragmentation of disciplines and institutions, the structures of reward and recognition, the financing of research in order to find marketable commodities, and unacknowledged constraints on the investigations, conditions that are accepted as givens without question.

The effect of recent economic changes on research should be a major concern of our community since it will determine the "self-evident" truths of the next decades. We also look at our own sciences and institutions when we ask: "Can this really be done? Can we adopt a whole-system approach?"

We can only answer this question by looking at the opposing processes at work. On the one hand, the internal intellectual needs of science move us increasingly toward the greater inclusiveness of our problems and our theoretical frameworks. This is expressed through conferences, books, and programs that emphasize inter-, multi- or trans-disciplinary frameworks. On the other hand, the economic changes in the knowledge industry promote fragmentation of knowledge, jealousy about boundaries, an emphasis on short-term results that are easily commodified, a shift of accountability from the horizontal to the vertical,

diminishing job security for researchers, a business-type structure of rewards and recognition, and the growing corporate influence in university life. All these factors work against the kind of whole-system approach discussed here.

A Note on Children

Children share the same needs as adults as well as having unique needs. The same needs include food and shelter, and poverty is the major obstacle here. Poverty affects children even before birth, as shown by the association of poverty with birth defects, low birth weight, and infant mortality, and after birth at all ages. Children are more vulnerable than adults to external insult.

1. Their immune systems are not yet developed.
2. Vulnerability to insults of many kinds is usually greatest for tissues that are actively differentiating or growing, have a rapid throughput of nutrients and toxins, and have a large surface to volume ratio.
3. Children lack many of the behavioral options for avoiding harm, because of physical strength and stature and their limited knowledge and experience.

One way of describing variability is to subtract the minimum value from the maximum and divide by the average value (Table 6).[2] Infant mortality varies by about 145 percent across U.S. states and 264 percent across Kansas counties (Table 7). Child mortality (ages 0–14) varies across counties by 180 percent, mortality for ages 15–24 varies 350 percent, but total age-adjusted death rates vary by only 73 percent across states and 59 percent across counties. And, for people over 75 years, the death rate varies by only 43 percent. We look at the variability because it tells us that some conditions that cause this mortality are varying geographically and therefore can be ameliorated with a substantial improvement in health. All of these variations are associated with social and economic conditions, but a small difference in economic resources has a bigger impact on children (Table 7).

While social conditions vary and affect children, state-organized efforts to protect children are allocated more equitably and therefore show less variation. For example, the immunization rate for children across counties varies by 86 percent. In the more thorough Cuban immunization program there is almost no variation; the centralized reporting and absence of private physicians make for reliable data.

[2] For technical reasons, the coefficient of variation, equal to the standard deviation divided by the average, is a more appropriate measure for statistical testing since it is not sensitive to the sample size. But for a nontechnical audience, the relative range has a more intuitive meaning. Table 6 shows that the qualitative conclusions are similar for both measures.

Table 6

Age-adjusted mean values, range/mean, and coefficients of variation (CV) for selected causes of death and low birth weight, Kansas and Cuba[a]

	Kansas			Cuba		
	Mean	Range/mean	CV	Mean	Range/mean	CV
IHD	167.8	0.85	13.8	159.8	0.34	12
Cancer	120.4	0.70	13.6	111.0	0.36	9.0
Cirrhosis	4.85	3.28	58.7	6.8	1.02	32.5
Diabetes	10.78	2.44	41.2	18.8	1.84	43.2
IMR[b]	7.81	2.91	63.2	7.9	0.60	18.2
LBW[b]	5.87	1.72	28.1	7.0	0.56	13.8

[a]Kansas data for 1988–95 (except as noted) from Singh (unpublished), unweighted (that is, each county given equal weight in averaging). Cuban data for 1996 from reference 11, age adjusted. Means for Cuba are the national means, but variation was calculated using the unweighted means over provinces. The differences are small. IHD, ischemic heart disease; IMR, infant mortality rate; LBW, low birth weight.
[b]Kansas data for 1989–93.

Although the average outcomes are comparable in Kansas and in Cuba, the variability is much greater in Kansas so that 51 Kansas counties have higher infant mortality than Cuba, and 27 of them do more poorly than Cuba's worst-off province of Isla de la Juventud. Furthermore, the variability has been increasing for Kansas and the United States as a whole but remaining steady for Cuba.

About a fourth of the private wells in Kansas are contaminated with nitrate. Nitrates are a particular risk to children, causing blue baby syndrome when a child is deprived of oxygen by nitrates in the blood. Nitrates are also associated with risks of spontaneous abortion and gastric cancer (16, 17). We cannot determine how many children are affected since physicians are not required to report cases to any data center. However, water quality seems to be an urgent environmental health issue in Kansas.

As mammals, we are born partly formed. Our development depends on regularly occurring environmental factors that have become incorporated into our developmental biology. The development of vision requires light. The development of muscles and bone requires exercise. Brain development requires stimulation. Intellectual development needs challenge. Emotional and social development require touch, attention, and loving care. Light is almost always available. The other influences reach the child first through the immediate caregivers, then through increasingly widening concentric circles of more numerous but less intense contacts with other people. Many children do not have these needs met.

Table 7

Geographic variation in infant mortality rate and low birth weight rate, United States, Kansas, and Cuba[a]

	Mean IMR or LBW over regions	Minimum	Maximum	Range/ mean
U.S. states				
IMR, 1980	12.6	9.2 Maine	25 Washington, D.C.	125%
IMR, 1995	7.6	5.2 Mass.	16.2 Washington, D.C.	145%
LBW, 1970	7.9	5.7 N. Dakota	12.5 Washington, D.C.	86%
LBW, 1995	7.3	5.3 Alaska, N. Dakota	13.4 Washington, D.C.	111%
Kansas counties				
IMR, 1966–70	19.0		51.5 Hamilton	255%
IMR, 1989–93	8.6	3.1 Decatur	22.7 Chautaqua	264%
LBW, 1981–83	6.2	0 Several counties	9.6 Clark	124%
LBW, 1991–93	6.4	1.9 Phillips, Republic	12.0 Wallace	158%
		1.9 Republic		
Cuba provinces				
IMR, 1975	27.5		35.1 Ciego de Avila	59%
IMR, 1996	7.9	18.8 Villa Clara	10.3 Isla de la Juventud	60%
LBW, 1977	10.6	5.4 Cienfuegos	11.9 Granma	43%
LBW, 1996	7.0	7.3 Sancti Spiritus	8.9 Guantanamo	54%
		4.9 Havana		

[a]IMR = infant mortality rate; LBW = low birth weight (less than 2,500 grams). The range is maximum – minimum value.

Therefore, a childhood program must first address inequity and inadequate income. Without such efforts, attempts to mitigate consequences of inadequate income, such as low parental education levels, will be thwarted. We have to support the caregivers in their homes with the skills, knowledge, and social support to provide effective early care. In an economy that increasingly requires two wage earners to barely keep up with a family's survival needs, and certainly to strive for some advancement in life, we have to reduce the contradiction between the demands of home and paid work, invent ways of making work child-friendly so that parents can jointly attend to their children at those times when it is especially necessary, and allow for the special needs of individual children. Finally, we have to improve organized care in daycare enrichment facilities and schools, providing material resources, training for caregivers, and the remuneration, autonomy, and respect that qualified and committed professional caregivers deserve and that can assure the quality of the care.

TOWARD A SYNTHESIS

Health is produced and eroded in a natural and social environment that varies in time and space and according to the social locations of people in various hierarchical, cooperative, and competitive relationships. External influences—chemical, physical, and microbial—impinge on us in a pattern that depends on how we produce and consume goods and use our time. What happens next depends on the coping mechanisms that we develop in the course of a lifetime. The external becomes part of the internal; previous experience alters our body and mind and our behavior in ways that influence how we respond to the next encounter. Our own physiological and psychological processes erase these impacts, some of them rapidly, some slowly, and some so slowly that they have permanent effects on us. But the internal also becomes external, as our own activity selects, transforms, and even defines our environment. For the most part, this pattern was not constructed with health in mind. The health consequences are essentially random, side effects of economic and social processes. But their consequences have become so powerful and pervasive that we now have to intervene in social development with health and well-being in mind.

The chain of events leading to disease includes four major contexts.

1. *The precipitating factors.* These are the familiar microorganisms, chemicals, and stressors, often referred to carelessly as the "causes" of disease. They tend to be highly specific, respond to particular climatic and ecological conditions, fluctuate with changing technologies and economic activity, and, in the case of microorganisms, adapt to what we do. Thus these factors are responsible for the ways in which different diseases have very individual distributions. Most research has been directed toward these factors and has provided some of our most dramatic successes. But the research is mostly on a case-by-case, disease-by- disease basis that does not see the whole pattern of our relations to the rest of nature, or prepare us for surprises. Here the most urgent task is to broaden research to consider the evolutionary ecology of disease. An analysis of health impacts must be incorporated into the design of technology so that the engineers prioritize health improvement as a goal—"If we don't need it and we can't get rid of it, don't make it!"

2. *The context of exposure.* These factors have intermediate specificity. The exposures to pesticides and toxins, to poor diet, to food poisoning, and to high-stress occupations are unevenly distributed across class and racial lines, with marginalized and disadvantaged communities having worse health outcomes for pretty much everything. Here the major tasks are tasks of promoting community action for equity and the consideration of the health impact of land use, urban planning, sanitation, and food-processing technologies.

3. *The context of vulnerability.* The factors of vulnerability are more generic because they depend on the same relatively small number of protective mechanisms in the body and in society: poverty and toxic exposures undermine health in general, a heart-friendly diet is also preventive of cancer, a sense of control over one's own life can help to avoid cirrhosis and lung cancer, racism can raise blood pressure and depress the immune system. These conditions give rise to correlated distributions among diseases that are not related medically and can be studied comparatively. This is a domain where individual and collective responsibilities interpenetrate most strongly, where empowerment and education can be most effective, and where the democratization of public health is most urgent.

4. *Context of therapy.* Medical care is not relevant to all disease and cannot claim credit for most of the expansion of life expectancy. Sometimes ignorance prevents effective therapy. Then we have to examine how the political economy of research and the culture of the research community created the present pattern of knowledge and ignorance. Sometimes medical decisions are influenced by nonmedical considerations or are guided more by custom and fashion than by validated research. Sometimes effective practices such as prenatal care and childhood immunization are simply not available to everyone. Current changes in health care delivery and the deskilling of the health professions threaten to undermine both the quality of care and its availability.

SOME CONCLUSIONS AND PROVISIONAL RECOMMENDATIONS

Among the U.S. states, Kansas health occupies a middling position. The United States as a whole does rather poorly among the developed countries and in some ways even compared to some developing countries. And the whole world does more poorly, and is less prepared to face inevitable change, than any lack of material or intellectual resources could excuse.

This preliminary report maps out some of the dimensions of health problems in Kansas and begins to develop an approach for looking at the whole. We have some firm conclusions, some plausible inferences, and some mere hints. Therefore our recommendations include suggestions for how to think about the issues, some specific proposals for implementing these ideas, and a perspective on future research.

There are several things we can do to correct this situation and to take seriously the international goals of the Alma-Ata conference on health for all.

First, think big. We have to pose a question big enough to accommodate an answer. For public health this means seeing the system in the large, including areas that are outside its traditional boundaries but have major effects on us: agriculture, environmental protection, industrial design, urban development, and education. A first step would be a consultative conference and continuing group

drawn from public and private agencies in all these fields. Our research program would move on to integrate analyses in these separate fields into a whole-systems model of Kansas health. Its goal would be a coherent policy to make Kansas a more healthful place.

Second, the variability of health outcomes across geographic areas, social groups, and occupations means that conditions that vary within Kansas affect health in major ways. Therefore we can set as preliminary goals the raising of health outcomes within the state to the level of the best achieved anywhere in the state:

- All counties can be as healthy as the five healthiest counties.
- Minorities can aim at health indicators equal to the health status of the majority white population.
- All occupations can aim at the health levels of the safest jobs.
- All people could have their risk profiles improved to the level of those with average income.

The more variable a health outcome over geographic areas or social indicators, the more can be gained by bringing the whole state up to the level of its best. When this is achieved, death rates will be reduced by some 20 percent.

This would be only a first step: we could also aim to reach the levels of the healthiest states in the Union and help our country rise to the level of the healthiest countries in Europe.

Our country is now rich enough to aspire to a rising standard of living, not so much through increased consumption of energy and materials as through investing in healthful habitats and even in designing production, not to minimize damage, but in such a way that work is fulfilling and health enhancing and even joyful.

One way to contribute to this process is to place rising and equitable health on the national and state agendas and to make it impossible for any candidates for public office to ignore the health needs of the population. Our research would pursue the analysis of the variability of health outcomes to identify possible areas of intervention. It would look at geographic patterns to answer such questions as why relative risks of hospitalization for many causes are greater, and deaths from specific diseases are earlier, in the southwest part of the state. Clusters of health problems below the county level will be examined in detail.

Third, all diseases are unique but also similar. Each has its own precipitating agent, its etiology and possible therapy. Traditional medicine and public health epidemiology emphasize the uniqueness of each disease at the expense of the generality. But we have shown that there are strong correlations among diseases that are not related medically. These correlations hold over geographic regions in very different societies, across time when conditions change rapidly, and over

social indicators. Similar factors affect our exposure or vulnerability to the major causes of death. The study of these patterns is a powerful research tool. It also suggests that health-enhancing measures that improve our resistance to one disease also improve our resistance to other diseases. We will develop comparative and correlational analyses to find out why the prevalences of medically unrelated diseases are often closely associated, and what measures might ameliorate multiple risks at the same time.

Therefore, taking on the bigger problem of improving health is not simply adding to a growing list of things to do for a growing list of problems. The problems of poverty, inequity, pollution, poor diet, unhealthful work and rest regimens, and inadequate health education affect health as a whole. Their improvement would improve health as a whole. And the inclusion of the other agencies with responsibilities in other areas of life increases the resources available.

An effective policy requires good theory. In order to have a valid theory of public health we have to challenge the traditional boundaries. We have to recognize inequality, class hierarchy, racism, regional decline, and social fragmentation as pathogenic agents central to our analysis. This requires a revision of our conceptualization, data collecting, and methods of interpretation.

We have to expand the way we analyze data, sometimes in exquisite microscopic detail, sometimes stepping back to see global patterns, always taking into account that the system is an integrated whole, with feedbacks, time lags, multilevel connections, sinks and sources. Our research will develop the mathematical methodology for interpreting this. We especially have to examine why so many epidemiological studies are inconclusive or inconsistent with each other.

We not only have to examine present-day health problems but also anticipate what might happen; instead of waiting for surprises, we need a program to prepare for uncertainty as a permanent fact of life. Our research will identify potential problems of disease emergence and resurgence, and strategies for confronting the specific emergencies that Kansas health might have to face.

We have to democratize health research and policy so that professional technical skill and theoretical structures can be combined with people's detailed, intimate, and intricate knowledge about their own circumstances. Our research will focus on the mobilization of untapped intelligence in our communities so that policies jointly arrived at can be jointly implemented. We need to encourage mechanisms such as town meetings, conferences of community groups, surveys, focus groups, and after-school clubs, to explore problems, develop solutions, and carry them out so that every Kansas county can be as healthy as the best counties.

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