A Guide for Health Impact Assessment

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Health impact assessment may be defined as a combination of procedures, methods and tools that systematically judges the potential, and sometimes unintended, effects of a policy, plan, program or project on the health of a population and the distribution of those effects within the population. HIA identifies appropriate actions to manage those effects.

-Adapted by the International Association of Impact Assessment from World Health Organization

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TABLE OF CONTENTS

The Values of Health Impact Assessment

From the International Association of Impact Assessment (Quigley, 2006)

Democracy – emphasizing the right of people to participate in the formulation and decisions of proposals that affect their life, both directly and through elected decision makers. In adhering to this value, the HIA method should involve and engage the public, and inform and influence decision makers. A distinction should be made between those who take risks voluntarily and those who are exposed to risks involuntarily (World Health Organization, 2001).

Equity – emphasizing the desire to reduce inequity that results from avoidable differences in the health determinants and/or health status within and between different population groups. In adhering to this value, HIA should consider the distribution of health impacts across the population, paying specific attention to vulnerable groups and recommend ways to improve the proposed development for affected groups.

Sustainable development – emphasizing that development meets the needs of the present generation without compromising the ability of future generations to meet their own needs. In adhering to this value, the HIA method should judge short- and long-term impacts of a proposal and provide those judgments within a time frame to inform decision makers. Good health is the basis of resilience in the human communities that support development.

Ethical use of evidence – emphasizing that transparent and rigorous processes are used to synthesize and interpret the evidence, that the best available evidence from different disciplines and methodologies is utilized, that all evidence is valued, and that recommendations are developed impartially. In adhering to this value, the HIA method should use evidence to judge impacts and inform recommendations; it should not set out to support or refute any proposal, and it should be rigorous and transparent.

Comprehensive approach to health – emphasizing that physical, mental, and social well-being is determined by a broad range of factors from all sectors of society (known as the wider determinants of health). In adhering to this value, the HIA method should be guided by the wider determinants of health.

PREFACE

Health Impact Assessment (HIA) has a simple and common sense purpose—to make visible the potentially significant human health consequences of public decisions and thus to facilitate the greater consideration of health in policy decisions. HIA allows decision-makers to: identify plausible, potential harms or benefits to health; enumerate the health benefits or adverse consequences of various policy options; analyze disproportionate or unequal harms or benefits to different populations; and modify policy design in more protective, beneficial, or equitable ways. HIA can provide a structure for discussion of issues where health concerns are a source of public controversy and can help generate buy-in for policy implementation.

HIA is a process that employs many types of evidence or expertise; each HIA includes a procedural step for determining the breadth of issues that will be analyzed in the process and the methods that will be employed. HIA is applicable to any policy sector (e.g., natural resources development, land use, labor). Internationally, several governments provide substantial technical and financial support for HIA and HIA is more routinely incorporated into public policy processes (WHO HIA). In California and the United States, the use of HIA is rapidly increasing, though without specific institutional mandates or extensive resources or guidance for practitioners. This Guide aims to fill a need in this emerging field by outlining key steps, activities, and issues in the HIA process.

The Guide complements Practice Standards for Health Impact Assessment published on April 7, 2009 by the North American HIA Practice Standards Working Group (www.hiacollaborative.org).Those standards are the collective product of HIA practitioners working in the North American context to translate the values underlying HIA, provide a set of benchmarks to guide HIA practice, and stimulate discussion about HIA content and quality.

The intent of the Guide is to support current and prospective practitioners of impact assessment in California and the United States, to foster thoughtful and high-quality use of HIA, and to promote consideration of health in all policies. The Guide provides a brief background on HIA, an outline of essential and common tasks in the HIA process, discussion of common issues and challenges encountered in the HIA process, examples of and links to resources for practice. It also provides suggestions for integrating health analysis within the regulatory environmental impact assessment process, obtaining inclusion from diverse stakeholders, and evaluating the HIA process. The Guide may be useful for public health or regulatory agencies responsible for implementing HIAs.

This Guide is not proscriptive, definitive, or exhaustive, nor is it a methodological toolkit for all HIA analysis. The guide does not address how to develop the capacity to conduct or institutionalize HIA (e.g., technical skills), how to construct a project team, budgeting, etc. The resources section of the guide provides links to other articles, guidance documents, and references that provide complementary information.

I. INTRODUCTION AND BACKGROUND

Living in a healthy place means having adequate housing; a secure and meaningful livelihood; access to schools, parks, and public spaces; safety and freedom from violence; unpolluted air, soil, and water; and a society that promotes not only opportunity and innovation but also cooperation, trust, and equity.

What is Health Impact Assessment (HIA)?

HIA is a systematic, structured practice that uses the best available theory and evidence to make reasoned judgments on the prospective health impacts of policy decisions, including projects, plans, programs, and policies undertaken by government or the private sector. Other defining characteristics of HIA include a broad definition of health and health determinants, application to policy making in all sectors, involvement and engagement with decision makers and affected stakeholders, explicit concern with vulnerable populations, and a commitment to inclusion and transparency (Quigley 2006). The two primary outputs of HIA are an analysis of health impacts and decision alternative and mitigation strategies to ensure that decisions protect and promote health.

Why conduct health impact assessment?

Living in a healthy place means having adequate housing; a secure and meaningful livelihood; access to schools, parks, and public spaces; safety and freedom from violence; unpolluted air, soil, and water; and a society that promotes not only opportunity and innovation but also cooperation, trust, and equity. While it is scientifically established that our health depends on such qualities and resources, the health impact of changes to these resources are often not explicitly considered by decision makers in most policy sectors (Marmot and Wilkinson 1999). In fact, the most important determinants of health and disease are subjects of policy making in institutional sectors outside the authority of the public health sector.

In 1986, the World Health Organization (WHO) urged policy makers in all sectors to "be aware of the health consequences of their decisions and to accept their responsibilities for health." (WHO 1986) Furthermore, WHO called on policy makers to conduct HIAs of their actions with significant effects on social, economic, and environmental conditions? The fundamental premise behind HIA is that decision-making processes informed by analysis of health impacts will lead to more health-promoting policy actions. HIA aims to support healthy public decision making in the following specific ways:

- **Identifying harms and benefits before decisions are made:** Sound public policy requires information on potential health impacts, including information on both short- and long-term effects and impacts on socially excluded or vulnerable populations.

HIA findings and recommendations can inform and motivate beneficial and health-protective changes to the design of a project or policy.

- **Identifying strategies for decisions to protect and promote health:** HIA offers strategies to address potentially significant adverse health impacts or to extend potential health benefits of a policy decision. Strategies can take the form of new decision alternatives, modifications to the proposed policy, program, or project; or targeted mitigation and monitoring measures.

- **Supporting inclusive and democratic decision-making:** Democracy and the ethical use of evidence are key values underlying HIA practice (Quigley 2006). HIA is not intended to endorse or oppose a policy or project - rather it is a way to provide information for the public and decision makers to help them understand the health impacts of a proposed decision and decision options and alternatives. Public health concerns can also be prominent sources of controversy in public decisions and HIA provides a way to respond to those concerns. Because protecting health is a widely shared value, HIA may identify areas of cooperation among opposing interests and common strategies that apply to diverse interest groups. Furthermore, a transparent accounting of impacts along with mitigations may support buy-in for decision implementation.

- **Protecting Social Equity and Justice** Environmental justice is defined as the "…fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies" (Clinton 1994). HIA provides a method to assess and address the health concerns of vulnerable populations with substantive analysis and alternatives and can promote social and environmental justice and reduce health inequities.

Steps in the HIA Process

1. ***Screening*** involves determining whether an HIA is valuable and feasible.
2. ***Scoping*** involves determining health issues for analysis, the temporal and spatial boundaries for analysis, and research methods.
3. ***Assessment*** involves using data, expertise and qualitative and quantitative research methods to judge the magnitude and likelihood of potential health impacts, their significance, and identifying appropriate mitigations and design alternatives.
4. ***Reporting*** involves synthesizing the assessment findings and communicating the results. This can take many forms including written reports, fact sheets, comment letters, and public meetings.
5. ***Monitoring*** involves tracking the decision and implementation effect on health determinants and health status.

- **Planning health and public health service delivery** Because HIA can anticipate changes in future conditions important to health, it may be valuable in planning health and public health service delivery and interventions.

- **Catalyzing social and institutional learning** A successful HIA identifies impacts, helps to fill knowledge gaps in decision making, and influences design for a particular policy, project, or plan. It also can serve as a tool for public and institutional learning. For example, HIA may lead to health-promoting design recommendations or mitigations being incorporated proactively into subsequent plans and projects at the design and planning stage.

What are the steps and activities in the HIA process?

HIA is an emerging practice in the United States and applications to date have been diverse in terms of approach, methods, and public engagement (Dannenberg 2008). As the purpose of HIA is to inform and support decision making, an HIA is optimally carried out prospectively before a decision is made. HIA can be useful at any stage of policy or project design; however, the earlier in the decision-making process that an HIA can be carried out, the greater the likelihood that HIA may provide timely information to decision makers to help understand the consequences of various alternatives.

The typical procedural steps in HIA are similar to those for other forms of impact assessment (e.g. environmental, social, and strategic) and include screening, scoping, assessment, reporting, and monitoring. These steps along with related tasks, methods, and resources are the subject of subsequent sections of this guide.

1. **Screening** involves determining whether HIA is valuable and feasible in a particular decision-making context.
2. **Scoping** involves determining health issues for analysis, the temporal and spatial boundaries for analysis, and the data and research methods employed in the analysis.
3. **Assessment** involves using data, expertise, and qualitative and quantitative research methods to judge the magnitude and likelihood of potential health impacts, their significance, and identifying appropriate mitigations and design alternatives.
4. **Reporting** involves documenting and synthesizing the assessment findings and communicating the results and recommendations of the assessment.
5. **Monitoring** involves tracking the decision and implementation effect on health determinants and health status.

HIA practice may occur along a broad continuum of breadth, methods, participation, and integration into regulatory processes. Choices in the scoping step - such as those regarding the issues analyzed, spatial and temporal boundaries for impacts, methods used, and timing of the process - should reflect the specific context and the priority health needs, interests, and questions of stakeholders and decision makers. Depending on the comprehensiveness and the methods employed, an HIA may take more or less time to complete.

A Continuum of HIA Practice		
Focused on analysis of a discrete hazard, exposure, or health outcome	**Breadth** ↔	Comprehensive consideration of all potential health effects, including positive and negative effects
Conducted by a single expert or public institution	**Participation** ↔	Oversight by multiple stakeholders or community members in partnership with public institutions
Stakeholder initiated	**Regulatory Integration** ↔	Integration within existing regulatory and non-regulatory assessment processes
Based on existing data and published research	**Methods** ↔	Collection and analysis of new data using multiple quantitative and qualitative methods

What health issues does HIA consider?

HIA employs a holistic definition of health and considers a broad set of social and environmental conditions to be determinants of health status. Issues and impacts analyzed within HIA can include physical and mental health outcomes like mortality and disability, behavioral factors, and environmental, social, and economic conditions.

Health Determinants Potentially Impacted by Public Policy Decisions			
Health Behaviors	**Neighborhood Services and Public Infrastructure**	**Environmental Conditions**	**Social, Economic, and Political Factors**
Diet Physical activity Smoking Other addictions Coping	Education Public transportation Health care Parks Community centers Water and waste systems	Housing Air, soil, and water quality Community noise Disease vectors	Livelihood Inequality Social cohesion and inclusion Political participation

How can HIA fit into existing governance institutions?

Currently, no laws explicitly require the use of HIA, per se, as an approach or method in regulatory analysis. Several legal frameworks in the United States at the federal and state levels require decision makers to analyze and avoid health effects and impacts. HIA is one method that could be used to achieve existing mandates under these rules.

For example, the National Environmental Policy Act (NEPA) of 1969 requires comprehensive and integrated environmental impact assessments of decisions with major effects on the physical environment and specifically mandates analysis of significant health effects in the development of an Environmental Impact Statement (EIS) (NEPA, 1969). State laws similar to NEPA, like the California Environmental Quality Act (CEQA), have equivalent requirements. Historically, there has been limited attention to health effects in the environmental review process, and several published empirical reviews suggest that health analysis in NEPA is currently inadequate (Arquiaga, 1994; Steinemann, 2000). For more information on NEPA, see Appendix II.

HIA may serve other policies, laws, and institutions that require health analysis. For example, Executive Order 12898 on Environmental Justice instructs all federal agencies to: “make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States (Clinton 1994).” Analysis of environmental justice impacts has served to protect health supporting resources in NEPA practice (Bass 1998).

Specific health analysis and HIA requirements are occasionally included in legislation. For example, California’s Global Warming Solutions Act (AB 32, 2006), asks the

California Air Resources Board (CARB) to consider the health effects of its proposed strategies and regulations to reduce or mitigate greenhouse gas emissions and state law separately mandates CARB to consider environmental justice issues in all policies and regulations. Washington State legislation (SB 6099, 2007) explicitly required an HIA to inform mitigation planning for the State Route-520 Bridge in Seattle by quantifying project effects on air pollution exposure and other hazards.

How does HIA differ from Health Risk Assessment and other Health Assessment tools?

HIA is a process that uses diverse analytic tools. Human health risk assessment (HRA) is one analytic method for estimating health impacts. Typically, HRA is used to analyze discrete relationships between a single environmental contaminant and a single health outcome. HRAs are occasionally conducted as part of environmental impact assessment under NEPA or other regulatory assessments, and can be used as one method in HIA. HRA requires substantial data including a documented weight of the evidence relationship between the exposure and the outcome, a quantifiable dose-response function, and data on changes in exposure. Currently, sufficient data to conduct HRAs exists for only a limited number of health-relevant environmental exposures and conditions.

The scope of health effects considered in an HIA is usually much broader than that analyzed by a single HRA and includes physical, social, and economic determinants. HIA is distinct from data, research or forecasting methodologies that may be used in the HIA process. For example, GIS tools and primary or secondary environmental measures (e.g., noise, air pollutants, housing conditions) can be used to profile baseline conditions in HIA. Epidemiology studies can elucidate causes of disease and exposure-response relationships. Environmental modeling allows prediction of hazardous exposures both spatially and temporally. Methods of economic valuation, similar to those used in cost-effectiveness analysis (CEA), and cost-benefit analysis (CBA), can provide a monetary perspective of impact in HIA.

What are some of the key lessons from HIA practice experience in the United States?

There has been limited formal evaluation of the HIA experience in the United States thus far (Wismar 2004). However, experience demonstrates that the practice has had important and productive outcomes (Corburn 2007). In some cases, transparent analysis of health impacts has shaped policy design through the inclusion of health promoting choices, alternatives, and mitigations. In other cases, HIA has catalyzed inter-disciplinary practices to begin to integrate health considerations in policy design. Where practiced, HIA appears to be affecting the knowledge of diverse public and private sector actors informing policy agendas, collaborations, and coalitions.

Key tips, based on experience of the author as well as published HIA evaluations, for effective HIA include following a systematic approach, being inclusive and transparent with process decisions, and responsibly and ethically using evidence. The North American HIA Practice standards, developed as a consensus among practitioners, provide an additional guide for quality practice with explicit objectives for each stage of the process.

- **Use all the steps of the HIA process** The steps of screening, scoping, assessment, reporting, and monitoring provide a tested approach for HIA. Screening considers factors that are predictive of the value and effectiveness of HIA. The systematic process will ensure comprehensive issue identification, prioritization of assessment resources, rigorous and robust analysis, and effective translation of findings and is flexible enough to be adapted to the needs of context.

- **Use a team approach involving decision stakeholders**
  A comprehensive assessment of health impacts requires a team approach with diverse skills and capacities. Public health expertise is essential but should be complemented with expertise in planning, environmental management, policy analysis, communication, and community engagement. Stakeholder involvement in HIA helps to accurately identify important health concerns and questions about a decision and provides insights about data and strategies for analysis.

General Plan Update, Humboldt County, 2008

As part of a General Plan update, the Board of Supervisors of Humboldt County asked the public health agency to consider the health impacts of three future growth alternatives ranging from restricting development to existing urban areas to allowing continued sprawl. The public health officer consulted with a non-profit organization to conduct an HIA on the three alternatives, with participation from the planning agency and a community group (Human Impact Partners, 2008). The analysis, based upon 35 community- prioritized indicators, found that the compact development alternative would improve health outcomes related to almost all the indicators, while the sprawl alternative would harm health. The HIA process led to a strong partnership between the planning and health agencies and an increase in participation in the General Plan process on the part of community members. The planning agency used the HIA extensively in forming the policies in the Circulation element and to support infill policies in the Housing Element.

- **Use the best available evidence and acknowledge limitations and uncertainty**

Judgments in HIA should be based on the best available evidence and should acknowledge evidence gaps and uncertainty. Certainty is not a reasonable or expected standard for HIA judgments. Practitioners should be aware of their own biases as well as those of stakeholders and decision makers.

- **Use regulatory requirements for health effects analysis as a vehicle for HIA findings when appropriate.** Existing law, including NEPA and CEQA, requires public health analysis of many decisions that may have adverse environmental impacts.
- **Provide a transparent account of the HIA process** Policy decisions may be contested politically and stakeholders may have firm positions about the value or costs of a particular course of action. The HIA should explain how scoping decisions were made and document its methods and findings.

II. SCREENING

Objective:

- **Determine whether to conduct an HIA.**

Because it is not possible or desirable to conduct an HIA on every project or policy decision, deciding whether to conduct an HIA (versus some other strategy to address health issues) should be the first step in the process (Taylor 2003). If health effects analysis is required by law, screening can consider whether HIA is the most useful method to achieve this mandate. Evaluating whether to conduct an HIA involves answering the following screening questions:

- **Value of HIA**
  - Are there potentially significant health effects associated with decision alternatives?
  - Could these impacts create or exacerbate health inequities?
  - Are the impacts already well understood or are they hidden, uncertain or controversial?
  - Are there potential approaches to mitigate health effects or leverage the decision to promote health not yet included in policy proposals?
- **Feasibility and capacity to do HIA**
  - Do available data and evidence support an HIA?
  - Are there resources and technical capacity to conduct analyses?
  - Is there leadership and commitment to communicate findings and recommendations within the decision-making process?
- **Receptiveness of the decision-making process**
  - Is the decision-making process open?
  - Do policy or legal requirements mandate addressing or mitigating health impacts?

Projects that may benefit most from HIA are those in which potential health impacts are significant or may disproportionately effect a vulnerable population: timely, meaningful analysis and effective communication is possible; and the decision-making process is receptive to the information. An HIA may not be warranted if existing regulations protect against a project's likely health impacts or a comprehensive and community responsive health analysis is already integrated with EIA.

An HIA may be particularly valuable if impacts are uncertain or there is controversy about the policy, plan, or project. An HIA may also be useful if health impacts are

scientifically established but not widely acknowledged or understood by decision makers and stakeholders or to evaluate strategies to mitigate known health impacts.

The feasibility of an HIA depends upon being able to conduct an informative HIA within the decision-making timeframe with available knowledge, methods, personnel, and other resources. Constraints on feasibility (e.g., limitations on data or time) may require limiting the scope of issues or methods of analysis.

The impact of an HIA depends, in large part, on the openness of decision makers to receiving and acting on the information. Openness is typically greater at earlier stages of policy or project development. If a decision-making process appears rigid, a HIA and effective communication may serve to open up the process to new issues and alternatives.

Effective screening requires having sufficient information about the decision needed, the decision makers, and stakeholders. Ideally, screening should involve decision makers and stakeholders to ensure constructive dialogue and acceptance of findings. Entities choosing to conduct an HIA should notify all stakeholders, responsible public officials, and the decision makers of these plans.

For some categories of decisions or projects, checklists may support issue or impact identification in the screening or scoping process. Below is an example of a checklist that can be used to scope the potential health impacts of land use and economic development decisions in a U.S. context. The list is not exhaustive or prioritized but illustrates the breadth of health determinants that may be considered in the scope of HIA. A similar checklist could be created or adapted from the example below for other project types or to reflect context specific concerns.

Example of a HIA Screening Checklist		
Essential Screening Questions	**Yes/No/ Unknown**	**Supporting Facts/ Rationale**
Value of and need for HIA ➢ Does the decision have the potential to effect, directly or indirectly (positively or negatively), health outcomes via environmental or social determinants of health? ➢ Could these impacts create or exacerbate health or social disparities? ➢ Are the proposal's impacts to health potentially significant in terms of the number of people impacted and/or the magnitude, breadth, and immediacy of impacts? ➢ Are the health impacts unknown, uncertain, or controversial? ➢ Could HIA recommendations potentially improve the impact that the plan, policy, or program has on health?		
Feasibility of conducting HIA ➢ Are leadership, resources, and technical capacity available to conduct analyses? ➢ Do data and research methods exist to analyze health impacts of concern associated with this decision? ➢ Which stakeholders have the interest and capacity to participate in an HIA (scoping, research, communication)?		
Receptiveness of the decision-making process ➢ Is there a pending decision regarding the project, plan, or policy? ➢ Has a final decision about the proposal been made? ➢ Are there policy/legal requirements mandating the consideration of direct and/or indirect health impacts? ➢ Is there sufficient time and is it feasible to analyze the project before a decision is made? ➢ Are stakeholders requesting an HIA to inform the decision-making process? ➢ Is the decision-making process open to HIA and/or recommendations for changes to design, mitigations, and alternatives?		

Health Determinants Potentially Impacted by Plans, Projects, and Policies	
Potential Effects on Health Determinants	**Relationship between Health Determinants and Health Outcomes**
Employment and Livelihood Will the decision affect: □ Level and security of employment? □ Proportion of the population living in relative or absolute poverty? □ Hazardous employment conditions? □ Employment quality or job benefits? □ Industrial diversity and resilience?	Unemployment results in material poverty, chronic stress, and low self-esteem. There is a dose-response relationship between income and life expectancy across the income distribution. Health care and sick leave benefits support the use of preventative care. Job autonomy predicts reduced mortality from cardiovascular disease.
Housing Will the decision affect: □ Housing affordability? □ Adequacy of housing supply? □ Quality or safety of housing? □ Residential segregation?	Crowded conditions can increase the hazard for infections, respiratory disease, fires, and poor mental health. Unaffordable rents or mortgages result in trade-offs between material needs such as housing, food, and medical care.
Food Security and Nutrition Will the decision affect: □ Supply or cost of food? □ Food safety? □ Access to food resources? □ Nutritional behaviors?	Adequate nutrition is necessary for normal development and growth, normal body homeostasis, immunity, and preventing obesity and diet-related diseases.
Environmental Quality Will the decision affect: □ Level of hazardous chemical or biological pollutants in outdoor air, soil, or drinking water[1]? □ Level of hazardous chemical or biological pollutants in indoor air? □ Level of environmental noise?	Air pollutant exposure retards lung growth, exacerbates respiratory disease, and increases cardio-pulmonary mortality. Indoor aero-allergens cause or exacerbate asthma. Water is a vehicle for communicable diseases. Chronic noise exposure harms sleep, temperament, hearing, and blood pressure. Solar and ionizing radiation are known carcinogens.

[1] Compliance with regulatory standards does not necessarily equate with health protection for all exposures or sub-populations.

□ Exposure to non-ionizing or ionizing radiation?	
Safety Will the decision affect: □ Demographic composition or social cohesion in an area? □ Risk and response to fire hazards? □ Hazard or frequency of transportation accidents or unintentional injuries?	Social cohesion inhibits crime and violence, which can result in injury or property loss and provoke fear or stress. Projects can stress capacity of public safety institutions, limiting their response capacity to emergencies. Projects may increase motor vehicle traffic and collisions.
Transportation Will the decision affect: □ Access to jobs, goods, services, and educational resources? □ Number of trips walking and bicycling? □ Vehicle miles traveled? □ Vehicle volumes or speeds? □ Availability and convenience of public transit services?	Access to employment, education, parks, and health care are critical for meeting health needs. Public transit provides such access for those without automobiles. Pedestrian and bicycle facilities facilitate active transport, reducing heart disease, diabetes, obesity, blood pressure, osteoporosis, symptoms of depression, anxiety, and falls in the elderly. Vehicle volume is proportional to collision rates and vehicle speeds are proportional to injury severity.
Education Will the decision affect: □ Access and capacity of schools for children or adults? □ Quality of educational resources?	Educational success predicts both health status and life expectancy. Children commuting to school get less sleep and exercise and greater exposure to vehicle pollution. Quality community schools can promote parent participation and good educational outcomes.
Parks and Natural Space Will the decision affect: □ Quality, proximity, or access to parks and public spaces? □ Natural spaces or habitats?	Contact with nature facilitates cognitive and physical development and serves a restorative function throughout life. Park access increases physical activity and reduces the risk of developing heart disease, diabetes, osteoporosis, and obesity. Trees and greens space remove air pollution from the air and mitigate urban heat island effects.
Goods and Services Will the decision affect: □ Quality and proximity of financial institutions?	Timely access and use of primary health services can prevent serious hospitalizations. Quality child care increases childhood educational and job outcomes. Local financial institutions help families create and maintain

□ Quality and proximity of child care services? □ Quality and proximity of health services?	wealth.
Social Cohesion Will the decision affect: □ Quality or frequency of contacts with friends, family members, and neighbors? □ Attitudes towards or stereotypes of racial, social, and ethnic groups? □ Participation in voluntary organizations and activities?	Physical and emotional support buffers stressful situations, supports illness recovery, prevents isolation, contributes to self-esteem, and reduces the risk of early death.
Social Equity and Inclusion Will the decision affect: □ Segregation by race, ethnicity, or income? □ Degree of inequality in income or wealth? □ Degree or quality of participation in public decision making?	Social contact across ethnic and income groups ensures equitable access to public health and educational services. Residents of low-income and ethnically segregated neighborhoods experience high rates of teenage childbearing, tuberculosis, cardiovascular disease, and homicide. Income inequality in a region or country predicts population life expectancy independent of income in wealthy countries. Participation and power in the political process affects government responsiveness to health needs and crises.

III. SCOPING

Objective:

- **Create a plan and timeline for conducting an HIA that identifies priority issues, research questions and methods, and participants' roles.**

Scoping defines the research objectives, methods, and boundaries of the HIA process. Setting the scope of the HIA means determining:

- Who will conduct the analysis and under what oversight?
- Which specific decision alternatives will be evaluated?
- Which potential health impacts will be analyzed?
- What are the geographic and temporal boundaries for impact analysis?
- Will disparate effects on any subpopulations be considered?
- What data, methods, and tools will be employed to evaluate impacts?
- Which experts and key informants will be engaged?
- What is the plan for stakeholder engagement and public review of the HIA?
- What is the timeframe for the assessment?

Some of these scoping questions will be discussed initially in the screening stage of the HIA. The scoping stage goes beyond these initial considerations in screening to make decisions about the research and work that the HIA will entail.

While HIA should focus on health impacts of greatest potential significance, an HIA team should not be overly selective in scoping. For example, a HIA initiated by one individual, public agency, academic discipline, business entity, or community group may choose issues or methods for impact analysis that are aligned with their interests, expertise, or values. Similarly, recommendations may reflect only stakeholder or agency interests rather than the range of best available alternatives. Unwittingly, decision makers may accept a limited or incomplete HIA as a full and objective accounting of all health issues.

Leadership for HIA may come from diverse arenas in the public or private sector. An individual, organization, or agency undertaking an HIA must have the necessary capacity and resources to do so, including some expertise in the likely public health impacts of the project; the ability to collect or access data or knowledge about the health conditions, economy, social environment, and cultural characteristics of the affected communities; the ability to coordinate participation among stakeholders and public and private organizations; and the ability to communicate findings to decision makers. Regardless of which entity conducts or coordinates the HIA, assessment of a comprehensive scope of impacts benefits from having a team of contributors with a diverse set of skills related to assessment and reporting.

Broad participation in scoping ensures the most important issues and best evidence are included in the analysis. Stakeholder and community participation provide knowledge and access to data sources and analytic tools that may be used in the assessment phase of the HIA. Community members knowledgeable about conditions in a place and the particulars of a proposed action also support comprehensive issue identification. Local medical providers bring first-hand knowledge about the health problems of people living in a particular place. Local, state, and federal public health agencies conduct disease surveillance and maintain health data systems (e.g., vital statistics, communicable disease reports) on the baseline health status of affected populations, have expertise to identify and understand potential health impacts, and help establish local public health priorities.

Participation in the scoping phase should also include expertise from diverse sectors and subject disciplines. Scoping of HIAs often requires considering and evaluating complex causal pathways among policy or project decisions and health outcomes. Accordingly, the realm of possible pathways that connect decisions to health impacts involves diverse environmental conditions and human biological mechanisms and HIA needs to employ corresponding expertise. For example, analyzing environmental impacts of neighborhood conditions on respiratory disease could require understanding housing quality and adequacy, patterns of social interaction, air pollution emissions sources and exposure pathways, endemic respiratory diseases, and respiratory physiology. HIA aims to provide a comprehensive accounting of the most important health impacts and the dominance of one sector or discipline can both bias the choice of impact analysis questions and limit the capacity to conduct needed analysis. For example, if participants in scoping only have expertise in one subject area (e.g., air or water pollution), then these issues are likely to get priority consideration in the scoping and analysis process, perhaps to the detriment of assessing other issues of similar significance.

Stakeholders can have more formal roles in the oversight of HIA. For example, in conducting a HIA on expansion plans for the Port of Oakland, the University of California, Berkeley Health Impact Group established a collaboration agreement with West Oakland neighborhood residents and stakeholders. Under this agreement, community stakeholders reviewed and approved the scope of the HIA and took responsibility for communicating results while the university was responsible for research (West Oakland HIA Working Group, 2007). Stakeholder oversight that is representative of diverse interests can add a significant measure of legitimacy and authority to the HIA process and its findings.

Resources and capacity to conduct an HIA should be considered in the course of scoping. While there may be many important health impacts and needs for analytic approaches, the scope of an HIA may depend on available data and methods and technical capacity to conduct the assessment. HIA methods that require the least resources include literature review, secondary data analysis, document review, and focus groups. Typically, in urban areas, there exists substantial data on demographic, economic, and environmental conditions. Original data collection, whether through surveys, exposure analysis, or health risk assessment, can require significant expertise and capacity.

All the agreements regarding the scoping questions should be documented as a part of the HIA process. This includes deciding who defines priority questions, who conducts the assessment, who reviews the findings, who prioritizes the recommendations, and who owns and communicates the results.

The example below outlines the scope of a HIA for a hypothetical decision to widen a limited-access highway that runs through residential neighborhoods. (The identified health impacts and analytic methods in the example should not be considered exhaustive.)

Hypothetical HIA Scope of a Highway Expansion Project	
Decision: Whether to Widen a Ten-Mile Stretch of Highway by Adding a Lane	
Scoping Question	**Response**
Roles?	• Local health department: Coordination, research, and report writing • University: Research and impact analysis • Project Sponsor: Research and report review • Community oversight board: Report review, recommendation development, and stakeholder communications
Design alternatives?	• Adding a lane in each direction to an existing highway • Ongoing maintenance of existing highway • Redirection of construction and operation funds to municipal bus agency
Geographic and temporal limits?	• Impacts on residential communities living within 1000 feet of the highway (on both sides) along the ten-mile stretch • Current and future impacts over a ten-year period
Hypothesized impacts?	• Residential and business demolition and displacement along the corridor • Increased vehicle air and noise emissions • Pedestrian hazards in adjacent residential neighborhoods from increased traffic • Increased stress, impairment of sleep and cognitive function, and hypertension from noise • Respiratory and heart disease morbidity and mortality from air pollutant exposure • Change of employment or school, loss of social networks, and loss of community services from displacement • Property devaluation and migration of due to increased hazards and reductions of neighborhood livability
Potentially vulnerable populations?	• Families living in housing adjacent to highway • Low-income seniors from a senior center that is close to the highway • Students and staff at a community school adjacent to highway
Data for baseline conditions assessment?	• Existing environmental quality measures (e.g., noise, air pollution) from regulatory agency monitoring and available environmental documents • Traffic volume data from local and state transportation agencies • Traffic injury data from law enforcement agency • Data on neighborhood health status from local health department? or hospital records • Complaint data records from the environmental health agencies • Map of community businesses, public services, and other neighborhood resources • Demographic data and trends from census data • Property values and trends from local tax assessment data

Impact analysis methods	• Modeled current and predicted noise levels using FHWA Traffic Noise Model • Predicted impacts of noise levels on community annoyance, sleep disturbance, school outcomes, and hypertension • Modeled current and predicted air pollutant concentrations of particulate matter and nitrogen oxides using physical dispersion models • Predicted impacts on pollutant levels on premature mortality and asthma exacerbations • Conducted qualitative analysis of traffic volume effects on pedestrian hazards and barriers to access • Conducted demographic analysis of impact burdens • Conducted economic analysis of property tax values
Potential mitigations?	• Measures to reduce noise emissions (e.g., road surface treatments or speed reductions) and to mitigate exposure (e.g., sound walls or residential window retrofits) • Measures to reduce air pollution exposures inside residences (e.g., ventilation system retrofits) • Engineering measures to re-route or calm traffic in residential areas • Mitigation fund to relocate displaced residents or businesses within community
Experts and key informants?	• Traffic engineers, noise and air quality modelers, environmental epidemiologists, school and senior center officials, local city legislator, neighborhood center director
HIA Timeframe?	• Assessment to be completed within three to four months in order to submit to transportation board, which will decide in six months whether to proceed
Public review?	• Traffic, air quality, and noise engineers to review exposure modeling results • Community advisory body to review assessment and alternatives analysis • Public hearing to share results organized by community advisory board • Public comment period

IV. ASSESSMENT

Objectives:

- **Develop a conceptual model for impact analysis.**
- **Determine the baseline heath status, health-relevant conditions, and vulnerabilities in the population or area potentially impacted by the decision.**
- **Judge prospective health impacts using available data, qualitative and quantitative analysis, and expert and experiential knowledge.**
- **Identify strategies for policy, program, or project design, mitigations and alternatives to protect and promote health.**

Impact analysis aims to provide prospective judgments on the existence, magnitude, and direction of potential health impacts that may occur in the future contingent on alternative decision choices. These judgments may or may not include quantitative predictions or projections. Impact analyses can serve several different purposes for decision makers. They can identify previously hidden, potential scenarios in which harms or benefits might occur, allowing decision makers to modify or design policy in protective or beneficial ways. They can enumerate costs and benefits and allow for a more comprehensive analysis of trade-offs. They may offer predictions or projections of effects, allowing evaluation against an established standard or criteria for action. They can serve to gauge or plan an adaptive response or they can be responsive to public concerns or questions. The needs of the decision-making process should be explicitly considered in determining the type and form of impact analysis.

While HIA may use diverse sources of evidence (e.g., empirical research, expert opinion, local knowledge, quantitative models) to evaluate hypothesis and research questions, it does not typically generate new empirical evidence. Rather, HIA uses existing theory and evidence to make judgments and evaluate future scenarios. The evidence used in HIA must be evaluated for internal and external validity; however, as HIA judgments are generally not testable or falsifiable, their validity may be better judged in terms of plausibility and transparency (Veerman 2007; Petticrew 2007). Issues related to the sources and uses of evidence and the validity of judgments are discussed in the sections below.

Developing a Conceptual Model

Impact analysis requires a conceptual model (logic model) linking the decision at hand to human health effects. Conceptual models are a framework for plausible scenarios for changes in population health in the future contingent on a particular decision. The conceptual model usually outlines several linked causal relationships and forms the basis of questions used to evaluate health impacts.

Conceptual models for HIA may integrate theories and empirical research from diverse disciplines. For example, a simple model linking a decision to expand a motor vehicle roadway with morbidity from asthma is illustrated below.

Roadway widening → Vehicle volume → Air Emissions → Pollutant Concentration → Pollutant Exposure → Asthma Morbidity

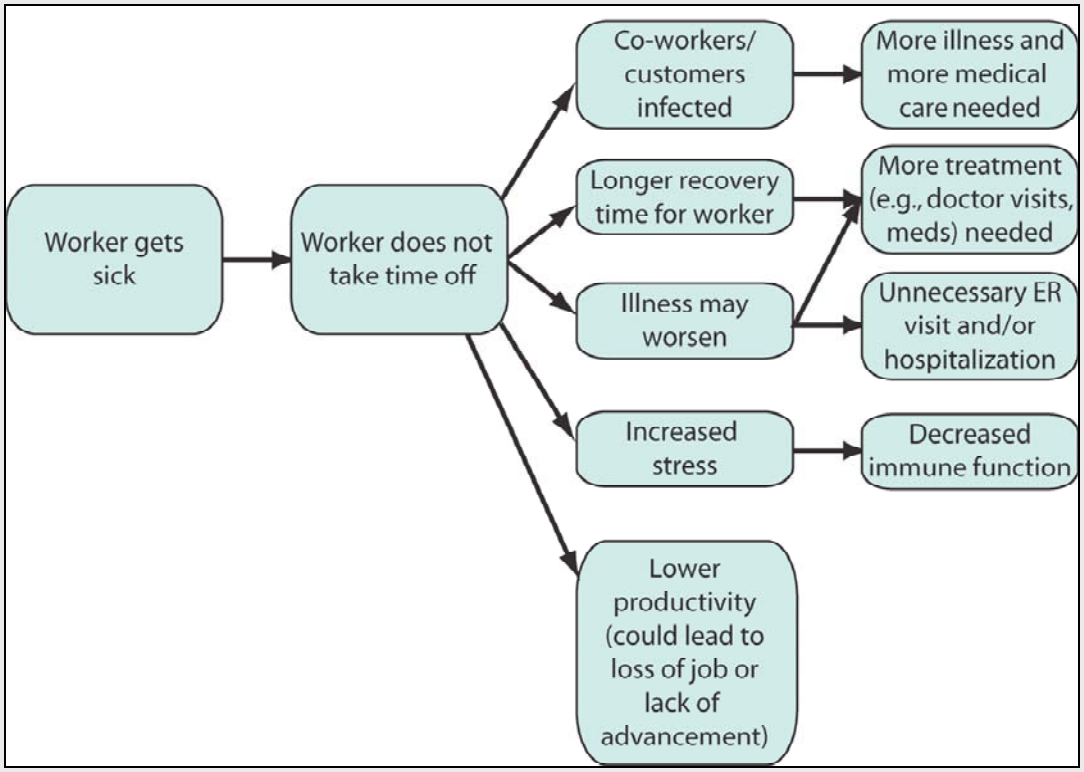
The relationship between roadways and vehicle volume is a function of transportation behavior, the relationship of vehicle volume to pollutant exposures are physical effects described by mechanistic models, and the relationship between exposure and morbidity is a biological effect established though epidemiologic research.

Conceptual models used in HIA should consider the interplay among contextual, environmental, and cultural factors; human and social behavior; and human biology. For example, the transmission of a communicable respiratory disease at the population level involves social contact among people in households, workplaces, and schools; environmental factors such as household crowding and ventilation; and social factors such as income and support networks.

The scenario described in the figure below—developed for an HIA of legislation mandating paid sick days in California—describes what might happen if a sick worker does not take unpaid time off and instead goes to work sick with a disease communicable through casual contact. Having access to paid sick days is hypothesized to influence the probability of the sick worker staying home from work. If the sick worker attends work when sick, he or she may transmit disease to co-workers or customers. If the worker defers rest or medical care, he or she may require more time to recover or suffer more severe disease requiring a greater level of health care intervention.

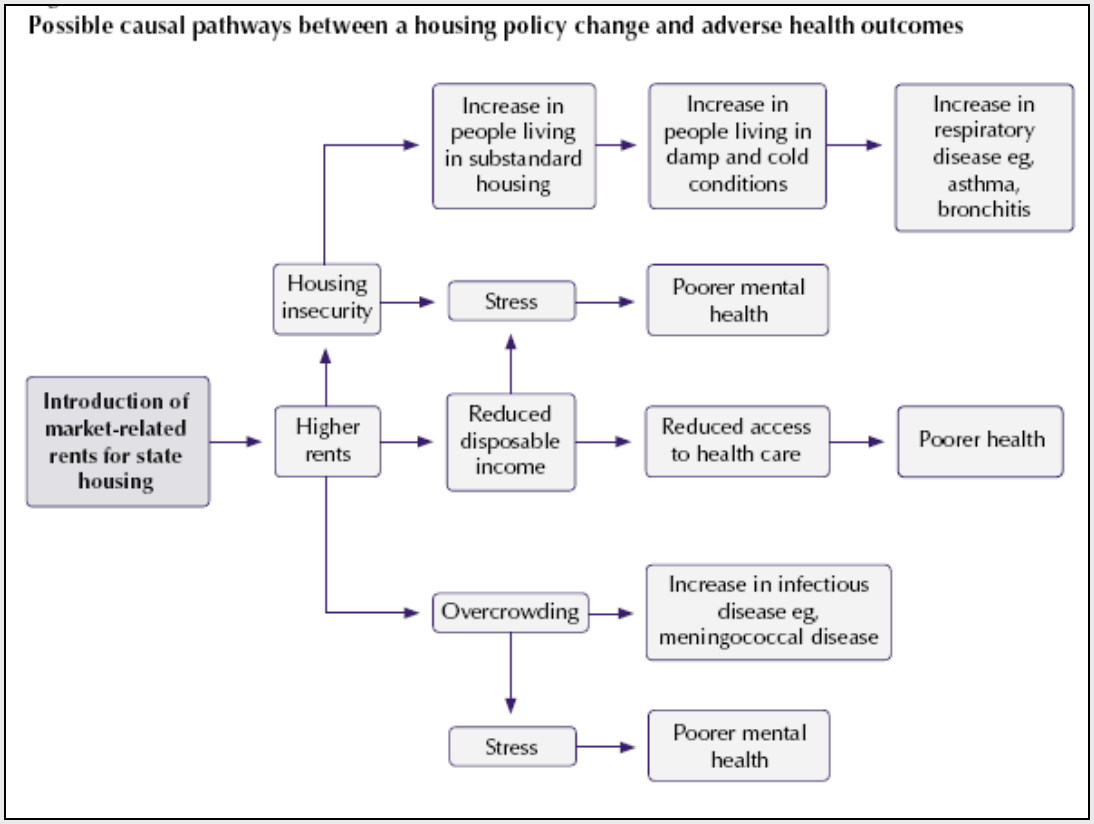
Conceptual models for HIA can describe multiple causal steps between decisions and health outcomes. Longer causal chains may introduce uncertainty with regards to the effect or its magnitude; however they do not necessarily make health effects implausible or unimportant. The scenario below describes a sequence of potential health consequences that may arise from changes in a housing rent policy for state housing. The immediate effect is increased housing rents. Secondary effects include housing insecurity, living in substandard housing, overcrowding, or an inadequate household income for essential needs. Tertiary effects are on health status and disease outcomes.

Potential Health Impacts of Worker Going to Work Ill



Source: Bhatia R, et al. A Health Impact Assessment of the California Healthy Families, Healthy Workplaces Act of 2008. Oakland, California: Human Impact Partners and San Francisco Department of Public Health. July 2008.

Potential Health Impacts of Changes in Housing Rents



Source: *Public Health Advisory Committee. A Guide to Health Impact Assessment: A Policy Tool for New Zealand. 2004*

Epidemiologic and Empirical Research

Epidemiologic and other empirical research is used in HIA in developing and evaluating the conceptual models and alternative scenarios. Empirical research provides evidence to support or refute causal links in models and to predict the magnitude and likelihood of effects.

All empirical evidence should be systematically evaluated for internal and external validity. A statistical or spatial association based on empirical observation through epidemiologic and empirical studies does not necessarily demonstrate cause and effect. In general, causal inferences should be made on the basis of the weight of the evidence. Reviews of evidence for HIA should use a priori study inclusion criteria reflecting the outcomes, exposure variables, and populations or time periods of interest and should be attentive to limited study power and biases due to selection error, loss to follow-up, analytic methods, and confounding (Mindell 2006). Criteria, such as those proposed by Sir Bradford-Hill, may help evaluate whether the weight of evidence lends support for a cause and effect relationship (Hill 1965). In considering external validity, the reviewer should consider whether it is appropriate to generalize findings from limited studies across time, place, or demographic subgroup. Evaluation of empirical research should be sensitive to documenting and addressing conflicting evidence.

Potential health impacts of the reallocation of mass transportation funds

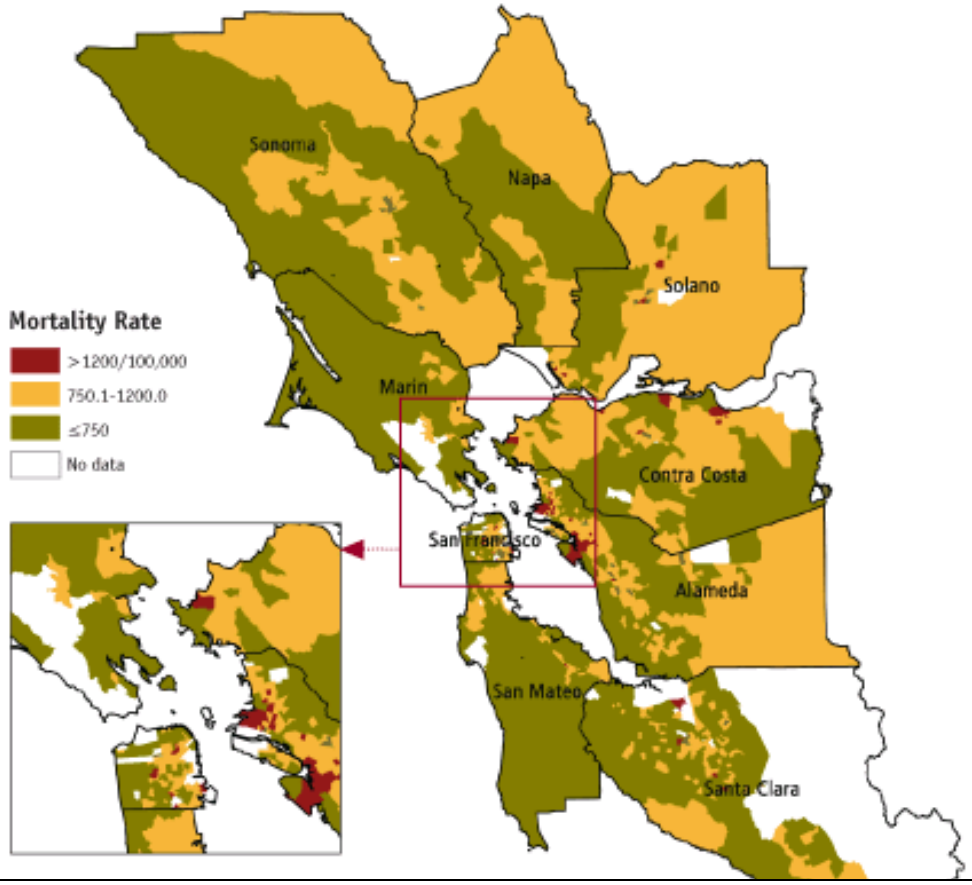
On August 21, 2007 the California State Legislature approved a budget that included the Governor of California's proposal reallocation of approximately $1.3 billion in mass transportation funding. A health impact assessment (HIA) of this proposal published in 2008 reviewed the research literature in consultation with experts in the transportation field to identify eight potentially significant pathways through which the proposed cuts to transit funding might impact public health: air, water and noise pollution; economics, land-use, physical activity, discretionary time and social capital. (UCLA, 2007)

Searchable databases, like PUBMED maintained by the National Institutes of Health, provide access to empirical literature in biomedicine and other disciplines (www.ncbi.nlm.nih.gov/pubmed). The Guide to Community Preventive Services is a collection of systematic reviews of programs and policies to improve health and prevent disease (www.thecommunityguide.org). In addition, the Cochrane Collaboration (www.cochrane.org) and the Campbell Collaboration (www.campbellcollaboration.org) provide systematic reviews, respectively, of medical and of social interventions in education, crime and justice, and social welfare. Public agencies, colleagues, online searches, and professional networks are sources for other unpublished works.

Baseline Conditions

A profile of existing conditions is necessary in HIA to depict the current health status of affected populations as well as potential sensitivities, vulnerabilities, and needs. Understanding baseline conditions is particularly important for HIA because pre-existing conditions both at the community and individual levels can mediate health impacts associated with environmental changes. For example, populations with baseline exposure to high levels of air pollutants or a high prevalence of diseases sensitive to pollution may be vulnerable to adverse health impacts from small incremental increases in air pollution.

Profiles of baseline conditions may include indicators for health status (e.g., life-expectancy) as well as indicators for known social, economic, and environmental health determinants (e.g., wages, air pollutant concentrations). Profiles of baseline conditions can illustrate variation or inequities in health status or health determinants related to place or population characteristics. Such inequities may highlight vulnerabilities related to health impacts or needs for project or policy design. For example, the map below illustrates the regional variation in mortality rates by census tract in the San Francisco Bay Area. The substantially higher localized rates in some tracts likely reflect a concentration of conditions adverse to health (e.g., poverty, social disorder) and lack of health assets (e.g., livelihood, parks, schools).



Regional Variation in Mortality Rates in the San Francisco
Source: Bay Area Bay Area Regional Health Inequities Initiative (www.barhii.org)

The selection of indicators for a baseline conditions analysis should reflect priority health issues being addressed in the HIA. Examples of potential community-level health indicators are provided in the table below.

	Examples of Health Status and Health Determinants Indicators
Health Determinants	**Examples of related social Indicators**
Livelihood	▪ Proportion of area residents employed ▪ Proportion of area residents living in relative or absolute poverty ▪ Share of jobs that meet health supporting criteria: self-sufficiency incomes, paid sick leave, health insurance, etc.
Housing	▪ Ratio of median income to median cost of housing ▪ Proportion of population living in overcrowded conditions ▪ Proportion of households without adequate heat, water, or sanitary services
Transportation	▪ Vehicle miles traveled per capita ▪ Proportion of households commuting to work by public transit ▪ Number, type, and location of traffic collisions
Retail and public services	▪ Proportion of population within ½ mile of a full-service grocery store or fresh produce market ▪ Proportion of population within a 30 minute transit or walking commute of a primary care public health facility ▪ Proportion of population within ½ mile of regional transit stop and ¼ mile of local public transit stop ▪ Proportion of residential units within ¼ and ½ mile of public elementary and middle schools
Access to parks and natural space	▪ Proportion of population within ¼ mile of neighborhood or regional park, open space, or publicly accessible shoreline ▪ Acres of neighborhood parks and natural habitats per capita ▪ Proportion of land area under tree canopy
Access to primary health services	▪ Proportion with government provided health services or health insurance ▪ Proportion of households within 1 mile of a health care center or primary care services
Environmental quality	▪ Proportion of population living a safe distance from roadways and industries emitting hazardous pollutants ▪ Capacity of drinking water supply ▪ Proportion of population living with ambient noise levels below 65 decibels ▪ Acres of cultivatable land ▪ Per capita waste generation
Social cohesion	▪ Proportion of voting age population participating in elections ▪ Perceived level of safety and “trust” of neighbors ▪ Rates of violent and property crimes ▪ Residential segregation by race/ethnicity and income

Data Sources, Data Collection, and Indicators Systems

To the extent feasible, analysis in HIA will use existing data from the diverse sources available. For example, in the United States, the Behavioral Risk Factor Surveillance System (BRFSS) provides data on indicators of certain health behaviors and risk factors, the National Center for Health Statistics (NCHS) compiles national vital statistics, and the Bureau of Labor Statistics (BLS) provides data on labor and employment conditions. Data on environmental conditions are available from regulatory

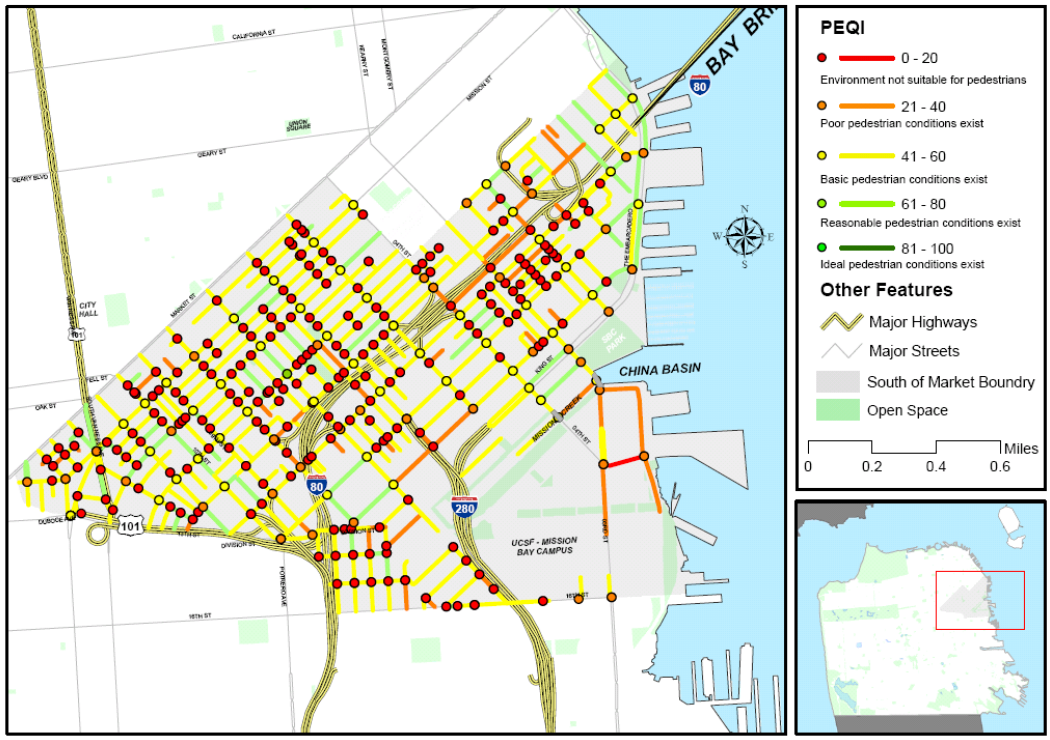
agencies and are often mapped spatially. For example, the U.S. Clean Air and Clean Water Acts created a national system to monitor select pollutants and the U.S. Environmental Protection Agency maintains national data on air and water quality. Local and state governments may track diverse data including traffic volumes, ambient levels of noise, traffic accidents, reported crime, and housing code violations. The University of California, Los Angeles (UCLA) HIA Clearinghouse (HIA-CLIC) maintains links to different data sources and methods useful for HIA (http://www.ph.ucla.edu/hs/hiaclic/).

Numerous place-based comprehensive indicator systems have been developed to monitor conditions relevant to health. Communities Count is a comprehensive health indicator system for King County, Washington (www.communitiescount.org). The Connecticut Association of Directors of Health has devised the Health Equity Index as a tool for evaluating social conditions in a community (www.cadh.org). In San Francisco, the Department of Public Health developed the Healthy Development Measurement Tool (HDMT) that includes a comprehensive set of community health indicators (www.thehdmt.org). The community indicators consortium (http://www.communityindicators.net/), Sustainable Measures (http://www.sustainablemeasures.com/), the International Sustainability Indicators Network (http://www.sustainabilityindicators.org/), Redefining Progress (http://www.rprogress.org), the CDC environmental public Health Indicators Project (http://www.cdc.gov/nceh/indicators/) are other sources of social, environmental, and economic indicators.

Desired data may not always be available to inform decision making or may not be available at the needed geographic scale. When unmet data needs exist, HIA may involve original data collection or development of new indictors to illustrate health-relevant conditions For example, to support HIA for development projects, San Francisco developed a Pedestrian Environmental Quality Index (PEQI) that requires collecting data on factors such as street crossing distance, signal timing, cross walk treatments, lateral separation, traffic speeds, traffic volumes, driveway conflicts, turn conflicts, lighting, and shade trees (www.sfphes.org). Each variable is weighted and scaled so that the PEQI represents a cumulative score (maximum 100) for an intersection or segment. Gathering and presenting the data in this way can help evaluate existing conditions and hazards and prioritize infrastructure improvement needs of walkers.

The figure below illustrates a PEQI map for several mixed residential-commercial neighborhoods in San Francisco. While basic pedestrian infrastructure exists (e.g., sidewalks and marked crosswalks), the environment is not particularly desirable for walkers, due to wide, multi-lane streets and heavy traffic volumes.

Pedestrian Environmental Quality Index in South of Market, San Francisco



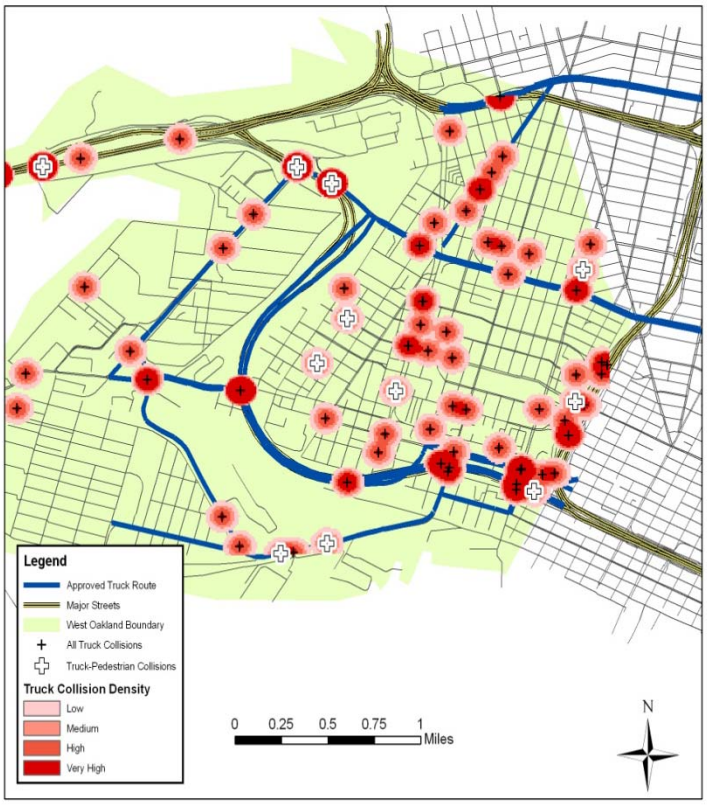
Other metrics generated to assess health determinants can be adapted for use in baseline conditions analysis. For example, the California Center for Public Health Advocacy created a Retail Food Environment Index (RFEI) based on the relative numbers of fast-food restaurants, convenience stores, supermarkets, and produce vendors. The baseline RFEI could help assess the scope, value, and impact of policies limiting or supporting alternatives to fast food outlets. CX3 is a tool developed by the California Department of Public Health Network for a Healthy California to collect neighborhood and store-level data on food and physical activity environments. Similar metrics to profile baseline health conditions could be developed to meet local needs and priorities for other issues and settings.

Mapping and Using Geographic Information Systems

Maps are commonly used in HIA to describe baseline conditions, but can also identify spatial relationships between places, populations, and environmental conditions and the joint spatial distribution of two or more conditions. Maps can illustrate the proximity of an environmental hazard in relationship to place or the presence of population and can illustrate the location of "hot spots" or spatial differences in the intensity of hazards. Furthermore, maps can illustrate the relationship between hazardous environmental condition and a vulnerability factor (e.g., sources of air pollution and presence of low-income households).

For example, air pollution, noise, and traffic hazards often share a distribution in relation to busy roadways. The map below illustrates the location and frequency of freight truck collisions related to freight routes in the West Oakland neighborhood of Oakland, California. The map used an existing state database of traffic collisions and local data on truck routes. The map, included in a HIA on maritime growth plans, illustrates spill over of truck traffic into residential neighborhoods from dedicated truck routes, indicating the need for actions to better ensure compliance to routes (UCBHIG, 2010).

Freight Routes and Truck-related Collisions in West Oakland



Maps can identify the location of community assets and resources related to health, including public infrastructure such as transit, private services like grocery stores, and natural resources like parks. This information may lead to inquiry to understand the value of these resources and their protection.

Spatial relationships among physical, economic, demographic, and health conditions depicted in maps may suggest causal hypotheses but do not necessarily prove cause and effect relationships. For example, the absence of supermarkets in areas where populations have higher rates of avoidable hospitalization for diabetes may illustrate the need for a health supporting resource but does not prove that lack of supermarkets is a principle cause of these hospitalizations or that the addition of supermarkets will lower hospitalization rates.

Maps can be used in HIA impact analysis in creative ways. In an HIA conducted to support the development of the Mac Arthur Bart transit village, existing aerial maps (accessed via google.org) served as a mechanism to evaluate the safety of pedestrian routes from the proposed village to common destinations (e.g., schools, parks).

Benchmarks and Standards

Another potential approach to analysis in HIA is to use existing qualitative or quantitative evaluative standards (e.g., benchmarks, checklists, thresholds) to assess the presence or absence of important health impacts.

EIAs commonly use an existing environmental rule or regulatory standard to determine whether an environmental effect is significant. If the measured or projected effect violates a rule or standard, then the impact is typically deemed significant. Available environmental standards are usually described in terms of a maximum level of emissions or discharges of a specific hazardous agent into the environment or a maximum acceptable level or concentration of a specific hazardous agent in an environmental medium (e.g., soil, air, water).

Using evaluative standards as a surrogate mechanism to conduct analysis in HIA is appealing because of efficiency; at the same time, reliance on such standards has several drawbacks and limitations. Formal rules or standards exist for a relatively small number of hazardous agents, noise, and radiation, and few standards exist for social and economic determinants of health. Standards for individual hazardous agents usually do not account for cumulative environmental effects. Standards may not reflect the most up-to-date scientific evidence, because they may not be revised frequently. In addition, as HIA often aims to provide a context-specific analysis, standards may have gaps or conflicts relative to local health priorities. Finally, since standard setting typically reflects both technical feasibility and political and economic considerations, standards may not be adequate to meet the actual health needs of a place or population.

Despite these limitations, it may be possible to develop health-based standards for use in HIA. The approach would require measurable and predictable outcomes, consensus on a health protective objective, and, in some cases, regulatory or legislative approval.

Some recent efforts have developed a broader set of health-relevant standards in land use planning decisions. For example, the Healthy Development Measurement Tool (HDMT; www.thehdmt.org) includes a checklist of quantitative and qualitative development targets that can be used to evaluate a typical urban development project. The development of the HDMT and these targets occurred both through a public process to select and prioritize impacts and indicators and a peer-review process to set quantitative targets (Farhang 2008). Design for Health's Thresholds Analysis Workbook (www.designforhealth.net) is a comprehensive score-based system that includes quantitative health thresholds for land use and urban planning (Forsyth 2009).

Qualitative research

Understanding local conditions and population vulnerabilities requires access to the day-to-day experiences of community members and their knowledge and perceptions of impacts. Such local knowledge (i.e., ecological knowledge) can be accessed through qualitative research including focus groups, structured and unstructured interviews, and group consensus processes. The local knowledge of community organizations and residents can complement or corroborate findings using other methods or raise additional hypotheses for research and analysis. Important local sources of expertise for HIA include community leaders, local medical providers, and public health officials. The text box above illustrates some of the health-relevant perceptions of the residents of the Trinity Plaza Apartment on their impending eviction and involuntary displacement.

Perceptions of residents facing eviction at the Trinity Plaza Apartments (SFDPH 2004):

- *[I] don't feel as I'm disturbing my neighbors when I ask for help when my sick husband has fallen and I cannot pick him up…. I know there is help around…*
- *I feel I had finally got the opportunity to settle down and be able to enjoy life at the age of 64, but now I have to worry, as I wonder where I'm going to move to when there is a lack of comparable rent in San Francisco.*
- *We are fearful, feelings are hurt, and [we're having] difficulty speaking about displacement, stressed, sleeplessness, anxiety, and the issue has been constantly going on.*

Quantitative estimation

HIA may also quantify measures of the magnitude of health impacts. Predictions in terms of common quantitative metrics (e.g., mortality, health care utilization) can also support direct comparisons among policy alternatives and economic valuation of policy costs or benefits.

Despite its desirability, quantitative estimation in HIA is not always feasible. Quantification of a prospective health effect should only occur if a causal relationship has been established between a decision effect and a health outcome and if a valid effect measure or "exposure-response" curve exists. These criteria suggest that quantitative estimation may not be possible for many of the potential health impacts of policy decisions.

Human health risk assessment (HRA) is an analytic tool commonly used in environmental regulatory analysis and impact assessment; it provides a quantitative estimate of a probabilistic risk or hazard of a physical exposure. HRA requires an established causal relationship and uses a known exposure-response function and data on changes in exposure and baseline disease prevalence. Exposure-response relationships are derived from animal or human experimental studies or epidemiologic studies and are often based on meta-analysis of high-quality studies or based on expert consensus. The output of HRA is expressed as a probability or frequency of a harmful effect on individuals or a population

resulting from environmental exposure. The HRA also documents the model, parameters, assumptions, and uncertainties used to make judgments.

Environmental regulatory agencies commonly use HRA in setting health-protective regulatory standards. For example, in a regulatory impact analysis of proposals to reduce the National Ambient Air Quality Standard (NAAQS) for PM2.5 (fine particles less that 2.5 micrometers in diameter), the U.S. Environmental Protection Agency (USEPA) determined that reducing the NAAQS for PM2.5 by 1 ug per cubic meter, from 15 to 14, would result in 1900 fewer premature deaths, 3700 fewer non-fatal heart attacks, and 2000 fewer emergency room visits for asthma each year (USEPA 2006). HRA is found infrequently in EIA as well (Steinneman, 2001).

HRA can be applied where policy effects include changes in environmental exposures. For example, forecasting impacts of a new transportation facility on respiratory disease could use predictions of motor vehicle emissions associated with changes in traffic volume and physical dispersion models to predict effects on regional and local air pollutant concentrations and then apply those exposures to pollution-respiratory disease dose-response functions. This approach has been used in several HIAs that have analyzed the impacts of new residential development adjacent to existing roadways.

Modified versions of HRA have been used to predict health impacts from changes in economic factors, such as income, in the absence of consensus on dose-response relationship. These applications have required careful consideration of the causal evidence and selection of effect measures from high-quality, externally valid studies. Using effect estimates directly from epidemiologic research, researchers have quantified changes in mortality and other health outcomes resulting from policies ranging from changes in wages (Bhatia & Katz 2001; Cole 2005 – see text box on this page), to climate mitigation strategies such as increased active transportation or decreased meat consumption. Evidence for causal relationships and quantitative effect measures or dose-response relationships exist for relatively few policy actions; this poses significant constraints for quantitative estimation, especially for innovative policies for which no empirical research exists. (See example of Menu Labeling HIA below.)

Health Impact Assessments on Two Living Wage Ordinances

San Francisco In 1999, at the request of the Board of Supervisors, the San Francisco Department of Public Health analyzed a proposed living wage ordinance for San Francisco, providing quantitative estimates of the impact of on adult health and children's development outcomes of adopting a living wage of $11.00 per hour (Bhatia& Katz, 2001). Using meta-analysis of peer-reviewed studies and effect measures relating income to health outcomes, the HIA predicted a decrease in the risk of premature death of 5% for adults 24-44 years of age in households whose current income was around $20,000. For the offspring of these workers, the analysis estimated that a living wage would result in an increase of a quarter of a year of completed education, a 34% increase in the rate of high school completion, and a 22% decrease in the risk of early childbirth. The analysis was used in city policy discussions both on the living wage and subsequent county wide minimum wage standard in 2003.

Los Angeles A 2005 HIA conducted by the UCLA Health Impact Project on the 1997 Los Angeles City Living Wage Ordinance found that both the wage and health insurance provisions of the ordinance would significantly reduce mortality among the approximately 10,000 beneficiaries (Cole 2005). The ordinance applied to employers engaged in work on city service contracts and mandated a $7.99 wage along with a $1.25 per hour contribution to health insurance benefits or an equivalent amount in additional wages. This HIA also concluded that providing health insurance was a more cost effective approach to reducing mortality than providing increased wages. The HIA did not estimate health impacts of additional ordinance provisions requiring at least 12 paid days off per year.

The table below identifies several examples in which HIA has employed data and tools to quantitatively estimate health impacts.

Examples of Quantitative Estimation in Health and Regulatory Impact Assessment

Subject / Reference	Outcomes Estimated	Data and Tools Used
State of California Ambient Air Quality Standards for Particulate Matter (CARB 2002)	▪ Mortality ▪ Respiratory Hospitalizations ▪ Acute Bronchitis ▪ Asthma ▪ Work Loss Days	▪ Concentration response functions derived from epidemiologic studies of PM 2.5 exposure ▪ California Department of Public Health mortality and morbidity statistics ▪ Difference between regional and background PM 2.5 concentrations based on state air quality monitoring networks
Neighborhoods Rezoning Plan, San Francisco, CA (CCSF, 2207)	▪ Changes in vehicle-pedestrian collision frequencies	▪ Area Level Regression Model of Vehicle-Pedestrian Injury Collisions (Wier 2009) ▪ San Francisco County Transportation Model ▪ Estimated population and vehicle trip changes associated with zoning changes ▪ Air pollution dispersion model (Bhatia & Rivard 2008) ▪ FHWA Traffic Noise Model (Seto 2007)
Pittsburg Railroad Avenue Specific Plan (HIP, 2008)	▪ Ambient particulate matter concentrations ▪ Ambient sound levels ▪ Traffic-attributable pre-mature mortality rates ▪ Noise-attributable sleep disturbance and annoyance	▪ Federal Highway Administration Traffic Noise Model ▪ Air Pollutant Dispersion Models ▪ Highway traffic volumes ▪ Meteorological data ▪ Transit service frequencies ▪ Commuter train noise measurement
San Francisco Living Wage Ordinance (Bhatia, 2001)	▪ Avoidable mortality ▪ High school graduation rates ▪ Teenage pregnancy	▪ Effect measure among income and health and child development outcomes based on controlled, prospective epidemiologic studies ▪ Bureau of Labor statistics on wages and income ▪ Future income based on current and proposed wage
Living Wage Ordinance, Los Angeles (Cole, 2005)	▪ Avoidable mortality	▪ Epidemiologic studies on income and mortality ▪ Epidemiologic studies on health insurance and mortality ▪ Estimated wage changes
Sugar Sweetened Beverage Regulatory Fee (Schneider, 2010)	▪ Share of medical expenses attributable to sweetened beverage consumption	▪ Meta-analysis of empirical research linking sweetened beverage consumption, overweight, and obesity ▪ Regression model of medical expenses and obesity status ▪ Local medical expenditure data
Redesign of Buford Highway, Atlanta (Rutt, 2010)	▪ Fatal and injury collisions ▪ Weekly minutes of walking	▪ Consensus crash reduction factors associated with transportation design interventions ▪ Observed relationship between perceived neighborhood pedestrian quality and minute of walking in San Diego
California Maximum Speed Limit Reduction (Bhabka, 2009)	▪ Changes in: greenhouse gas emissions ▪ Particulate matter emissions ▪ Fatal collisions ▪ Fuel consumption	▪ Baseline highway speed / traffic volume distribution from California Department of Transportation highway traffic database ▪ Department of Energy fuel economy data ▪ California Air Resources Board EMFAC 2007 Emissions model ▪ Expected changes in highway speeds from empirical studies on speed limit changes ▪ Empirical studies on highway speeds and injury rates

Challenges in Quantitative Estimation: the California Menu Labeling HIA

A Health Impact Assessment conducted in 2009 of "point of sale" labeling of calories in California statute estimated effects on the future weight gain of Los Angeles residents [Kuo 2009]. At the time of the HIA, there were no empirical evaluations of real-world interventions; experimental studies of menu labeling, including one with a randomized experimental design, had not demonstrated a substantial or consistent effect of calorie labeling on energy consumption [Harnack 2008].

To estimate an impact on population weight, the authors assumed that the net effect (reduction) on population-level energy balance would be the simple mathematical product of annual chain restaurant meals consumed, the number of consumers responding to the new information, the change in caloric content of individual consumers meal choices, and the calories per pound of human weight.

Calorie Labeling → Energy Choices → Consumer Weight → Population Weight

The HIA's principal prediction was that 10% percent of chain restaurant consumers ordering reduced calorie meals would result in avoidance of 40% of the weight gain in the county. The result, suggesting that responding consumers would lose four times their own expected weight gain as a result of this intervention, appeared implausible. Review of this exercise identified several likely faulty assumptions.

First, to assess the effect of self-reported influence on calories purchased, the HIA used one cross-sectional study in a single chain that had voluntarily posted calorie information. While the 100 kcal difference was substantial, the single study, in the light of contradictory experimental evidence, was not sufficient to either demonstrate a causal effect of menu labeling or generalize the effect to the intervention or to other chains or locations.

Second, the HIA assumed calories not consumed at a chain restaurant meal would translate into an equivalent change in net energy balance. The HIA cited research suggesting that neither short-term underfeeding nor overfeeding resulted in subsequent compensatory changes in food energy intake; however the same research demonstrated no effects of these interventions on body weight with the implication that food restriction or excess result in compensatory effects on energy expenditure [Levitsky 2005; Levitsky 2010].

Third, the HIA assumed that the subpopulation responding to calorie labeling restaurants would be the same as those gaining a substantial amount of weight, something that was not evident from any research.

Finally, the HIA applied forecast weight loss of responding individuals to non-responders and did not account for the eating behaviors and weight trajectories of non-responders.

While the HIA authors acknowledged the limited data, the exercise suggests that attempts to quantify effects with limited causal evidence and without externally valid effect measures may generate unreliable or implausible projections.

It is also important to consider how quantitative forecasting supports the overall objective of HIA. As all health effects of a policy choice may not be amenable to quantification, relying on quantitative forecasting exclusively may present a partial or biased accounting of health effects. Quantification can also be resource intensive and divert from other impact assessment activities.

Original Empirical Investigations

Although resource intensive, original epidemiologic studies may generate an understanding of health impacts or may develop and validate exposure-response relationships. Quantitative forecasting may require developing and validating new predictive models. For example, Weir et al. developed and validated a regression model for HIA to relate environmental characteristics to the number of vehicle-pedestrian injury collisions in San Francisco (Wier 2009). (See text box.) This model predicted the impacts of changes in land use designations on pedestrian collisions. In the HIA of the Healthy Families Act, original analysis of National Health Interview Survey data was used to evaluate the association between having paid sick days and medical care utilization (HIP 2009). Original epidemiologic investigations may be warranted if the intensity of effect is potentially large but uncertain.

Planned Growth and Pedestrian Collisions in San Francisco

To predict the effects of land use development on pedestrian safety in San Francisco, the Department of Public Health developed a county-level model of environmental predictors of pedestrian-vehicle collisions (Wier 2009). Using binomial multivariate regression, eight variables predicted 71% of the variation in ten-year averaged pedestrian-vehicle frequencies among census-tracts: traffic volume, proportion of arterial streets, neighborhood commercial land use, total land area (square miles), employee population, resident population, proportion of households in poverty, and proportion of residents older than 65. Planning data, including data on future resident and employee populations and traffic volumes, provided parameters for the model to estimate prospective impacts on pedestrian-vehicle collisions. The plans projected a 15% increase in traffic volume and a 16% percent change in populations. The model forecast that planned growth in four historically industrial and mixed-use neighborhoods would result in a cumulative 17% increase in 5-year pedestrian injury collisions or over 30 additional collisions each year. Forecasts for individual neighborhoods demonstrated substantial variation in hazards for new residents.

Analysis of disproportionate effects and environmental justice

Health inequities are systematic disparities in health status or in the major social determinants of health between groups with different social advantage/disadvantage (e.g., wealth, power, prestige) (Braveman 2003). An explicit objective of HIA is to prevent public policies from generating or perpetuating health inequities.

Identifying and addressing disproportionate health effects through HIA can help fulfill federal government mandates for environmental justice. USEPA defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or a socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from the execution of federal, state, local, and tribal plans, programs and policies.

Executive Order 12982 charged federal agencies to make achieving environmental justice part of their missions by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions (Clinton, 1994). A Presidential memo accompanying the order further charged agencies to analyze and mitigate disproportionate impacts though the NEPA process.

Determining whether an action will cause adverse health effects disproportionately burdening a socially excluded population requires evaluating four factors (CEQ 1997; USEPA 1998; USEPA 1999):

Impacts on Health Disparities: HIA of California Ballot Proposition 49 (UCLA, 2002)

California Proposition 49, passed by voters in November 2002, increased mandatory state funding for after-school programs from $117.5 million per year to $550 million per year. An HIA conducted by the UCLA Health Impact Project in 2003 found that while this reallocation theoretically could produce significant health benefits for low-income youth by decreasing rates of risky behaviors, reducing criminal activity, and raising participants' socio-economic status by improving educational achievement, the lack of strict means-testing for program eligibility could result in a decreased proportion of after-school program funds directed towards low-income students and schools. Furthermore, reallocation of up to $550 million per year from the state's general fund to after-school programs could necessitate budget cuts to health and social service programs. Rules subsequently promulgated by the California Department of Education targeted Proposition 49 funds to low income schools and students.

(Report available at: http://www.ph.ucla.edu/hs/health-impact/reports.htm)

1. Whether the action will have significant adverse health or environmental effect on a vulnerable population (e.g., low income, elderly, ethnic minority);
2. Whether the magnitude of the adverse effect (e.g., the risk or rate of hazard exposure) on that population is likely to exceed the risk or rate to a comparison group in the general population;
3. Whether the effect will contribute cumulatively to a pre-existing adverse condition or exposures; and
4. Whether attributes common to a vulnerable population will mediate or exacerbate an adverse health effect on the population.

For this last factor, the disproportionate health or environmental effects on vulnerable communities may occur both because of proximity to a hazard (e.g., greater exposure to pollution) and a shared vulnerability (e.g., higher prevalence of a disease), a shared cultural practice, or unique dependence on an impacted environment resource (e.g., locally caught fish for sustenance).

HIA should consider and analyze disproportionate impacts or environmental justice. In general, the data and tools required to analyze disproportionate impacts are no different from the tools used in impact analysis. Demographic data may indicate the presence and location of socially vulnerable communities, GIS tools may help spatially correlate impacts with the location of affected populations, and local public health data may bring attention to health sensitivities of local populations. Known health concerns about a project or plan among members of lower-income or socially marginal communities should sensitize the HIA team to the potential for disproportionate impacts and the need for rigorous consideration.

Cumulative Effects

Cumulative effects are the combined and incremental effects of human activities on environmental resources, human communities, or ecosystems (40 CFR §1508.7.; USEPA 1999). Many analytic methods can be used to quantitatively assess cumulative effects. Effects may be combined spatially (e.g., modeling multiple point sources of the same hazardous exposure on a receptor), temporally (e.g., incremental air pollution due to additions to roadway capacity), or as the combination of exposures or hazards with common mechanisms of toxicity (e.g., cholinesterase inhibition) or effects on the same biologic endpoint (e.g., cancer). Cumulative effects analysis may also involve assessing joint effects of dissimilar exposures with dissimilar mechanisms of actions, although this is more difficult and combining multiple effects in terms of a single health outcome metric may not be possible. One study associated a combination of noise and overcrowding (two environmental conditions associated with poverty) with higher stress and stress hormone levels in children (Evans 2004).

Assessing and quantifying the health effects of cumulative, place-based exposures is an important, emerging research area for public health and environmental science. A National

Cumulative Effects of Location and Regional Traffic on a San Francisco Neighborhood (Wier 2009)

In response to community concerns, the San Francisco Department of Public Health (SFDPH), PODER (People Organizing to Demand Environmental and Economic Rights) and the University of California, Berkeley School of Public Health (UCB) collaborated to research the impacts of local and regional freight and automobile traffic on the Excelsior/Southeast area of San Francisco. Methods employed included air quality and noise modeling and monitoring, community surveys, secondary data analysis, traffic counting, community photography, and surveys of the physical characteristics of the pedestrian environment. The assessment revealed heavy local cut-through traffic; adverse impacts of regional freeway traffic on local noise levels and air quality; residential concerns regarding traffic hazards, trucks, air pollution, and traffic-related sleep disturbances; and impacts on a predominantly non-white, immigrant community.

With this assessment, PODER, community members, and key community allies mobilized to demand the Board of Supervisors resolution direct SFDPH, the San Francisco Municipal Transportation Agency, and local legislative staff to identify protective truck routing policies. The case study was unique in its focus on the cumulative impacts of transportation planning policy decisions on local residents considering the transportation infrastructure, not pollution emissions, as the fundamental source of environmental hazard.

Academy of Sciences consensus report on risk assessment concluded that there is a need for such assessments to include "…combined risks posed by aggregate exposure to multiple agents or stressors; aggregate exposure includes all routes, pathways, and sources of exposure to a given agent or stressor. (Committee on Improving Risk Analysis 2008). Although it may not be possible to quantify all health effects and quantification may not describe effects using the same metric or measure, HIA can support the understanding and consideration of cumulative effects by analyzing multiple effects unconstrained by the need for a common metric. The example in the text box illustrates how transportation systems impacts may act "cumulatively" on the human community and offer areas for further research.

Economic valuation of interventions and health impacts

Occasionally, the decision-making process may need to place an economic value on health impacts in comparing economic benefits against costs or in comparing the relative cost effectiveness of alternative strategies. For example, cost-benefit analysis is routinely required in the evaluation of federal environmental regulations and interventions. Cost-benefit evaluation of regulations compares the economic cost of regulations with the economic benefit indirect and direct costs of averted heath impacts.

Cost Benefit Analysis of Greenhouse Gas Regulations

A Congressional Budget Office cost-benefit analysis of the American Clean Energy and Security (ACES) Act predicted that the Act would cut greenhouse gas emissions in capped sectors by nearly 12% in 2020 and that the net annual economy wide cost of the cap-and-trade program in 2020 would be $22 billion—or about $175 per household.

Economic valuation of health effects can be applied based on a quantitative HIA if data exist to place a monetary value on the analyzed health effects. Data are available to assign economic values to outcomes such as years of lost life, loss of quality of life, health care utilization, and the loss of employment.

For example, HIA may produces estimates of impacts on unintentional injuries such as road injuries suffered by pedestrians. Vehicle injuries to pedestrians have significant economic costs. An analysis of 1999 California data on vehicle injuries to pedestrians revealed over $3.9 billion in direct and indirect costs ($692,000 per injury).

Estimates of economic costs of pedestrian injury by injury severity in California.

Pedestrian Injury Severity	Economic Cost per Injury
Fatal Injury	$ 2,709,000
Severe Injury	$ 180,000
Visible Injury	$ 38,000
Complaint of Pain	$ 20,000

Cost-benefit analysis is a distinct, related, decision-support tool that might use results from an HIA. As an example, the City Controller of San Francisco conducted a cost-benefit analysis of proposed air quality regulations for enhanced building ventilation in residences near busy roadways (Office of the Controller 2008). The annual cost of the most expensive mitigation approach, individual unit ventilation systems, adding operating and maintenance costs, and accounting for the space to accommodate the system, was estimated at $727 per unit per year. On the other hand, estimates of the

health benefits, using methods developed for HIA, were valued at about $2,100 per unit per year.

Unlike HIA, cost-benefit analysis aims to provide a "bottom line" evaluation of the desirability of a decision using a common, monetary metric. This relies on the assumption that all important effects of a decision, positive and negative, can be valued and expressed in monetary terms. Economic valuation may undervalue public goods and may value health differently in different populations (e.g., populations not in the labor force). Economic valuation of health and welfare outcomes raises particular methodological and ethical issues, including how to value health and life and how to value the present costs of latent impacts (Revesz 1999).

A complete discussion of methods, applications, and limits of economic valuation is beyond the scope of this guide. USEPA has published guidelines for economic analysis that may be a resource for economic valuation in HIA (USEPA 2000). Brodin and Hodge (2008) have also recently discussed several common issues in the application of economic valuation in HIA practice.

Validity of Judgments in Impact Analysis

HIA applies available knowledge and theory to make reasoned judgments about the future (Veerman, 2007). The task of prediction in HIA is somewhat analogous to the task of diagnosis and prognosis in medical practice where a practitioner applies training and experience, a patient's history, and diagnostic tests. Prognosis in medicine assumes uncertainty and the possibility of error, the need for monitoring, and future adjustment to therapy; the quality of clinical judgment is evaluated against those made by peers in similar situations.

Similarly, within HIA, the validity of judgments rests on whether the judgment is plausible, is based on sound scientific evidence, applies good judgment, and acknowledges uncertainty. Principles for the ethical use of evidence are outlined in the IAIA HIA Practice Principles (Quigley 2006) and include considering and valuing all forms of evidence and acknowledging uncertainty.

Judging the quality of evidence is not straightforward. Use of accepted scientifically valid methods, peer-reviewed evidence, and systematic reviews are three possible criteria for judging evidence quality. But the lack of robust, formal, scientific evidence should not preclude reasoned, experience-based predictions. Informed judgments of health effects can be based on available information while recognizing data and evidence limitations.

Some Principles for the Ethical Use of Evidence in HIA

- Consider evidence, both supporting and refuting *a priori* hypotheses, from diverse sources including available statistics, empirical research, professional expertise, local knowledge, and the products of original investigations.
- Use evidence from well-designed and peer-reviewed systematic reviews.
- Justify the selection or exclusion of particular methodologies and data sources.
- Make explicit any assumptions, particularly quantitative estimates of hazards or impacts.
- Identify data gaps, uncertainties, and limitations.
- Allow stakeholders to critique the validity of findings.

Valuing all forms of evidence means that, in addition to traditional sources of data and expertise, the assessor considers local knowledge. In general, the use of diverse and complementary approaches supports better judgments. Transparency demands documenting sources of evidence and methods, including literature search strategies; justifying the use or exclusion of particular methods; and acknowledging when insufficient information exists to assess health impacts.

Predictions must document all of the assumptions used. For example, a prediction may assume presence or persistence of certain environmental, social, or economic conditions or the applicability of findings in one population to other populations. An HIA should qualitatively assess the uncertainty of findings and predictions and acknowledge assumptions in forecasting methods and inferences from empirical work. Allowing experts and stakeholders to criticize HIA findings through opportunities for public comments on a draft report can help identify such limitations.

An HIA should consider how effects may be mediated by conditions of a particular place or time. For example, health impacts of a decision to convert farm land to residential

uses will depend on the remaining agricultural resources and who controls or owns those resources. Similarly, health impacts of a decision to demolish and redevelop existing housing will depend on the supply and cost of remaining housing. Health effects also will depend on particular vulnerability or resiliency factors in a community. A population may have greater susceptibility to a specific health impact because of a demographic characteristic (e.g., poverty, the susceptibility of the young to pedestrian injuries), a higher prevalence of certain health conditions (e.g., asthma), environmental hazards or stressors (e.g., noise), or cultural dependence on natural resources (e.g., sustenance consumption of local wildlife).

When using complex mathematical models to make quantitative estimates, sensitivity analysis (SA) can help examine the relative importance of uncertain data inputs on predicted outcomes. SA can employ various techniques but generally varies the input parameters for a model based on some assumed distribution. Examples of SA exist in environmental and public health assessments and in cost analysis.

HIA practitioners need to be attentive to sources of bias in judgments. Bias in HIA may result from stakeholder, decision-maker, or regulatory agency influence on a practitioner or a practitioner's own interest. Bias can lead to HIA practitioners overstating or understating impacts or their certainty. Bias can result in omitting a significant impact analysis question in the scoping process (so-called type III error).

Impacts of Paid Sick Days on Influenza Transmission

Judgments made in the HIA on the California Health Families Healthy Workplaces Act provide an example of managing limited and uncertain data. In this HIA, the assessment team reviewed evidence that could support the hypothesis that paid sick days would reduce the health impact of an influenza pandemic (SFDPH 2008). No specific studies had addressed this question directly and few studies had looked at the health effects of paid sick days. Available evidence established the following facts: (1)based on models using the best available evidence, interventions that limited social contacts could be expected to reduce pandemic flu cases 15-34%; (2) the benefit of the intervention was a function of the rate of compliance; (3) employees who had paid sick days available, took, on average, one day more per year of leave for sickness (about 1/3 more days); (4) paid sick days benefits were held by about half of the working population and disproportionately held by those with higher income; and (5) pandemic influenza could result in 100 million infections in the United States. From this indirect evidence the authors concluded that a uniform requirement for paid sick days would significantly reduce the consequences of an influenza pandemic with a moderate to high degree of certainty. The judgment recognized that quantifying the health impact required more data on the relationship between paid sick days and compliance with social distancing measures.

Assessment of the Significance of Impacts

Most regulatory environmental impact assessments include assessment of impact significance. Significance of impacts relates both to objective characteristics of impacts and to how societies value or prioritize these characteristics. Clearly important is the magnitude or intensity of the impact and its extent over time and space. Other characteristics of impacts include the certainty of whether an impact will occur, whether the impact adds or acts cumulatively with other impacts or existing conditions, whether

there are distributional effects (inequities), whether the impact is reversible or permanent, and whether the impact can be mitigated.

Some health impacts and health-relevant environmental conditions have established quantitative criteria for impact significance. In these cases, legal decisions, regulatory standards, or established policy goals (e.g., National Ambient Air Quality Criteria, Healthy People 2020) can provide the basis for judgments of significance in impact assessment. However, as discussed above, established benchmarks may not reflect local values or exist for the breadth of impacts likely to be included in HIA.

Judgments about social significance are understandably normative. Objective characterization of the magnitude, direction, and certainty of health impacts does not necessarily equate to conclusions about the social significance of impacts. Social significance involves additional value judgments made outside of and apart from the HIA process. Social values or priorities (e.g., adversity to risks, relative value of individual or collective risks) can vary considerably among and within populations and places and values related to the acceptability or unacceptability of impacts often conflict among affected populations. Public decisions typically have multiple potential health effects. Thus, summative judgments in HIA will often require evaluating trade-offs or cumulative impacts of dissimilar effects described with dissimilar metrics. For these reasons, the social significance of impacts characterized in HIA should be determined in a transparent process by stakeholders and the affected community apart from the HIA process.

Using consensus processes for making judgments

Group or consensus processes to synthesize evidence may support summative judgments and make transparent the moderating effects of values and biases on these judgments. For example, in the Delphi method, a panel of experts answers a question iteratively and is given the opportunity to revise answers after reviewing an anonymous summary of other experts' forecasts. The intent is for the group to converge towards a consensus.

Deliberative processes can also bring together scientific experts and stakeholders, facilitating more inclusive participation in HIA judgments. For example, in the Danish Board of Technology's Consensus Conference, a lay panel deliberates and develops a consensus on a particular science or technology issue and experts contribute testimony and analysis in response to questions posed by the lay panel (Anderson 1999). Habitat Conservation Planning provides another example of consensus-building among diverse and conflicting interests as an alternative to command and control environmental regulations (Sabel 2000).

Criteria for Alternatives and Mitigations

- Responsive to projected impacts
- Specific and actionable
- Experience-based and effective
- Enforceable or susceptible to monitoring
- Technically feasible
- Politically feasible
- Economically efficient
- Meet multi-objectives
- Do not have additional negative consequences

Strategies for Policy Design and Implementation

A key function of HIA is to identify and analyze opportunities for a decision to respond to health needs. The HIA may identify alternative ways to design a policy, program, project or plan, its location, or its timing to benefit health or incorporate mitigation and management strategies to lessen anticipated adverse health effects. HIAs could also suggest ways to monitor potential but uncertain impacts or identify needs to enhance communication with stakeholders. Strategies recommended by an HIA should be responsive to and grounded in the findings of impact analysis.

It is not always necessary or appropriate for an HIA to include recommendations. HIA primarily analyzes impacts. For example, HIAs of legislative initiatives on minimum wage and paid sick day requirements in California documented health impacts but did not endorse positions on these policy choices or offer alternatives. An HIA may inform a decision with discrete choices and limited alternatives. Decisions made during scoping may also limit the role of the assessment in proposing changes to the policy under review.

Describing a complete process to identify the breadth of potential alternatives and mitigations is beyond the scope of this guide. Developing, evaluating, and prioritizing strategies, whether alternatives or mitigations, first requires a clear understanding of a proposed project, plan, or policy and knowledge and research of existing policy implementation, design practices, and mitigation. Typically, considering alternative policy designs requires consultation with others, as the HIA team may lack expertise to provide recommendations. This underscores the need for HIA to be an interdisciplinary analysis. The skills and expertise needed to identify and analyze alternatives and mitigations are often different from those needed to identify and analyze health impacts. These skills may lie with project proponents, others who are familiar with project design and implementation, community members, and other professionals. Communication with policy makers/developers and stakeholders is often needed to gauge the buy-in or feasibility of policy changes.

HIA should provide substantive analysis of why recommended changes are justified and beneficial. If possible, HIA should estimate effects of recommended mitigations on health outcomes. Including and implementing mitigations and alternatives into a project or policy design could also be supported by evidence of feasibility, efficiency, cost benefit, cost-effectiveness, and political acceptability. Further analysis might test the sensitivity of outcomes to a design change.

Eastern Neighborhoods Rezoning and Area Plans, San Francisco, 2007

Participating as part of a team conducting the environmental impact assessment for the Eastern Neighborhoods Rezoning and Area Plans, staff from the San Francisco Department of Public Health analyzed conflicts between industrial uses, roadways, and proposed new residential uses and found that the rezoning would substantially increase human health hazards from noise, air pollutants, and pedestrian collisions. The Department proposed that projects in proximity to high traffic volumes assess the concentration of PM 2.5 from traffic sources and include ventilation and filtration systems where exposure levels were above a pre-defined threshold.

HIA practitioners should be mindful that identifying and incorporating mitigations may not always result in policy decisions that are healthful or ethical in a holistic sense. For example, a decision to incorporate mitigations may provide needed political support for policy adoption even though those mitigations may only offer partial relief from adverse health impacts of a policy. Because HIA typically looks at multiple health-related outcomes, it is important to provide an evaluation of a policy holistically, with and without available and recommended design alternatives.

Public Housing Flooring Policies, San Francisco, 2003

In 2003, as part of public-private partnerships to reduce avoidable asthma exacerbations, the San Francisco Department of Public Health facilitated a HIA on alternative policies for flooring in publicly constructed or subsidized housing. The HIA process involved public meetings, dialogue, and knowledge sharing among residents, advocates, housing authority staff, and health experts, supplemented with resident surveys. Considering health and legal and economic feasibility, the HIA recommended that the Housing Authority set aside a proportion of new units to be carpet-free for tenants with asthma and that the Authority educate tenants on reasonable accommodation provisions that would facilitate carpet removal for affected tenants. Local legislators and the Housing Authority approved both recommendations.

V. REPORTING

Objective:

- **Communicate the findings and recommendations of an HIA in the decision-making processes.**

The HIA report provides a description of the process, a succinct and coherent statement of the potential health impacts of a proposal and its alternatives, and any recommended mitigations and measures to prevent negative impacts or strengthen health benefits. The report forms the basis for communication with decision makers, responsible administrators, and stakeholders.

A comprehensive report should identify all the participants and their roles in the HIA, describe the scoping process, and describe assessment outcomes. The report should, for each issue analyzed, discuss the available scientific evidence, profile existing conditions, describe analytic methods, document and interpret analytic results, characterize the health impacts and their significance, and, if necessary, list recommendations for policy, program, or project design alternatives or mitigations. If included, recommendations for decision alternatives, policy recommendations, or mitigations should be related to impacts and justified with regards to both feasibility and efficacy.

HIA reports should be succinct and based on evidence collected, used, and synthesized during the process. A successful report often focuses attention on the key information, whether impacts or alternatives, necessary to drive action. The HIA report may include detailed technical appendices or reference more detailed studies that provide the basis for judgments and recommendations.

Findings may be reasonably prioritized based on overall magnitude of health benefit, impact on vulnerable populations, and perceived public concerns; however, HIA best serves health interests by reflecting a complete, objective, and transparent rendering of the process.

Effective reporting requires presenting the findings and recommendations in ways meaningful to different target audiences and stakeholders. An HIA report often forms the basis for more targeted communication (e.g., fact sheets, public testimony, panel discussions, graphic and visual illustrations, comments on regulatory decision-making and peer-reviewed publications).

The HIA reporting process should offer stakeholders and decision-makers a meaningful opportunity to critically review evidence, methods, findings, conclusions, and recommendations. Ideally, a draft report should be made available and readily accessible for public review and comment. Upon receipt of comments, the HIA team should address substantive criticisms either through a formal written response or through report revisions. The final HIA report should be publicly accessible.

Key Elements of HIA Reports	
Element	**Rationale**
Policy objective(s)	HIA aims to provide a holistic assessment and policy objectives may be health promoting. Understanding the policy objectives is critical to considering trade-offs among cost and benefits.
Design features or parameters of the policy, plan, or project and design alternatives	The impacts of a policy are dependent on its design; mitigation strategies typically involve changes to design parameters. Analysis and consideration of mitigations must be grounded in an understanding of the proposed design. For example, if the HIA describes a proposal to mine coal, it should also describe facilities needed to transport coal and plans to reclaim land after coal extraction.
Documentation of the scoping process and its outcomes	All HIA analysis flows from the scoping process. Decisions on what to study and what methods to use should be transparent so readers understand why assessors focused on particular impacts or used particular analytic choices.
Profile of baseline conditions relevant to health impacts	Prospective health impacts are dependent on baseline health conditions. For example, the impact of a freeway expansion on asthma hospitalization rates would be worse in communities with high baseline asthma prevalence.
Impact analysis and judgments of significance	While reports should be succinct, HIAs should transparently report on all impacts analyzed whether findings are adverse or beneficial, significant or insignificant. Failure to do so could bias decision making and raise public concerns about the quality of the decision-making process. Impact analysis also justifies proposed mitigations and alternatives.
Vulnerable populations and disproportionate impacts	An impact may have no appreciable health effect on a population as a whole but may significantly impact a subpopulation. For example, a project that results in poisoning local fish populations may have marginal nutritional impact on most residents but may severely negatively affect the nutrition of subpopulations culturally or economically dependent on fishing.
Assumptions and parameters used in assessment models	The validity of predictions often depends on the validity of assumptions. For example, prediction models based on national data may not be valid if there are substantial differences between national and local populations.
Determination of significance or non-significance	Significance or acceptability is a subjective judgment that should be validated against the norms of a place or context. Assessors should not judge an impact as non-significant without reference to an established standard or public process for making that determination. For each impact, the report should clearly identify any existing and relevant environmental or health standards, objectives, or targets in a community.
Proposed alternatives or mitigations along with evidence of their feasibility and effectiveness	Alternatives and mitigations proposed in an HIA require substantive analysis that considers the efficacy of mitigation in addressing the impact and, its political and technical feasibility.

VI. MONITORING

Objective:

- **Monitor the implementation of the policy decision and its outcomes on health determinants and health status.**

Monitoring refers to tracking how a decision is implemented and the resulting health outcomes. Monitoring allows stakeholders and policy makers to see the actual adverse health impacts that result from a policy decision and can provide evidence required for reevaluating or adapting a policy. Monitoring can provide an early warning system to detect unexpected or uncertain adverse outcomes.

The first step in monitoring is identifying key processes and outcomes for tracking. Similar to indicators used for profiling baseline conditions in the analysis phase of HIA, appropriate indicators for monitoring can include health outcomes, health-relevant behaviors, and health determinants. Monitoring ideally requires collection of these indicators before, during, and after policy implementation. Process monitoring may focus on conformity with an agreed-upon design or implementation process for the policy, program, or plan or compliance with required mitigations or regulations.

Essential Tasks in Monitoring

- Define implementation tasks, outcomes, and indicators for long-term monitoring.
- Identify a lead individual or organization to conduct monitoring.
- Develop a monitoring plan or program, including a plan to report monitoring findings to decision makers and HIA stakeholders.
- Ensure resources to conduct, complete, and report the monitoring.

If monitoring will include health status outcomes, the HIA team should consider issues of latency and specificity in relation to implementation of decisions. Monitoring can observe changes in health outcomes expected to shift rapidly with shifts in environmental conditions. For example, roadway collisions and injuries may be expected to change contemporaneous with changes in vehicle traffic volumes or roadway conditions. Long lag times between decisions and their implementation or between implementation and health endpoints can limit the feasibility of observing changes in health outcomes. Similarly, it is challenging to interpret changes in indicators when health outcomes are influenced by multiple individual and community level determinants (e.g., hospitalizations for diabetes).

Monitoring cannot generally provide conclusive answers to questions of cause and effect. If recommendations are implemented to prevent adverse health outcomes and long-term monitoring reveals little change in health indicators, it may not be possible to determine with certainty whether this is due to effective mitigation of adverse health effects or to imprecise predictions regarding the impact itself. Still, monitoring may be

useful to test the predictive judgments of impact analysis, check the validity of impact analysis tools, or provide lessons for subsequent analysis.

Resources for conducting an HIA may not include resources for long-term monitoring; however, HIA can still include a recommended monitoring plan. Mitigation monitoring plans with reporting to regulatory or decision-making agencies are commonly used in EIA. Also called environmental management plans or impact management plans, a mitigation monitoring plan documents mitigation measures and agency responsibilities and roles in ensuring and documenting mitigation achievement.

Mitigation monitoring plans typically list a summary of the potential impacts requiring mitigation, a description of required mitigation measures, responsibilities and a schedule for implementation, requirements for surveillance and auditing, and triggers and contingency actions to address excessive or unexpected impacts. Public agency and project proponent responsibilities for mitigation and monitoring should be clearly defined, including arrangements for coordination and disclosure.

VII. STAKEHOLDER PARTICIPATION

Inclusive and meaningful participation of affected residents and other stakeholders in the policy making process is a fundamental hallmark of democracy and social justice. Historically, decision making has been largely tied to power and/or expert driven and has allowed only limited opportunity for meaningful and open participation (Arnstein 1969). Recently, more deliberative and inclusive public participation processes have emerged. (Fischer 2000).

Within a HIA process, participation of diverse stakeholders can help identify relevant research questions, sources of data and information, and proposals for alternatives and mitigations. Meaningful and inclusive public participation can also ensure that the HIA addresses community priorities and makes judgments that take into account community values.

Stakeholders may include individuals or groups with a known or perceived interest in the outcomes of a decision that is the subject of a HIA, including residents, employees or employers, sponsors of economic development projects, health providers or public health officials, and government agencies responsible for policy implementation or enforcement.

While stakeholders may hold opposing positions on decision alternatives, all stakeholders have contributions to make to an HIA. Residents are most often the best sources for identifying community priorities. Project proponents are likely to have knowledge about the feasibility of alternatives. Health providers bring essential information about the health status and vulnerabilities of community members. Environmental agencies may have data on environmental conditions relevant to health.

If experts or public institutions are directing or leading an HIA, the process can include significant opportunities for stakeholder participation. For example, HIA practitioners may convene community residents to participate in a scoping process to better focus research questions on community priorities. In the assessment phase, practitioners may use focus groups to gain insight and knowledge about health effects and mitigation strategies. Analysis of alternatives can involve a dialogue with experts, project proponents, and policy implementers. The table below provides other examples of possible community roles in stages of the HIA process.

Stage of HIA	Example of Community and Stakeholder Involvement
Screening	▪ Community stakeholders identify the need for and create political demand for an HIA
Scoping	▪ Community stakeholders participate in or conduct scoping exercises to identify high priority community health issues and concerns
Assessment	▪ Community members and stakeholders participate in interviews and focus groups conducted by staff ▪ Community members organize, develop, and conduct a survey ▪ Stakeholders interpret or "ground truth" staff research
Reporting	▪ Stakeholders interpret and prioritize findings and recommendations ▪ Stakeholders report and communicate HIA findings to the media and decision makers
Monitoring	▪ Stakeholders create a "watchdog" group and monitor decision outcomes and long-term results

Stakeholders such as affected community organizations may also have the capacity to take a more direct leadership role in the organization and conduct of the HIA process. For example, a community organization could call for an HIA, organize a team to conduct it, conduct a public scoping process, and provide overall ownership and oversight of the process. In this case, experts would serve a community-led process in a range of supporting roles including facilitation, research, data collection, analysis of impacts, and public testimony. An HIA to analyze the health impacts of growth at the Port of Oakland involved collaboration among community stakeholders with a memorandum of understanding among parties to define roles and responsibilities.

VIII. EVALUATION

Evaluation concerns both the HIA process and its outcomes or impacts (Taylor 2003). Evaluation is important to developing HIA practice and providing lessons to practitioners and others interested in institutionalization of the field. However, HIA evaluation is a nascent field and while several authors have suggested evaluation frameworks and measures, definitive guidance does not yet exist (Wismar 2004; Parry 2005; Mathias 2009).

Process evaluation may provide valuable insight into ways to improve the relevance and legitimacy of the process, the accuracy of predictions, or the translation of the findings to decision makers. The North American Consensus Practice Standards forms one set of criteria for the process that might serve in evaluation (North American Practice Standards Working Group 2009).

Outcomes evaluation is a longer-term undertaking that focuses on the influence of the HIA on the decision-making process and outcomes. HIA presumes that informing decision makers of health impacts can identify or motivate beneficial and protective changes to the design of a project or policy, lead to decision alternatives, or influence the adoption of a policy. Such effects can result from the rational use of information by decision makers or the political use of information by interest groups.

Outcomes evaluation for HIA should also consider impacts on the future climate for HIA and other indirect or unanticipated effects (Wismar 2004). HIA is a vehicle for institutional and social learning and may have important outcomes in the way decision makers think about the health in policy making, in the ways institutions integrate health considerations into policy design; and on relationships between the public health community and institutions outside the health sector.

Outcomes evaluation requires both commitment and resources. The simplest form of evaluation may involve an assessment team and HIA sponsors reviewing and reflecting on the HIA outcomes against objectives established in the screening phase. A more complete evaluation will identify an individual or organization to lead the evaluation, identify key evaluation questions and data sources, and ensure resources to complete and report the evaluation to decision makers and stakeholders.

Questions for HIA Outcomes Evaluation	
Effects on design, adoption, or implementation of the project/policy	• Did the project or policy include a design change or mitigation to protect or promote health? • Did decision makers consider or adopt an alternative to address health needs? • Did decision makers postpone the decision to conduct further research on health issues?
Effects on the political environment for the policy decision	• Were new connections between the decision and health evident in the media, statements by public officials or stakeholders, public testimony, public documents, or policy statements? • Are new interest groups (e.g., public health advocates) supporting or opposing the decision?
Effects on institutional practices concerning health in decision making	• Are public health institutions more engaged in policy evaluation in other sectors? • Are there greater public or institutional supports or resources for HIA? • Are there efforts to institutionalize health analysis or health criteria into policy design and decision making?

REFERENCES

1. Anderson IA, Jaeger B. Scenario workshops and consensus conferences: Towards more democratic decision making. Science and Public Policy. 1999; 26: 331-340.
2. Arnstein S. A ladder of citizen participation. Journal of the American Planning Association. 1969; 35(4): 216-224. Available at: http://lithgow-schmidt.dk/sherry-arnstein/ladder-of-citizen-participation.html.
3. Arquiaga MC, Canter LW, Nelson DI. Integration of health impact considerations in environmental impact studies. Impact Assessment. 1994; 12: 175-197.
4. Bass R. Evaluating environmental justice under the National Environmental Policy Act. Environmental Impact Assessment Review. 1998; 18:83-92.
5. Bhabka R, Negev M. May 2009. A health impact assessment of reducing highway speeds in California. Class project. University of California, Berkeley SPH 267D.
6. Bhatia R, Rivard T. 2008. Assessment and mitigation of air pollutant health effects from intra-urban roadways: Guidance for land use planning and environmental review. San Francisco, CA: San Francisco Department of Public Health.
7. Bhatia R, Wernham A. Integrating human health into environmental impact assessment: An unrealized opportunity for environmental health and justice. Environmental Health Perspectives. April 2008; 116: 991-1000.
8. Bhatia R. Katz M. Estimation of health benefits accruing from a living wage ordinance. American Journal of Public Health. 2001; 91: 1398-1402.
9. Bhatia R. Protecting health with Environmental Impact Assessment: A case study of San Francisco land use decision-making. American Journal of Public Health. 2007; 97: 406-413.
10. Braveman P, Gruskin S. Defining equity in health. Journal of Epidemiology and Community Health. 2003; 57: 254-258.
11. Brodin H, Hodge S. 2008. A guide to quantitative methods in Health Impact Assessment. Stockholm: Swedish National Institute of Public Health. Available at: http://www.fhi.se/PageFiles/6057/R2008-41-Quantitative-Methods-in-HIA.pdf.
12. California Air Resources Board. 2002. Staff report: Public hearing to consider amendments to the Ambient Air Quality Standards for Particulate Matter and Sulfates. Available: http://www.arb.ca.gov/research/aaqs/std-rs/pm-final/pm-final.htm.
13. California Global Warming Solutions Act (AB 32). 2006.
14. Clinton WJ. 1994. Executive Order 12898: Federal actions to address environmental justice in minority populations and low-income populations. Federal Register 59: 7269. Washington, D.C.: White House.

15. Cole B, Wilhelm M, Long P, Fielding J, Kominski G., Morgenstern H. Prospects for Health Impact Assessment in the United States: New and improved Environmental Impact Assessment or something different? Journal of Health Politics, Policy and Law. 2004; 29: 1153-1186.

16. Cole B, Fielding J. Health impact assessment: A tool to help policy makers understand health beyond health care. Annual Reviews of Public Health. 2007; 28: 393-412.

17. Cole BL, Shimkhada R, Morgenstern H, Kominski G, Fielding JE, Wu. S. Projected health impact of the Los Angeles City living wage ordinance. Journal of Epidemiology and Community Health. 2005; 59: 645-650.

18. Committee on Improving Risk Analysis Approaches used by the U.S. Environmental Protection Agency. 2008. Science and Decisions: Advancing Risk Assessment. Washington DC: National Academies Press.

19. Corburn J, Bhatia R. Health Impact Assessment in San Francisco: Incorporating the social determinants of health into environmental planning. Journal of Environmental Planning and Management. 2007; 50: 323-341.

20. Council on Environmental Quality (CEQ). 1997. Environmental Justice: Guidance under the National Environmental Health Policy Act. Washington, DC: President's Council on Environmental Quality.

21. CEQ. 1997. The National Environmental Health Policy Act: A study of its effectiveness after twenty five years. Washington, DC: President's Council on Environmental Quality.

22. Dannenberg A, Bhatia R, Cole B, Heaton S, Feldman J, Rutt C. Use of Health Impact Assessment in the United States: 27 case studies, 1999-2007. American Journal of Preventive Medicine. 2008; 34: 241-256.

23. Davies K, Sadler B. 1997. Environmental Assessment and human health: Perspectives, approaches, and future directions. Ottawa: Health Canada.

24. Evans G, Marcynyszyn LA. Environmental justice, cumulative environmental risk, and health among low- and middle-income children in Upstate New York. American Journal of Public Health. 2004; 94: 1942-1944.

25. Farhang L, Bhatia R, Comerford-Scully C, Corburn J, Gaydos M, Malekfzali S. Creating tools for healthy development: Case study of San Francisco's eastern neighborhoods Community Health Impact Assessment. Journal of Public Health Policy and Management. 2008; 14(3): 255-263.

26. Fischer F. 2000. Citizens, Experts and the Environment: The Politics of Local Knowledge. North Carolina: Duke University Press.

27. Harnack LJ, French SA. Effect of point-of-purchase calorie labeling on restaurant and cafeteria food choices: A review of the literature. The International Journal of Behavioral Nutrition and Physical Activity. 2008; 5: 51-51.

28. Hill AB. The environment and disease: association or causation? Proceedings of the Royal Society of Medicine. 1965; 58: 295–300.

29. Karkkainen BC. Towards a smarter NEPA: Monitoring and managing government's environmental performance. Columbia Law Review. 2002; 102: 903-972.

30. Kuo T, Jarosz CJ, Simon P, Fielding JE. Menu labeling as a potential strategy for combating the obesity epidemic: a Health Impact Assessment. American Journal of Public Health. 2009; 99: 1680-6.

31. Levitsky DA, Derosimo L. One day of food restriction does not result in an increase in subsequent daily food intake in humans. Physiology and Behavior. 2010.. [Epub ahead of print].

32. Levitsky DA. The non-regulation of food intake in humans: hope for reversing the epidemic of obesity. Physiology and Behavior. 2005; 86: 623-32.

33. Marmot M, Wilkinson R, eds. 1999. The Social Determinants of Health. New York City: Oxford University Press.

34. Mathias KR, Harris-Roxas B. Process and impact evaluation of the Greater Christchurch urban development strategy Health Impact Assessment. BMC Public Health. 2009; 9:97. doi:10.1186/1471-2459-9-97.

35. Mindell J, Biddulph JP, Boaz A, Boltong A, Curtis S, Joffe M, Lock K, Taylor L. 2006. A guide to reviewing published evidence for use in Health Impact Assessment. London: London Health Observatory. Available at: www.lho.org.uk/download.aspx?urlid= 10846&urlt=1.

36. National Environment Policy Act of 1969 (NEPA) 42 USC §4331.

37. North American HIA Practice Standards Working Group. 2009. Practice standards for Health Impact Assessment. Available at: http://www.sfphes.org/HIA_Practice_Standards.htm.

38. Office of Economic Analysis. 2008. Requiring air quality assessment and ventilation in certain urban infill residential developments: Economic impact report. San Francisco: Office of the Controller.

39. Parry JM, Kemm J. Criteria for use in the evaluation of health impact assessments. Public Health. 2005; 119: 1122-1129.

40. Petticrew M, Cummins S, Sparks L, Findlay A. Validating health impact assessment: Prediction is difficult (especially about the future). Environmental Impact Assessment Review. 2007; 27: 101-107.

41. Quigley, R., L. denBroeder, P. Furu, A. Bond, B. Cave, R. Bos. 2006. Health Impact Assessment international best practice principles. Special publication series No.5. Fargo, USA: International Association for Impact Assessment. Available at: http://www.iaia.org/publicdocuments/special-publications/SP5.pdf.

42. Revesz RL. Environmental regulation, cost-benefit analysis, and the discounting of human lives. Columbia Law Review. 1999; 99(4): 941-1017.

43. Rutt CD, et al. A case study examining the applicability of using Health Impact Assessment to evaluate a greyfield redevelopment project in Atlanta, GA. Unpublished Manuscript.

44. Sabel C, Fung A, Karkkainen B. 2000. Beyond Backyard Environmentalism. Boston: Beacon Press.

45. Senate Bill 6099. 2007. Hiring a mediator to help the department of transportation develop a state route number 520 expansion impact plan. Washington State Legislature.

46. Seto EY, Holt A, Rivard T, Bhatia R. Spatial distribution of traffic induced noise exposures in a US city: an analytic tool for assessing the health impacts of urban planning decisions. International Journal of Health Geographics. 2007; 6: 24.

47. Steinemann A. Rethinking human health impact assessment. Environmental Impact Assessment Review 2000; 20: 627-645.

48. Taylor L, Gowman N, Lethbridge J, Quigley R. 2003. Deciding if a health impact assessment is required (screening for HIA). NHS Health Development Agency. Avaliable at: www.iaia.org/publicdocuments/pubs_ref_material/Screening%20for%20HIA%20pdf.pdf.

49. Taylor L, Gowman N, Quigley R. Evaluating Health Impact Assessment. 2003. NHS Health Development Agency. Available at: http://www.iaia.org/publicdocuments/pubs_ref_material/Evaluating%20HIA%20pdf.pdf

50. U.S. Environmental Protection Agency (USEPA). 1999, Final Guidance for Consideration of Environmental Justice in Clean Air Act 309 Reviews. Washington, DC: USEPA.

51. USEPA. Consideration of cumulative impacts in EPA review of NEPA documents. 1999.

52. UC Berkeley Health Impact Group. 2010. Health impacts of the Port of Oakland on West Oakland.

53. UCLA HIA Project. August 2007. Mass Transit HIA: Potential health impacts of the Governor's Proposed Redirection of California State Transportation Spillover Funds. Available at: http://www.ph.ucla.edu/hs/health-impact/docs/massTransitHIA_June2008.pdf. .

54. USEPA. 1998. Guidance for incorporating environmental justice concerns in EPA's NEPA Compliance Analyses. Washington DC: USEPA. Available at: http://www.epa.gov/region1/ej/pdfs/ej_guidance_nepa_epa0498.pdf .

55. USEPA. 2000. Guidelines for preparing economic analysis. Washington DC: USEPA.

56. USEPA. 2006. Regulatory impact assessment. National ambient air quality standards for particle pollution. Washington DC: USEPA.

57. Veerman JL Mackenbach JP, Barendregt JJ. Validity of predictions in health impact assessment. Journal of Epidemiology and Community Health. 2007; 61: 363-366.

58. Weir M, Weintraub J, Seto E, Humphreys E, Bhatia R. An area-level model of vehicle-pedestrian injury collisions with implications for land use and transportation planning. Accident Analysis & Prevention. 2009; 41: 137–145.

59. Wernham A. Inupiat health and proposed Alaskan oil development: Results of the first integrated Health Impact Assessment/Environmental Impact Statement of proposed oil development on Alaska's North Slope. Ecohealth. 2007; 4: 500-513.

60. West Oakland HIA Working Group and UC Berkeley Health Impact Group. October 22, 2007. Principles of collaboration for the Port Of Oakland Health Impact Assessment.

61. Wier M, Sciammas C, Seto E, Bhatia R, Rivard T. Health, traffic, and environmental justice: Collaborative research and community action in San Francisco, California. American Journal of Public Health. 2009; 99(S3): S499-S502.

62. Wismar M. The effectiveness of health impact assessment. Eurohealth. 2004; 10: 41-43.

63. World Health Organization: Health Impact Assessment. Examples of HIA. Available at: http://www.who.int/hia/examples/en/index.html.

APPENDIX I.

Practice Resources

International Websites

- HIA Community Wiki – www.healthimpactassessment.pbworks.com
- World Health Organization HIA website – www.who.int/hia/en/
- HIA Connect (Australia) – www.hiaconnect.edu.au/
- HIA Gateway (UK) – www.apho.org.uk/default.aspx?QN=P_HIA
- London Health Commission – www.londonshealth.gov.uk/hia.htm

U.S. Government Websites

- National Association of City and County Health Officials (USA) – www.naccho.org/topics/environmental/landuseplanning/HIA.cfm
- Centers for Disease Control and Prevention – www.cdc.gov/healthyplaces/hia.htm
- San Francisco Department of Public Health – www.sfphes.org

University HIA Education, Research and Practice Programs

- University of California, Los Angeles – HIA Clearinghouse Learning and Information Center – www.ph.ucla.edu/hs/hiaclic
- University of California, Berkeley Health Impact Group – http://sites.google.com/site/ucbhia/
- University of Minnesota, University of Colorado, and Cornell University – Design for Health – www.designforhealth.net/
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Private HIA Practitioners

- Human Impact Partners – www.humanimpact.org
- Habitat Health Impact Consulting – www.habitatcorp.com

Guidance for Health, Community, and Social Impact Assessment

- California Department of Transportation. 1997. Community Impact Assessment. CalTrans Environmental Handbook Volume 4. Available at: http://www.dot.ca.gov/ser/envhand.htm
- Community Impact Assessment: A Quick Reference for Transportation. 1996. United States Department of Transportation. Available at: www.ciatrans.net/CIA_Quick_Reference/Purpose.html

- Council on Environmental Quality (CEQ) Environmental Justice: Guidance under the National Environmental Health Policy Act. Washington, DC: President's Council on Environmental Quality, 1997.
- enHealth. 2001. Health Impact Assessment Guidelines. Canberra: Commonwealth Department of Health and Aged Care. Available at: www.dhs.vic.gov.au/nphp/enhealth/council/pubs/pdf/hia_guidelines.pdf
- Harris P, Harris-Roxas B, Harris E, Kemp L. 2007. Health impact assessment: A practical guide. University of New South Wales: Sydney. Available at: www.hiaconnect.edu.au/hia_a_practical_guide.htm
- Human Impact Partners. 2008. Health Impact Assessment: A Toolkit for Community Based Planning. Available at: www.humanimpact.org/Tools.html
- International Finance Corporation. 2009. Introduction to Health Impact Assessment. Available at: www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/p_HealthImpactAssessment/$FILE/HealthImpact.pdf
- Inter-organizational Committee on Guidelines and Principles 1994. Guidelines and principles for social impact assessment. US. Dep. Commerce., NOAA Tech. Memo. NMFS-F/SPO-16, 29 p. Available at: www.st.nmfs.noaa.gov/tm/spo/spo16.pdf
- North American HIA Practice Standards Working Group. Practice Standards for Health Impact Assessment, Version 1. North American HIA Practice Standards Working Group, April 7, 2009. Available at: www.sfphes.org
- U.S. Environmental Protection Agency (USEPA). Final Guidance for Consideration of Environmental Justice in Clean Air Act 309 Reviews. Washington, DC: USEPA, 1999.
- U.S. Environmental Protection Agency. (USEPA) Consideration of Cumulative Impacts in EPA Review of NEPA Documents. May 1999.

Impact Assessment Texts and Reviews

- Lock K. 2000. Health Impact Assessment. British Medical Journal. 320; 1395-1398.
- Becker HA and Vanclay F. 2003. The International Handbook of Social Impact Assessment: Conceptual and Methodological Advances. Cheltenham, UK: Edward Elgar.
- Burdge RJ. 1998. A Conceptual Approach to Social Impact Assessment. Social Middleton: Ecology Press.
- Kemm JR, Parry J, Palmer S. 2004. Health Impact Assessment: Concepts, Theory, Techniques, and Applications. USA: Oxford University Press.

Reviews on Social and Environmental Determinants of Health

- Wilkinson R and Marmot M. 2003. Social Determinants of Health: The Solid Facts (2nd ed). Copenhagen: World Health Organization, Regional Office for Europe. Available at: www.euro.who.int/DOCUMENT/E81384.PDF
- Ewing R, Frank L, Kreutzer R. 2006. Understanding the Relationship between Public Health and the Built Environment: A Report to the LEED-ND Core Committee. Available at: www.usgbc.org/ShowFile.aspx?DocumentID=1736
- Flournoy R, Yen I. 2004. The Influence of Community Factors on Health: An Annotated Bibliography. Oakland: PolicyLink. Available at: www.policylink.org/site/c.lkIXLbMNJrE/b.5137443/apps/s/content.asp?ct=6999737
- Kawachi I, Berkman LF. 2003. Neighborhoods and Health. New York: Oxford University Press.
- US Environmental Protection Agency. 2001. Our Built and Natural Environments. Washington DC. Available at: www.epa.gov/dced/pdf/built.pdf

Health, Social, Economic, and Environmental Indicators

- Healthy People 2010. Leading Health Indicators – www.healthypeople.gov/lhi/
- National Center for Health Statistics – www.cdc.gov/nchs/
- WHO Statistical Information System – www.who.int/whosis/en
- U.S. Census Bureau – www.census.gov/
- U.S. Bureau of Labor Statistics – www.bls.gov/
- U.S. Department of Health and Human Services - Community Health Status Indicators Report – www.communityhealth.hhs.gov/homepage.aspx?j=1
- Healthy Development Measurement Tool – www.thehdmt.org
- USEPA Environmental Indicators Gateway – www.epa.gov/indicators/

APPENDIX II.

Integrating Health and Environmental Impact Assessment

Environmental Impact Assessment (EIA) refers to a practice of integrated impact analysis of governmental actions typically conducted to meet statutory or regulatory mandate. The practice developed to serve regulatory requirements under the 1969 National Environmental Policy Act (NEPA) (CEQ 1997). Both NEPA as well as related State laws require analysis of certain direct and indirect health effects of projects, generally when the project will involve a major change in the physical environment (CEQ 1978 §1508.8; EQ 1978 §1508.27; CEQ 1997; EPA 1998)

The 1969 National Environmental Policy Act (NEPA) charged the Federal government agencies "to use all practicable means, consistent with other essential considerations of national policy" to "assure for all Americans safe, healthful, productive and aesthetically and culturally pleasing surroundings" (NEPA 1969 §4331). The law requires that any major federal action significantly affecting the quality of the human environment must undergo an evaluation and public disclosure of its environmental effects (NEPA 1969). The Council on Environmental Quality (CEQ) which promulgates regulations for implementing NEPA (40 CFR 1500-1508) emphasizes that the "human environment" is to be "interpreted comprehensively" under NEPA to include "the natural and physical environment and the relationship of people with that environment" (40 CFR 1508.14). NEPA regulations further define “effects” as those that are “…ecological, aesthetic, historic, cultural, economic, social, or **health**, whether direct, indirect, or cumulative,” (CEQ 1978 §1508.8).

Health should be an explicit factor in determining the significance of environmental effects. According to NEPA regulations, the significance of an action must be analyzed at the level of society as a whole, the affected region, the affected interests, and the locality and may vary by settings. Judgments of intensity, or severity should reflect the particular characteristics or vulnerabilities in an area or context (e.g., proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, endangered species or ecologically critical areas) and consider the degree to which a proposed action affects **public health or safety**, the degree to which effects are controversial or uncertain, the opportunity for an action to establish a precedent for future actions, the potential for an individually insignificant action to be cumulatively significant, and the potential for an action to violate Federal, State, or local law or requirements imposed for the protection of the environment. (CEQ 1978 §1508.27) The U.S. Centers for Disease Control has an official regulatory role in reviewing of health effects in EISs conducted by Federal agencies.

HIA may offer one approach to conduct an integrated health analysis as part of the EIA process, and has recently been used in several jurisdictions to fulfill regulatory requirements under NEPA or similar state laws. (Davies & Sadler 1997; Bhatia and Wernham 2008).

Stage in EIA	Requirements Relevant to Health Analysis
Screening	Under NEPA, federal agencies conduct an EIS when they determine their action to be a "major federal action significantly effecting the quality of the human environment" (NEPA Sec. 102 [42 USC § 4332]).
Scoping	When an EIS is required, agencies are required to conduct analysis of any health effects of the action. Agencies can determine the need for and type of health analysis based upon knowledge about community health status and environmental conditions and social vulnerabilities. This information is available through public hearings, literature review, and consultation with local health agencies and other health experts. NEPA does not prescribe data sources and methods and evidence. Agencies may determine the specific methods of analysis and identify mitigations and alternatives through a similar process.
Assessment	Assessment in an EIS involves roughly the same process as assessment in HIA. This includes a description of the affected environment (baseline conditions), an analysis of environmental consequences of the decision alternatives, and recommendations for measures to protect health. A specific consideration in determining "significance" of an effect is "the degree to which the proposed action affects public health or safety" (40 CFR 1508.27).
Reporting	Assessment of health effects is reported within the Draft EIS (DEIS) either in subsections related to a category of environmental effect or in a public health, community health, or environmental justice subsection. The DEIS is subject to public comment, reassessed and revised based upon those comments, and released as a Final EIS (FEIS). Using the information in the FEIS, agency management renders a final "Record of Decision" approving, modifying, or rejecting the proposed action.
Monitoring	Typically, an EIS that includes required mitigation also includes a mitigation monitoring plan.

Seventeen state-level versions of NEPA are referenced on the NEPA website (http://www.nepa.gov/nepa/regs/states/states.cfm). Fourteen of these contain language that would support the inclusion of health effects analysis. For example, in California, the California Environmental Quality Act (CEQA) statute and guidelines includes human health impacts within the scope of potential adverse environmental impacts.[2] CEQA requires an Environmental Impact Report (EIR) to be prepared whenever the environmental effects of discretionary public decision has the potential significant adverse effects on human beings, either directly or indirectly (CCR §15065). CEQA regulations also specifically require that environmental impact

[2] Public Resources Code § 21000 of CEQA states that "the intent of the Legislature [is] that the government of the state take immediate steps to identify any critical thresholds for the health and safety of the people of the state and take all coordinated actions necessary to prevent such thresholds being reached." 14 Cal. Code Regulation §15065 states that a lead agency must find that a project may have a significant impact and require that an EIR be prepared if "…the environmental effects of a project will cause substantial adverse effects on human beings, either directly or indirectly." 14 Cal. Code Regulation §15126.2 requires that the EIR discuss "health and safety problems caused by the physical changes."

reports (EIR) discuss "health and safety problems caused by the physical changes" (CCR §15126.2). In California, CEQA case law has consistently upheld the requirement to study public health impacts related to changes in environmental quality.[3]

Environmental effects considered in EIA can include damage to the health of biota, disruption of food webs; loss or transformation of habitats and natural areas; removal of natural resources; transformation of natural systems or landscapes; pollution of water, soil, or air, and change or development of the built environment. Diverse adverse effects on humans and human health can result indirectly from these environmental effects. Common indirect environmental effects on health or human welfare can include:

- Adverse health effects from a change in exposure or proximity to a new or existing environmental hazard, including air, water, or soil pollutants, noise, radiation, biological pathogens and injury hazards
- Reduction of the quality or quantity of recreational opportunities or access to or contact with natural areas;
- Prevention of culturally important uses of land and natural resources or damage to a culturally important, archaeological, paleontological, or architectural resource;
- Loss of natural resource or foreclosure of future use of natural resources for livelihood or sustainability (e.g., loss of a food, energy, or water resources);
- Change in the quality of housing
- Displacement or forced migration.

Despite statutory requirements, research on EIA practice shows that there is inconsistent and incomplete attention to health effects analysis in EIA practice (Arquiaga 1994; Cole 2004; Davies and Sadler 1997; Steinemann 2000; Wernham 2007). One review of 42 Federal EIAs conducted under NEPA found that more than half contained no mention of health; a minority contained narrow discussions of health risks (usually cancer risk assessments) associated with chemicals or radiation (Steinemann 2000). An international review demonstrated that EIA rarely considers health impacts mediated via changes in the built environment, social determinants, or economic impacts (Davies and Sadler 1997).

A number of institutional, organizational, and disciplinary factors may help explain the inattention to health within EIA (Bhatia & Wernham 2008; Rattle and Kwiatkowski 2003). For example, public health agencies may not be aware of EIA requirements or engage with the agencies responsible for these assessments. Health stakeholders have only infrequently used EIA to protect health interests and administrative or court challenges on inadequate health analyses are rare. Furthermore, health agencies appear to have few resources for cross-sector collaboration.

In the US, Federal agencies are becoming more attentive to the gaps in health analysis within NEPA. The Executive Order on Environmental Justice further established NEPA as a mechanism to ensure federal agencies analyze and mitigate disproportionately high health and

[3] For example: *Bakersfield Citizens for Local Control v. City of Bakersfield*, *Berkeley Keep Jets Over the Bay Committee vs. Board of Port Commissioners of the City of Oakland*, and *Californians for Alternatives to Toxics v. Department of Food and Agriculture.*

Actions to support integration of analysis of health effects within EIA:

- Apprise decision makers and responsible lead agency official of the requirements for health analysis under EIA statutes
- Identify health-relevant environmental effects, potential public health impacts, and population sensitivities
- Ensure public health agencies participate in the EIA process as participating or cooperating agencies
- Identify available data sources and research methods or provide lead agency officials with data and evidence on health impacts,
- Identify public health scientists or other experts to conduct research for EIA
- Apply analytic tools to study health impacts
- Develop health-based significance thresholds
- Identify mitigations and alternatives that would diminish adverse health impacts
- Ensure agencies with health expertise (such as local, regional, state, and tribal health agencies) are participating in the EIA process
- Review and critique environmental and health effects analysis in the EIA
- Conduct an HIA on the project subject to EIA
- Provide watchdog role for mitigation monitoring

environmental impacts.[4] The Presidential Memorandum that accompanied the Executive Order specified several specific mechanisms through which NEPA could support environmental justice by: identifying disproportionately high and adverse environmental and health effects of federal actions on minority and low-income communities; identifying measures to address such environmental and health impacts; providing opportunities for community input in the NEPA process, including identifying potential effects and mitigation measures in consultation with affected communities (Clinton 1994). Both the CEQ and USEPA have issued guidance for preparation and review of NEPA documents with regards to cumulative impacts and environmental justice that address the requirements for health effects analysis (CEQ 1997; EPA 1998). In California, the USEPA has recommended conducting HIA in the course of maritime port expansion projects to achieve NEPA EJ requirements (USEPA 2008.)

NEPA does not require an HIA per se to occur as a separate and independent process from the process for producing an environmental impact statement (EIS). The EIS process under NEPA has several entry points for integrating health concerns and analysis. (See text box on this page); HIA may be one approach to assess health effects under NEPA.

The conduct of public health analysis in a NEPA-document would generally mirror the process used to analyze other environmental effects in an EIS. Health effects analysis could be documented as part of an EIS (e.g., a public health chapter) or as indirect effects of impacts on environmental resources (e.g., impacts on air quality or housing). Key outputs would include

- The baseline health status of affected communities, including both health status indicators, indicators of health resources, and indicators of conditions making the community vulnerable to health effects of the action.
- Analysis of the potential health consequences of the alternatives.

[4] Executive Order 12898 instructs Federal agencies to: make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States.

- A discussion of disproportionate health effects on affect low income or minority populations (Executive Order 12898), or children (Executive Order 13045)[5].
- Identification of potential mitigation measures or alternatives to address any significant health effects.

NEPA, and the related state laws, have strong provisions for public input, with mandates for public comment periods during which impacted communities along with public agencies may submit input on the scope and adequacy of the EIA analysis. A lead agency must publish a notice when they intend to conduct an EIA; circulate a draft EIA for pubic review; and solicit comments on the draft. The lead agency must respond to all comments in writing, accounting for the input either by modifying the EIA or by justifying the original analysis. NEPA also mandates the responsible, or "lead," agency to solicit participation by state, local, and tribal governments and agencies with legal jurisdiction or relevant expertise (CEQ 1978 § 4331(a), §4332(2)).

Mitigating Impacts of National Petroleum Reserve Lease Sales, Alaska, 2007

Participating as a cooperating agency in the NEPA process, the Alaskan Intertribal Council conducted an HIA on proposed oil and gas leasing in the 4.6-million-acre Northeast National Petroleum Reserve, which lies within Alaska's 89,000-square-mile North Slope Borough. The Bureau of Land Management encouraged leases and permittees engaged in oil and gas exploration, development, and abandonment procedures in the planning area to work with the local communities to develop and implement measures to avoid or minimize the potential impacts. The Environmental Impact Statement included strategies to mitigate potential impacts on infectious disease transmission, sustenance resources, nutrition, and livelihoods based on strategies used in development experiences elsewhere in the world (Wernham 2007).

[5] Executive Order 13045 states that agencies must: make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and ... shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.