

## Corporation-induced Diseases, Upstream Epidemiologic Surveillance, and Urban Health

René I. Jahiel

---

**ABSTRACT** *Corporation-induced diseases are defined as diseases of consumers, workers, or community residents who have been exposed to disease agents contained in corporate products. To study the epidemiology and to guide expanded surveillance of these diseases, a new analytical framework is proposed. This framework is based on the agent–host–environment model and the upstream multilevel epidemiologic approach and posits an epidemiologic cascade starting with government-sanctioned corporate profit making and ending in a social cost, i.e., harm to population health. Each of the framework’s levels addresses a specific level of analysis, including government, corporations, corporate conduits, the environment of the host, and the host. The explained variable at one level is also the explanatory variable at the next lower level. In this way, a causal chain can be followed along the epidemiologic cascade from the site of societal power down to the host. The framework thus describes the pathways by which corporate decisions filter down to disease production in the host and identifies opportunities for epidemiologic surveillance. Since the environment of city dwellers is strongly shaped by corporations that are far upstream and several levels away, the framework has relevance for the study of urban health. Corporations that influence the health of urban populations include developers and financial corporations that determine growth or decay of urban neighborhoods, as well as companies that use strategies based on neighborhood characteristics to sell products that harm consumer health. Epidemiological inquiry and surveillance are necessary at all levels to provide the knowledge needed for action to protect the health of the population. To achieve optimal inquiry and surveillance at the uppermost levels, epidemiologists will have to work with political scientists and other social scientists and to utilize novel sources of information.*

**KEYWORDS** *Corporations, Corporation-induced diseases, Multilevel causal chains, Epidemiologic cascade, Epidemiologic surveillance, Urban health.*

---

### INTRODUCTION

Epidemics due to commercial activity have been known for centuries. An example is the gin epidemic in London in the eighteenth century.<sup>1</sup> However, it was only in 1995 that Beatrice Majnoni d’Intignano, from the University of Paris, developed the concept of industrial epidemic as a generic approach to the marked increase in diseases attributed to consumption of industrial products (tobacco, alcohol, food, cars, guns, etc.) that occurred in the second half of the twentieth century and that tends to affect young as well as older individuals. She pointed to the role of the

---

Jahiel is with the Department of Community Medicine, University of Connecticut Health Center, Farmington, CT, USA.

Correspondence: René I. Jahiel, Department of Community Medicine, University of Connecticut Health Center, 263 Farmington Avenue, Farmington, 06030 CT, USA. (E-mail: jahiel@nso2.uchc.edu)

consumers and distinguished two broad classes of consumers in relation to their susceptibility to industrial diseases, but she also pointed out that industrial corporations had not met their responsibilities because of asymmetric information and moral hazard situations.<sup>2-4</sup> The concept of industrial epidemics was broadened to include epidemic and endemics of diseases associated with not only consumption of industrial products but also exposure of workers at the job site and of community residents to such products.<sup>5</sup>

In the past 25 years, numerous studies have provided a wealth of information on the methods used by for-profit corporations to promote hazardous products, such as tobacco,<sup>6</sup> food,<sup>7</sup> alcohol,<sup>8</sup> automobiles,<sup>9</sup> asbestos,<sup>10</sup> lead and vinyl chloride,<sup>11</sup> and silicosis.<sup>12</sup> These studies show consistent corporate behavior across industries. Corporate decision makers strived to achieve control over governmental regulation of tobacco<sup>6</sup> and food<sup>7</sup> to lower governmental classification of carcinogenic potential of their products<sup>13</sup> and to persuade governmental agencies to adopt permissible threshold concentrations of industrial products that are significantly higher than those reported to be hazardous to health.<sup>14-18</sup> They attempt to throw doubt on scientific evidence,<sup>19-23</sup> thus influencing not only regulatory agencies but also public opinion, courts, and juries. When the hazards of the products cannot be denied, they use administrative or court actions to delay implementation of regulation.<sup>6,24-26</sup> Finally, they shift attention away from the health risks of products by framing the issue in a different way, such as asserting that the users of their products are entitled to their free choice or making it appear that the risks of weakening regulations are preferable to interference by “big government.”<sup>27,28</sup>

These strategies are not unique to a few industries but rather are shared by corporations across a wide variety of industries.<sup>29-31</sup> The growing importance of diseases related to for-profit corporations<sup>32,33</sup> calls for a change from a paradigm focused on the host to one focused on the corporation. The new paradigm is not based on anomalous corporate behavior but rather on the very nature of for-profit corporation as entities designed to maximize profit for the benefit of their stockholders, so that the aim of their executives and directors is to increase profit in a competitive environment and to leave social and health costs for others to address.<sup>31,34-36</sup> The role of corporations in our society, their integration with other social structures, and their exercise of power have been discussed extensively.<sup>31-34</sup> I propose to define a new category of “corporation-induced diseases” as diseases of consumers, workers, or community residents who have been exposed in the market place, work site, or community, respectively, to disease agents that are part of the products or processes of corporate activity. The purpose of this article is to advance the epidemiologic study of corporation-induced diseases and to extend epidemiologic surveillance upstream to the level of corporations and government. It presents a new analytical framework to study the epidemiology of corporation-induced diseases and to guide an expanded surveillance for these diseases in the physical and social environments. I will first discuss the public health model and the multilevel upstream approach that underlay the framework, then I will describe its rationale and structure and its application to surveillance, and finally, I will discuss its utility for urban health.

#### **PUBLIC HEALTH’S HOST–AGENT–ENVIRONMENT MODEL**

The classic host–agent–environment triad of public health<sup>37</sup> is readily applicable when a component of a corporation’s product has been clearly identified as an agent of disease with epidemiology’s causal criteria.<sup>38</sup> The consumer, worker, or community

resident who has been exposed to such corporation-borne agents is the host. The environment is the environment where exposure of the host to the agent occurs.

An important variant of the host–environment–agent model adds a vector as a fourth component. The vector is an organism where the agent may evolve and replicate, be carried through different environments, and is finally introduced in the host. It has been suggested that corporations are the vectors of the agents contained in their products and processes.<sup>39,40</sup> The term vector has also been used in a different way as the product that carries an agent of disease, for instance, the cigarette as a vector of nicotine or energy-rich foods as vectors of the chronic positive energy balance that is the agent of obesity.<sup>41</sup> This is not the way this term is used in this article. In this paper, the vectors are the corporations that make, distribute, and sell products that contain agents of disease.

Both for-profit corporate vectors and biological vectors (such as mosquitoes, the vectors of malaria plasmodia) interact with different environments during the production, transport, and transmission of the agents. Both for-profit corporate and biologic vectors have developed ways to increase the effectiveness of transmission of the agent. The biological vectors do it by natural selection of strains or molecular structures that facilitate transmission, while the corporate vectors have developed societal methods to increase exposure to their agents by targeting susceptible groups through advertising, peer pressure, or even addiction. Both types of vectors have developed ways of protecting themselves from adverse environmental conditions: The biological vectors do it with natural selection of strains that are resistant to measures employed against them, and the corporate vectors do it with public relations and interaction with governmental regulatory agencies.

However, this analogy should not be pushed too far. While biological vectors are clearly distinct from the environment and usually have little influence on it, corporations have profound connections with and influence on the environment.<sup>31,34–36</sup> Their agents are contained in products that are valued by society. This is in contrast to pathogenic microbes that are usually not valued by society. Because of that value, individuals seek industrial products, and in considering regulatory action, society has to weigh their value to individuals, society, and corporations against their hazard to health. Further, the importance of corporations in contemporary political economy gives them an ability to determine societal values,<sup>31,34–36</sup> and their influence over government gives them the power to affect the economic environment, while their influence on governmental regulation gives them the ability to influence the physical environment. These various influences take place in environments that are at various distances (socially, temporally, and geographically) from the hosts. Therefore, while the public health host–agent–environment triad is compatible with corporate vectors, it must be modified with a multilevel approach to the social structures linked to corporations at various distances from the point of contact of their agents and the hosts.

## MULTILEVEL EPIDEMIOLOGY

Notwithstanding calls for upstream studies of causes of disease by McKinlay in the 1970s<sup>42</sup> and the renewed interest in social inequality and disease following the Black report in 1980,<sup>43</sup> epidemiologists maintained their focus on the nonhierarchical web causation model<sup>44</sup> and on the risk-factor black-box model<sup>45</sup> until the 1990s. There followed a surge of interest in multilevel<sup>46</sup> and systems-oriented approaches<sup>47</sup> to causality in epidemiology, but it was not until the middle of the 1990s that an active

search for new approaches started. Then, Krieger presented her critique of the web of causation model,<sup>48</sup> Pearce pointed to what had been lost in the change from traditional environment-oriented epidemiology to the person-oriented modern epidemiology,<sup>49</sup> and the Sussers presented their Chinese boxes model.<sup>50</sup> Multilevel analysis was well established in epidemiology by that time, but studies were centered on the effects of group-level characteristics on individual-level outcomes.<sup>51</sup> Krieger developed the concept of embodiment<sup>52–54</sup> for the interaction of person and society that is central to the epidemiologic theory.

However, new methods for multilevel epidemiologic investigations did not develop. There may have been two reasons for this. First, as pointed out by McMichael,<sup>55</sup> epidemiologists are “prisoners of the proximal” who are impaired in studying events distal to their subject, the host. Second, the levels that have been used may be too general. For instance, Krieger listed them as global, national, regional, areas or groups, household, and individuals.<sup>56</sup>

## ANALYTICAL FRAMEWORK

The analytical framework presented here was developed initially in studies of homelessness<sup>57</sup> and of disability.<sup>58</sup> In this multilevel model, the levels are defined in ways that relate them to the flow of power through a social environment that has a harmful effect on people (the hosts), a different unit of analysis is used at each level, and explained variables defined on the unit of analysis at one level become explanatory variables defined on the unit of analysis at the next lower level. In this way, the framework provides a putative causal chain extending from the highest level of societal power to the host, referred to here as an “epidemiologic cascade.”

In previous studies of disability, this framework was tested and further developed with case studies that confirmed the robustness of the framework as a translevel causal chain and also showed the importance of additional explanatory variables including level-specific variables that are external to the causal chain and intra- or interlevel positive and negative feedback variables.<sup>58</sup>

In the present context, the site of social power is a corporate–government complex that directs the production and sale of a product that contains an agent of disease for its consumers, the hosts. Such products include tobacco, alcohol, foods, cars, guns, or drugs.<sup>4,31</sup> The same framework can also be used for products that are harmful to workers in the job environment or to community residents exposed to effluents or waste products of corporate activity in their community<sup>5</sup>; however, this article is restricted to harm done to consumers of the products.

The analytical framework is shown in Table 1. The epidemiologic cascade variables are in bold type; feedback variables are in italics; other variables are in regular type.

In the first and most distal level, the unit of analysis is the government. The term corporate–government complex is used in this article to refer to the great influence of corporations on government; however, the government is the final authority, and therefore it is the unit of analysis at level 1. Government includes its executive, legislative, and judicial branches at the federal, state, and local levels. The explanatory variables at level 1 include past government actions, problems faced by the government, and other external influences, including, as an important feedback loop from level 2, pressure from corporations. The explained variables are governmental policies and actions, i.e., laws, regulations, court decisions, or governmental interventions.

**TABLE 1 The epidemiologic cascade**

Level	Explanatory variables	Units of analysis	Explained variables
1	<b>Political factors</b> <i>Corporate pressures</i> Other pressures	Government	<b>Government policies</b>
2.	<b>Government policies</b> Market opportunities <i>Conduits feedback</i> Past profits	Corporation	<b>Corporate decisions aimed at increasing sales and profits</b>
3	<b>Corporation decisions</b> Other influences	Conduits	<b>Corporate pressures on the environment</b>
4	<b>Corporate pressures on the environment</b> Other influences	Environment of the hosts; retailers	<b>Modified environment</b>
5	<b>Modified environment</b> <b>Sales pressures</b> Other influences Host decisions	Hosts	<b>Consumption of product and corporate profits</b>
6	<b>Consumption of product</b> Host factors Environmental factors	Hosts	<b>Disease outcome</b>

In the second level, the governmental policies and actions (explained variables of level 1) become explanatory variables at level 2. The unit of analysis is the corporation or its highest decision making level, including executives, their consultants, and board members. Other explanatory variables are feedback from lower levels, market opportunities, and past profits. The explained variables are profit targets and the actions initiated by corporate decision makers to secure such targets.

In the third level, the actions initiated by corporate decision makers (explanatory variables) are passed on to corporate conduits, the next unit of analysis. Conduits are individuals or organizations employed by, under contract with, or acting in the interests of corporations that carry on the actions initiated by the corporations' decision makers. Examples of conduits are distributors, advertisers, public relations, trade associations, lawyers, or scientists. They do not usually engage in direct interaction with the hosts. Their actions, the explained variables, aim to modify the environment in specific ways, referred to as pressures on the environment, to promote sales of the product, by making it more attractive to the consumer or otherwise facilitating and overcoming barriers to sales.

In the fourth level, corporate pressures on the environment (explanatory variables) interact with the environment and the retailers, the units of analysis at that level, and these interactions result in a modified environment, the explained variable. Examples of environmental features that may be modified include retail sites, products for sale, advertisements, or peer pressure.

The modified environment (the explained variable at level 4) becomes an explanatory variable at level 5, and it interacts with the host who is the unit of analysis at that level, to yield, as explained variables, exposure to disease agents present in the products that are consumed.

The sixth level shown in Table 1 has the host as the unit of analysis, consumption of the product as the explanatory variable, and disease outcome as the explained variable.

## **APPLICATION OF THE FRAMEWORK TO EPIDEMIOLOGIC SURVEILLANCE FOR CORPORATION-INDUCED DISEASES**

This presentation of epidemiologic surveillance of corporation-induced diseases starts with the lowest level and proceeds upstream because epidemiologic surveillance is more developed at the lower than the upper levels.

### **Level 6**

The level 6 unit of analysis is the population (host) at risk of the disease. The explanatory variable is the exposure to agents contained in consumed corporation products. The object of surveillance (the explained variable) is the prevalence of diseases associated with these agents. Data are easy to obtain at that level. They are useful for case-control studies with nonexposed populations, and they may be used as documentation for compensation lawsuits, catalysts for studies at the higher levels, and an alert to the public.

### **Level 5**

At level 5, the unit of analysis is also the host. The explanatory variables are environmental features that facilitate consumption of the product (the explained variable of level 4), along with other factors that may influence the host. The object of surveillance at that level, the explained variable, is the consumption of the agent-containing product. Surveys may assess consumption with behavioral markers (e.g., history of use of product or actual observation) or biological markers (such as the presence of the agent in body fluids or tissues or in deoxyribonucleic acid adducts). This form of surveillance is relatively late in the epidemiological cascade, but it often allows enough time for effective secondary prevention and for taking measures to decrease further consumption in the population.

### **Level 4**

At level 4, the units of analysis are the environments of the host such as towns, neighborhoods, and retailers. The explanatory variables are the actions of conduits that modify the environment to increase sales or profits. The objects of surveillance, i.e., the explained variables, are descriptors of the modified environment. They can be grouped in several categories, as indicators of:

- (a) Product availability, such as number of retail units (e.g., vending machines, restaurants, bars, gun dealers), their location, and time of sales
- (b) Amount of product usually provided for consumption, such as the portion size,<sup>59-60</sup> density of automobile traffic, and frequency of gun fights
- (c) Concentration of the agent in the product or its disease-producing power, such as the strength of street drugs, amount of nicotine in cigarettes, amount of alcohol in drinks, or amount of unhealthy fatty acids, sugar, or salt in foods
- (d) Product promotion in advertisements, free samples, or role models in movies
- (e) Reassurance about the safety of the product, in outlets to the public at large
- (f) Peer pressure to buy the product as it is revealed in questionnaire studies
- (g) Effectiveness of campaigns to extol users of products, to present a favorable image of the corporation, and to promote people's free choice to use the products

In addition to inducements for buying the product, the explained variables include the results of efforts to decrease barriers to sales by lowering:

- (h) Taxes on the products and therefore their price<sup>61</sup>
- (i) Legal barriers to the sale of the product, such as sites for smoking, age restrictions for sales of products or driving licenses, and restrictions on gun sales

Clearly, a large number of indicators are available to assess the environment of consumption. They may be used to assess over time the direction of change in the environment. Further, they provide a guide to countermeasures that may address each environmental change and to study their efficacy in reducing consumption.<sup>8</sup>

Further work may help to elucidate the fraction of the environmental pressure on consumption represented by each indicator as well as the interactions among indicators. When that is done, it may be possible to construct a single index of pressure for consumption of a given product in a given environment. Such an index might be a better tool to assess the corporation-attributable fraction of risk to health rather than one based on a single indicator such as advertisement.

Surveillance at level 4 followed by dissemination of information is a potent catalyst to organize the community against hazardous environments. It is a guide to public health authorities for primary preventive measures in the environment. In contrast with surveillance at the three levels discussed above, epidemiologic surveillance at levels 1 to 3 is a relatively new undertaking for public health authorities.

### Level 3

There is a considerable body of knowledge regarding the corporate conduits for tobacco,<sup>6</sup> food,<sup>7</sup> and alcohol.<sup>8</sup> The conduits, the units of analysis at level 3, may be categorized as (a) market specialists, distributors, (b) advertisers, (c) public relations workers, (d) lawyers, and (e) scientists.<sup>31</sup> The objects of surveillance, i.e., the explained variables, are (a) what markets are currently being developed, where and with what target groups, and what products, (b) what the conduits' plans are for diffusion of information via advertising or other promotion, (c) what educational or issue-framing messages are being prepared by public relations organizations, (d) what court actions are being initiated by lawyers for the corporations, and (e) what programs are being developed to recruit, instruct, and oversee scientists to do studies that put the corporation products in a good light.<sup>23</sup>

New sources of information seldom used by epidemiologists are needed at level 3, such as trade journals for the various types of conduits, articles in periodicals, periodic reports of the corporations to their stockholders and to the Securities and Exchange Commission, newsletters from companies that advise investors on stocks, inquiries with the corporations' information services, careful reading of publications released by the corporations or their allies, analysis of the boards of directors of organizations that are suspected of working on behalf of the corporations, monitoring court actions organized by corporation lawyers, and analysis of scientific reports or papers that are at a significant variance with other research results regarding the safety of corporation products, especially to detect study designs favorable to the corporation and evidence of financial support of the research by the corporations. Information from these sources may stimulate steps to oppose corporate pressures on the environment.

**Level 2**

Level 2 units of analysis are the corporations or their decision makers, e.g., president, top-level executives or consultants, and board members. The explanatory variables include governmental policies and actions relevant to the corporations, as well as features of the economy that reveal market opportunities. The objects of surveillance, i.e., the explained variables, are the strategies developed by the executives of the corporations to increase sales and profits by developing new and strengthening old markets, making the products more attractive, projecting a positive image of the corporation, and neutralizing the effects of scientific reports of harmful effects of their products. These strategies guide the selection and instruction of conduits.

Surveillance at level 2 has not yet emerged in a systematic way. When it does, it will encounter several obstacles, foremost among which is the secrecy in which a corporation makes and transmits their decisions. This may require new sources of information for epidemiologists, such as trade publications, financial magazines, stock broker appraisals of companies, and reports to the Securities and Exchange Commission, all of which are readily available. Regulatory agency staff is often the cognizant of corporations' activities, and they may be a source of information. Corporation whistle blowers, investigative reporters, and academic scientists have often been good sources of information.<sup>6</sup> The opening of records of tobacco corporations following the Master Settlement<sup>62</sup> has become an important source of information. Company documents released during court actions may also provide data on corporate strategies. The importance of surveillance for explanatory and explained variables at level 2 is that it provides information on activities of corporations well in advance of events that may lead to harm so that legal or political action may be undertaken to prevent them.

**Feedback Explaining Variables**

Variables that provide feedback are important at all levels but particularly at the upper ones. Feedback from corporations (an explanatory variable at level 1) either directly from the corporate executives at level 2 or through lobbies that are corporate conduits at level 3, has a profound effect on governmental actions relevant to corporate activities, and therefore they are an important object of epidemiologic surveillance.

Such feedback variables include information provided to the government by research contracts with corporations,<sup>7,11</sup> sharing of other corporate research information with the government,<sup>7,11</sup> participation in commissions or committees organized by the government,<sup>11</sup> networking within the government to influence regulatory reports of permissible levels of agents in products,<sup>14</sup> timing of implementation of decisions,<sup>25</sup> or even selection of a more favorable regulatory agency.<sup>26</sup> Other such variables are the direct influence on policy makers or administrative staff, based on prospects of future jobs with the corporation, the so-called revolving door,<sup>7</sup> gifts, or, in the instance of elected officials, financial support for their electoral campaigns.<sup>7</sup>

Feedback variables that have an impact on the government are an important object of surveillance. Epidemiologists may keep track of the representation of corporation executives in governmental commissions or committees; of governmental contracts to corporations; and, of registered lobbyists for the corporations, as well as records of corporate inputs into congressional hearings or responses to federal requests of comments before regulations are issued.<sup>7</sup> Lobbying activities on behalf of corporations are also important objects of surveillance.

Surveillance for these feedback activities provides epidemiologists with information prior to governmental action, and they may transmit this information to public health officials who may in turn exert their own pressure on legislators at or before markup or on executive staff before regulations are issued or work with legislators and executive staff to propose new legislation or regulations.

### Level 1

At level 1, the unit of analysis is the government, either as a whole or one of its departments or regulatory agencies, and the explanatory variables include (a) past governmental actions or laws that impose constraints on the government, (b) the political climate of the nation (conservative or liberal, probusiness or prolabor, inclined to solidarity or supportive of social and economic inequality etc.), political party in power, public opinion about the corporation and pressures from various interest groups, cost and cost-benefit considerations regarding preventive action, legislators' factors regarding the particular industry (for instance, is it important in the legislator's district?), and time variables, such as relative urgency of action, and (c) influences from corporations or their conduits as discussed in the section on the feedback variables above.

When the unit of analysis is a regulatory agency of the government, the level 1-explained variables may be a regulation or the implementation of a regulation. When it is an executive department, the explained variable may be a governmental contract to a corporation. When the unit of analysis is the legislature, the explained variable may be a law. When it is a judicial body, the explained variable may be a court action. Examples of level 1 surveillance include daily monitoring of the Federal Record, the Congressional Record, Congressional hearing schedules and reports, and analyses of final laws and regulations.

The significance of level 1 surveillance is that it highlights government actions that are favorable to corporation-induced harm so that one may relay that information to the public and to health-related interest groups who may engage the government and elicit public support against governmental actions that facilitate such harm.

## APPLICATION OF THE FRAMEWORK TO URBAN HEALTH

Epidemiologic approaches to urban health are usually listed as ecological, with the city as the unit of analysis (to find how characteristics of cities relate to measures of the health of their populations), contextual, with the individual as the unit of analysis (e.g., to study how characteristics of the area where the individuals live relate to their health), and multilevel, with two units of analysis, i.e., the city or the unit in the city and the individual (to find how characteristics of the city or a unit thereof relate to the health of individuals independently from other individual factors).<sup>63</sup> The framework proposed here provides a different kind of multilevel epidemiologic approach referred to as an epidemiologic cascade. In the epidemiologic cascade, each level has a different unit of analysis, and a putative causal chain links these units across the different levels.

This approach is particularly suitable for epidemiologic studies of urban health. The physical and social environments of cities provide a high number of explanatory variables.<sup>64</sup> However, these are in turn produced by social forces upstream of that environment. Urban areas in the postindustrial or metropolitan age are highly dependent upon movements of capital that lead to concentration or deconcentration,<sup>65</sup> gentrification or redlining, and neglect and are accompanied by moves of both

low-level unskilled workers and professionals, management or financial services in and out of cities, and of financial and other services to keep up with these changes.

Capital flows in postindustrial cities are controlled chiefly by corporations whose policies lead to large movements of real-estate, financial, and industrial products in and out of cities or neighborhoods. Disinvestments by financial, real-estate, and industrial corporations lead to decay or even contagious destruction of neighborhoods.<sup>66</sup> Conversely, corporate investments may lead to growth of neighborhoods or even of whole cities. A second upstream influence on urban areas derives from the dependence of urban areas upon a hierarchy of governments, including those of the town or county, the state,<sup>67</sup> and the federal government.

The relationships among these levels and their projections down to urban areas and residents of these areas are outlined in Table 2. The epidemiological cascade starts with real-estate, financial, and development corporations as units of analysis in level 1 of Table 2, where it is motivated by prospects of economic gains (explanatory variables) that lead to strategies for concentration or deconcentration of resources in specific areas. This step is usually integrated with interaction with the government, the unit of analysis in level 2, which leads to local governmental support for the corporations' project. Surveillance at levels 1 and 2 in Table 2 may be conducted with the same general approaches as in the earlier discussion based on Table 1. The integrated activities of corporations and government may go on for years before changes occur in the cities. Thus, surveillance at levels 1 and 2 of Table 2 may give public health authorities the time to develop resistance at the public opinion and governmental policy levels.

Developments at levels 1 and 2 determine the fate of a given neighborhood, whether growth or decay. In both instances, financial, service, housing, and industrial corporations (the latter corporation including tobacco, alcohol, food, cars, guns, and other products) have input through conduits in the neighborhood, but the nature of the input differs for growing and decaying areas.

In growth areas, some corporations promote products that are associated with so-called diseases of affluence,<sup>68</sup> while others promote healthy foods, exercise facilities, and other healthy activities that contribute to better health. Corporations also have important markets in poorer neighborhoods (central city in the USA, industrial suburbs in Europe) that provide them with special opportunities. Poor residents have in general fewer of the resources needed to avoid harm to health.<sup>69</sup> Their environment is often stressful, and they may respond to stress by smoking, drinking, or eating excessively. They have few legal resources to mount defenses in administrative offices or in courts. Further, they have concentrations of a special population that serves as targets for corporate advertising and promotions such as children, immigrant, or minorities.

Corporations target poor urban populations for profit. They promote harm at city schools in the form of junk foods and foods rich in calories and unhealthy fatty acids.<sup>7</sup> Tobacco and alcohol companies target specifically Afro-American or Hispanic residents in poor areas of cities.<sup>70-74</sup> Youth are also targeted in such areas.<sup>75,76</sup> Sophisticated attention to culture is used to target young adults in different minority groups.<sup>77</sup> Real-estate corporations make a profit out of low-income areas by minimizing their services to poor housing,<sup>58</sup> thereby making it unhealthy.<sup>78</sup> The percentage of children exposed to noxious car effluents increased with decreased median family income for all races except whites.<sup>79</sup> The gun industry profits indirectly from the large number of guns used in central cities, even though they are often obtained illegally.

**TABLE 2 Epidemiologic cascade in urban setting**

Level	Explanatory variables	Units of analysis	Explained variables
1	Opportunities for growth and for financial gains	Corporations (developers, and financial institutions)	Projects for investments or disinvestments in urban areas
2	Projects for investments or disinvestments in urban areas	Government	Approval/modification of project
At that point, the involved areas are on their way to growth or decay and the next steps will involve different corporate pressures for (a) growth areas and (b) decay areas			
3	Final investment/ disinvestment decisions	Corporations (real estate, food, alcohol, tobacco, cars,)	Decisions for promoting outlets in the areas
4	Decisions for promoting and setting up outlets in the area	Conduits	Pressures on the local environment
5	Pressures on the local environment	Local environment retailers	Modified sales environment
6	Modified sales environment; host factors; environmental factors	Hosts	Consumption of products
7	Consumption of products Host factors Environmental factors	Hosts	Disease outcome

## DISCUSSION

The epidemiologic cascade framework is subject to the same causal criteria<sup>38</sup> and precautionary principle<sup>80</sup> as other domains of epidemiology. The causal chain that extends down the cascade accounts for only some of the potential causal factors at each level. Upstream case studies of disability<sup>58</sup> revealed intra- and interlevel feedbacks as well as external factors at each level, some of which may be instances of the indirect causes discussed by Krieger.<sup>56</sup> Case studies may be needed, with qualitative methods, before enough is known about the variables that are involved at the various levels to devise studies with quantitative methods.

The challenge of this approach is that it targets the institutions and systems that mediate the social power and social forces that social epidemiology has been concerned with for some time. It could enrich thinking about social causes of disease. The approach may also be important in surveillance studies because it targets initiators of harm to health and also because it provides surveillance at several levels, some of which may be more amenable to timely preventive action. It may also guide action at different levels in public health campaigns to change corporate practices that harm health.<sup>81</sup> These surveillance studies would require new sources of information that epidemiologists have not used in the past and might require collaboration with scientists in social or managerial disciplines that have more germane expertise.

This approach to surveillance may be relevant to urban health, particularly at the most distal one (levels 1 and 2 of Table 2) where it may help to detect planned urban changes that could modify the nature of neighborhoods and it would give community organizations and public health advocates<sup>81</sup> time to react preemptively.

## REFERENCES

1. Coffey TG. Beer street: gin lane—some views of 18th century drinking. *Q J Alcohol Stud.* 1966;27:669–692.
2. Majnoni d'Intignano B. Epidémies industrielles. *Commentaire.* 1995;71:557–565.
3. Majnoni d'Intignano B. Industrial Epidemics. In: Chinitz D, Cohen J, eds. *Government and Health Systems: Implications of Differing Involvements.* Chichester, NY: Wiley; 1998.
4. Majnoni d'Intignano B. *Économie de la santé.* Paris: Presses Universitaires de France; 2001.
5. Jahiel RI, Babor TF. Industrial epidemic, public health advocacy, and the alcohol industry: lessons from other fields. *Addiction.* 2007;102:1335–1339.
6. Kessler DA. *Question of Intent: A Great American Battle Against a Deadly Industry.* New York: Public Affairs; 2001.
7. Nestle M. *Food Politics: How the Food Industry Influences Nutrition and Health.* Berkeley, CA: University of California Press; 2002.
8. Babor TF, Caetano R, Casswell S, et al. *Alcohol: No Ordinary Commodity.* New York: Oxford University Press; 2003.
9. MacLennan CA. From accidents to crash: the automobile industry and the politics of injury. *Med Anthropol Q.* 1988;2:233–251.
10. Lillienthal D. The silence: the asbestos industry and early occupational cancer research. *Am J Public Health.* 1991;81:791–800.
11. Markowitz G, Rosner D. *Denial and Deceit.* Berkeley: University of California Press; 2003.
12. Rosner D, Markowitz G. *Deadly Dust: Silicosis and the Politics of Occupational Disease in Twentieth Century America.* Princeton: Princeton University Press; 1991.
13. Sass JB. Industry efforts to weaken the EPA's classification of the carcinogenicity of 1,3-butadiene. *Int J Occupat Environ Med.* 2005;11:378–383.
14. Castleman BI, Ziem GL. Corporate influences on threshold limit values. *Am J Ind Med.* 1988;13:531–539.
15. Egilman DS, Bagley S, Biklen M, Golub AS, Bohme SR. The beryllium “double standard” standard. *Int J Health Serv.* 2003;33:769–812.
16. Lanska DJ. Limitations of occupational air contaminant standards as exemplified by the neurotoxin n-hexane. *J Public Health Policy.* 1999;20:441–457.
17. Roach SA, Rappaport SM. But they are not thresholds. A critical analysis of the documentation of threshold limit values. *Am J Ind Med.* 1990;17:727–753.
18. Gennaro V, Tomatis L. Business bias: how epidemiological studies may underestimate or fail to detect increased risks of cancer and other diseases. *Int J Occup Environ Health.* 2005;11:356–358.
19. Michaels D, Monforton, C. Contested science and the protection of the public's health and environment. *Am J Public Health.* 2005;95:S39–S48.
20. Procter RN. *Cancer Wars: How Politics Shape What We Know and Don't Know About Cancer.* New York: Basic; 1995.
21. Fagin D, Lavelle C. *Deception: How the Chemical Industry Manipulates Science, Breaks the Law and Threatens Your Health.* New Jersey: Birch Lane; 1997.
22. Rampton S, Stauber S. *Trust Us We're the Experts: How Industry Manipulates Science and Gambles With Your Future.* New York: Penguin Putnam; 2000.
23. Ong EK, Glantz SA. Constructing “sound science” and “good epidemiology”. Tobacco, lawyers, and public relation firms. *Am J Public Health.* 2001;91:1749–1757.
24. Michaels D. Waiting for the body count: corporate decision-making and bladder cancer in the dye industry. *Med Anthropol Q.* 1988;2:215–232.
25. Monforton C. Weight of the evidence or wait for the evidence? Protecting underground miners from Diesel particulate matter. *Am J Public Health.* 2008;96:271–276.
26. Muggli ME, Hurt RD, Repace J. The tobacco industry's political efforts to derail the EPA report on ETS. *Am J Prev Med.* 2004;26:167–177.

27. Siegel M, Doner L. *Marketing Public Health. Strategies to Promote Social Change*. Sudbury, MA: Jones & Bartlett; 2004.
28. Menashe CL, Siegel M. The power off a frame: analysis of newspaper coverage of tobacco issues—United States, 1985–1996. *J Health Commun*. 1998;3:307–325.
29. Michaels D. Doubt is their product. *Sci Am*. 2005;292(6):96–101.
30. Bohme SE, Zornbedian G, Egilman DS. Maximizing profit and endangering health: corporate strategies to avoid litigation and regulation. *Int J Occupat Environ Health*. 2005;11:338–348.
31. Freudenberg N. Public health advocacy to change corporate practices. *Health Educ Behav*. 2005;32:298–391.
32. Mokdad AH, Marks JB, Stroup DF, Geberding JL. Actual causes of death in the United States, 2000. *JAMA*. 2004;291:1238–1245.
33. Galea S, Freudenberg N. Counting the impact of corporate practices on health. Paper presented at the 5th meeting of the Study Group on Industrial Diseases of the Ecole Libre des Hautes Etudes; February 8, 2007; New York, NY.
34. Spitzer S. A systemic approach to occupational and environmental health. *Int J Occupat Environ Health*. 2005;11:444–455.
35. Wiist WH. Public health and the anti-corporate movement: rationale and recommendations. *Am J Public Health*. 2006;96:1370–1375.
36. Reich RB. *Supercapitalism. The Transformation of Business, Democracy, and Everyday Life*. New York: Alfred A. Knopf; 2007.
37. Timmreck TC. *An Introduction to Epidemiology*. Sudbury: Jones and Bartlett; 1998.
38. Rossman KJ, Greenland S. *Modern Epidemiology*. 2nd edn. Philadelphia: Lippincott-Raven; 1998.
39. Sweanor D. Why tobacco companies proceed as they do. Presented at INGCAT International NGO Mobilisation Meeting; 15–16 May 1999; Geneva, Switzerland. Available at: [http://www.islamset.com/healnews/smoking/INGCAT/David\\_Sweanor.html](http://www.islamset.com/healnews/smoking/INGCAT/David_Sweanor.html). Accessed on: August 24, 2006.
40. Guardino SD, Daynard R. Tobacco industry lawyers as “disease vectors”. *Tobacco Control*. 2007;16:224–228.
41. Egger G, Awinburn B, Rossner S. Dusting off the epidemiologic triad: could it work with obesity? *Obes Rev*. 2003;4:115–119.
42. McKinlay J. A case for refocusing upstream; the political economy of illness. In: Gartley J, ed. *Patients, Physicians and Illness: A Sourcebook in Behavioral Science and Health*. New York: Free; 1979.
43. Black D, Morris JN, Smith C, Townsend P. *The Black Report (Report of the Working Group on Inequalities in Health)*. London, England: Penguin; 1982.
44. McMahon B, Pugh TF. *Epidemiologic Methods*. Boston, MA: Little Brown and Co.; 1960.
45. Peto R. The need for ignorance in cancer research. In: Duncan R, Weston Smith M, eds. *The Encyclopedia of Medical Ignorance*. Oxford, England: Pergamon; 1984.
46. Van Korff M, Koepsell T, Curry S, Diehr P. Multilevel research in epidemiologic research on health behaviors and outcomes. *Am J Epidemiol*. 1992;123:1077–1082.
47. Loomis D, Wing S. Is molecular epidemiology a germ theory for the end of the twentieth Century? *Int J Epidemiol*. 1990;19:1–3.
48. Krieger N. Epidemiology and the web of causation: has anyone seen the spider? *Soc Sci Med*. 1994;39:887–903.
49. Pearce N. Traditional epidemiology, modern epidemiology, and public health. *Am J Public Health*. 1996;86:678–683.
50. Susser M, Susser E. Choosing a future for epidemiology II from black box to Chinese box and eco-epidemiology. *Am J Public Health*. 1996;86:674–677.
51. Diez-Roux AV. Bringing context back into epidemiology: variables and fallacies in multilevel analysis. *Am J Public Health*. 1998;88:216–222.
52. Krieger N. Embodying inequality: a review of concepts, measures and methods for studying health consequences of discrimination. *Int J Health Serv*. 1999;29:295–352.

53. Krieger N. Theories for social epidemiology in the 21st Century: an ecosocial perspective. *Int J Epidemiol*. 2002;30:668–677.
54. Krieger N. Embodiment: a conceptual glossary for epidemiology. *J Epidemiol Commun Health*. 2005;59:350–355.
55. McMichael AJ. Prisoners of the proximate: loosening the constraints on epidemiologists. *Am J Epidemiol*. 1999;149:887–897.
56. Krieger N. Proximal, distal, and the politics of causation: what's level got to do with it? *Am J Public Health*. 2008;98:221–230.
57. Jahiel RI. Homeless-making processes and the homeless-makers. In: Jahiel RI, ed. *Homelessness: A Prevention-oriented Approach*. Baltimore: The Johns Hopkins University Press; 1992:269–296.
58. Jahiel RI. Social modulation of disability. Development of an analytical framework and study of distal interactions. *Eur J Disab Res*. 2007;1:23–42.
59. Young LR, Nestle M. The contribution of expanding portion sizes to the US obesity epidemic. *Am J Public Health*. 2002;92:246–249.
60. Nielsen SJ, Popkin BM. Patterns and trends in food portion sizes, 1977–1998. *JAMA*. 2003;289:450–453.
61. Grossman M. Health benefits of increases in alcohol and cigarette taxes. *Br J Addict*. 1989;84:1193–1204.
62. Daynard WA, Parmet W, Kelder G, Davidson P. Implications for tobacco control of the multistate tobacco settlement. *Am J Public Health*. 2001;91:1967–1971.
63. Galea S, Vlahov D. Epidemiology and urban health research. In: Galea S, Vlahov D, eds. *Handbook of Urban Health. Populations, Methods and Practice*. New York: Springer; 2005:259–276.
64. Galea S, Vlahov D. Urban health: evidences, challenges and directions. *Annu Rev Public Health*. 2005;26:341–365.
65. Gottdiener M. *The Social Production of Urban Space*. Austin: Texas University Press; 1988.
66. Wallace R. Homelessness, contagious destruction of housing, and municipal service cuts in New York City. 1—demographics of a housing deficit. *Environ Plan A*. 1989;21:1585–16012.
67. Gurr TR, King DS. *The State and the City*. Chicago: The Chicago University Press; 1987.
68. Trowell HC, Burkitt DP. *Western Diseases, Their Emergence and Prevention*. Cambridge, MA: Harvard University Press; 1981.
69. Link BG, Phelan JC. Social conditions as fundamental causes of disease. *J Health Soc Behav*. 1995;35:80–94.
70. Luke d, Esmondo E, Bloom Y. Smoke signs: patterns of tobacco billboard advertising in a metropolitan region. *Tobacco Control*. 2000;9:16–23.
71. Yerger VB, Prsewoznik J, Malone RE. Racialized geography, corporate activity, and health disparities: tobacco industry targeting of inner cities. *J Health Care Poor Underserved*. 2007;16(4 Suppl):10–38.
72. Hackbarth DP, Silvestri B, Cooper W. Tobacco and alcohol billboards in 50 Chicago neighborhoods: market segmentation to sell dangerous products to the poor. *J Public Health Policy*. 1995;16:213–230.
73. Stoddard JK, Johnson CA, Sussman S, Dent C, Boley-Cruz T. Tailoring outdoor tobacco advertising to minorities in Los Angeles County. *J Health Commun*. 1998;3:137–145.
74. Romley JA, Cohen D, Ringel J, Sturm B. Alcohol and environmental justice: the density of liquor stores and bars in urban neighborhoods in the United States. *J Stud Alcohol Drugs*. 2007;68:4–55.
75. Ammerman SD, Nolden M. Neighborhood-based tobacco advertising targeting adolescents. *West J Med*. 1995;162:514–518.
76. Hilton C, Farrelly MC, Weitzenkamp D, Lindsey D, Haviland ML. Youth smoking prevention and tobacco industry revenue. *Tobacco Control*. 1996;15:103–106.

77. Alaniz ML, Wilkes C. Pro-drinking messages and message environments for young adults: the case of alcohol advertising in African American, Latino, and Native American communities. *J Public Health Policy*. 1998;19:447–472.
78. Krieger J, Higgins DL. Housing and health: time again for public health action. *Am J Public Health*. 2002;92:758–768.
79. Gunier RB, Hertz, A, Von Behren J, Reynolds P. Traffic density in California: socioeconomic and ethnic differences among potentially exposed children. *J Exposure Anal Environ Epidemiol*. 2003;13:240–246.
80. Foster KR, Vecchia P, Repacholi MH. Science and the precautionary principle. *Science*. 2000;288:979–981.
81. Freudenberg N, Bradley SP, Serrano M. Public health campaigns to change industry practices that damage health: An analysis of 12 case studies. *Health Educ Behav*. 2008 (in press).