

Special Feature: Indigenous Perspectives

Original Contribution

Inupiat Health and Proposed Alaskan Oil Development: Results of the First Integrated Health Impact Assessment/ Environmental Impact Statement for Proposed Oil Development on Alaska's North Slope

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Abstract: We report on the first Health Impact Assessment (HIA) for proposed oil and gas development in Alaska's North Slope region. Public health is not generally analyzed in the Environmental Impact Statement (EIS) process in the U.S. We conducted an HIA for proposed oil development within the National Petroleum Reserve - Alaska in response to growing concerns among North Slope Inupiat communities regarding the potential impacts of regional industrial expansion on their health and culture. We employed a qualitative HIA methodology, involving a combination of stakeholder input, literature review, and qualitative analysis, through which we identified potential health effects. The possible health outcomes identified include increases in diabetes and related metabolic conditions as a result of dietary change; rising rates of substance abuse, domestic violence, and suicide; increased injury rates; more frequent asthma exacerbations; and increased exposure to organic pollutant, including carcinogens and endocrine disruptors. There are also potential benefits, including funding for infrastructure and health care; increased employment and income; and continued funding of existing infrastructure. Based on these findings, we recommend a series of public health mitigation measures. This project represents the first formal effort to include a systematic assessment of public health within the U.S. EIS process. The inclusion of public health concerns within an EIS may offer an important and underutilized avenue through which to argue for environmental management strategies that focus on public health, and may offer communities a stronger voice in the EIS process.

Keywords: Inuit, Environmental Impact Statement, Health Impact Assessment, National Environmental Policy Act, human health

INTRODUCTION

This article describes the initial results of the first Health Impact Assessment (HIA) undertaken for oil and gas

development on Alaska's North Slope. This work also represents the first formal effort to undertake an HIA within the legal framework of the National Environmental Policy Act (NEPA), the statute that established the Environmental Impact Statement (EIS) process and which forms the foundation of environmental regulation in the U.S. The inclusion of a broad, systematic analysis of health within a

U.S. EIS is unprecedented (Steinemann, 2000; Cole et al., 2004; Cole and Fielding, 2007). The federal agencies involved have commented that this work has implications for the implementation of NEPA elsewhere in the U.S.

Alaskan Energy Development, the EIS Process, and Human Health

Large industrial development in the U.S. is regulated through the NEPA-mandated EIS process. NEPA requires federal agencies to consider the effects of their policies or programs on the “human environment” (42 USC § 4332). NEPA is unique among environmental statutes: rather than establishing regulatory thresholds for the impacts identified in an EIS, it promotes environmental protection through an open, comprehensive public disclosure of the likely consequences of a project.

A number of surveys of NEPA practice have found that the consideration of public health in the EIS process is limited or absent, both within the U.S. and internationally (Steinemann, 2000; Cole et al., 2004). Yet, because of their scale, projects under NEPA’s jurisdiction often involve not only environmental effects, but also substantial changes in local economies, employment patterns, population, culture, and infrastructure—important determinants of health and health disparity.

The health effects of oil and gas development are a matter of growing concern for the Inupiat people of Alaska’s North Slope. Communities near active and proposed oil and gas development have raised the issue of health eloquently and repeatedly in public testimony on past EISs. The National Research Council has criticized the North Slope planning process for a deficient consideration of health issues (National Research Council, 2003). Compounding the problem, changes in U.S. energy policy over the last six years have brought increasing pressure on Alaska as a domestic source of petroleum, and have generated a flurry of proposals to expand oil leasing in the region to include most of the 24 million acre National Petroleum Reserve – Alaska (NPR-A) and the northern outer continental shelf (OCS). Because Inupiat communities are deeply dependent on subsistence hunting, fishing, and whaling in these areas, these proposals have generated tremendous local concern.

Proposed leasing in the Teshekpuk Lake Special Area (TLSA) of Northeast NPR-A has been a focal point for community concerns. The core calving area for the Teshekpuk Lake caribou herd, a critical molting habitat for a

rich variety of migratory waterfowl, and a productive fishery, the TLSA constitutes the traditional center of onshore subsistence activity in the region. Protected from development under a 1998 EIS, the TLSA was reconsidered for leasing under a 2004 federal mandate. An “Amended EIS” process ensued, concluding with a decision to permit development in the region (BLM, 1998). This decision was subsequently struck down in a federal district court case in 2006 (U.S. District Court for the District of Alaska, 2006). The Bureau of Land Management (BLM), the regulatory agency for the region, responded by initiating a “Supplemental EIS.”

HIA and the Integration of Health into the EIS Process

Notwithstanding the historical lack of health information in NEPA documents, human health was a core concern of the original legislation. The Act’s stated purpose is to “stimulate the health and welfare of man” (42 USC § 4321). The central importance of health to the objectives of NEPA is further established through five additional references to health within the statute. The Code of Federal Regulations governing NEPA’s implementation explicitly defines public health as one of the effects which must be considered in an EIS (40 CFR § 1500–1508). NEPA also requires cross-disciplinary collaboration between natural, physical, and social sciences to further its objectives (42 USC § 4332). We reasoned, therefore, that a strong case could be made for the inclusion of public health analysis in the Supplemental EIS.

HIA provides a systematic process and methodology to anticipate and proactively address the potential health consequences of a program or policy in order to maximize the potential benefits and minimize adverse outcomes (Quigley et al., 2006). HIA takes a comprehensive and inclusive approach to evaluating potential health effects, and the analysis is founded on the conceptual framework of the social and environmental determinants of health.

While interest in HIA in the U.S. is growing, its use here has been limited to date; most efforts have occurred independent of the EIS process, addressing both policies and development projects (Cole and Fielding, 2007). Bhatia (2007) recently reported HIAs submitted by the San Francisco Department of Public Health as formal comments on two active environmental impact reports, which resulted in the adoption of important new mitigation. Our work appears to be the first reported HIA formally integrated into a federal EIS.

A number of barriers and challenges to integrating HIA into the EIS process have been described, including (1) resistance on the part of EIA professionals; (2) a perception that NEPA does not explicitly require the consideration of public health; (3) concerns about the reliability of predictions regarding health given the litigious atmosphere of the EIS process; (4) the risk that integrating HIA into the highly structured and regulated EIS process will necessitate a narrower consideration of health; (5) a bias toward the consideration of narrower physical rather than broader social determinants of health (Cole et al., 2004; Bronson and Noble, 2006; Cole and Fielding, 2007). Steinemann (2000), on the other hand, advocates a broad approach to health within the EIS process, arguing that it would ensure that the EIS serves as a “proactive planning tool, rather than a reactive remedial tool.”

METHODS

Study Area

Our HIA addressed proposed oil and gas leasing in the 4.6-million-acre Northeast NPR-A, which lies within Alaska’s 89,000-square-mile North Slope Borough (NSB). The first major oil discovery on the North Slope occurred at Prudhoe Bay in 1967. Over the three decades since full-scale production began at Prudhoe Bay, development has spread closer to villages and areas of active subsistence use both on- and offshore.

Study Population

The NSB includes eight Inupiat villages, ranging in population from 250 at Point Lay to over 4,000 in Barrow. The villages are remote, with no permanent roads leading to or between them.

The Inupiat people consider themselves a subsistence culture. Despite extensive social and economic change since initial contact with American whalers in the mid-1800s, the Inupiat people still rely heavily on hunting, fishing, and whaling as both the mainstay of their diet and the cornerstone of their culture and social organization. The importance of subsistence activities to rural Alaska Native communities has been described as follows:

Subsistence is a way of life in rural Alaska that is vital to the preservation of communities, tribal cultures, and economies. Subsistence

resources have great nutritional, economical, cultural, and spiritual importance in the lives of rural Alaskans... Subsistence, being integral to our worldview and among the strongest remaining ties to our ancient cultures, is as much spiritual and cultural, as it is physical (Alaska Federation of Natives, as quoted in BLM, 2005)

Because of the role of oil revenue in the North Slope economy, Inupiat decision-makers have generally supported oil development, as long as subsistence impacts are minimal. Over the last 15 years, however, development has spread west to within a few miles of Nuiqsut, the first North Slope community in close proximity to active oil development. For years, Nuiqsut residents have expressed concern about the potential associations between oil development and health. In public hearings, residents have testified to concerns ranging from possible effects of contaminants (including cancer, asthma, and thyroid disease) to a rise in social problems such as alcoholism, domestic violence, and suicide (Ahtuanguak, 2003), and, increasingly, to more generalized fears regarding the survival of Inupiat culture and tradition.

Health Impact Assessment Process and Methodology

HIA methodology is relatively new and still changing. HIAs may be broadly divided into qualitative versus quantitative approaches, with qualitative HIA being somewhat more common because of the breadth of concerns addressed, complexity of assumptions and uncertainty of other project-related effects, and the focus on the social determinants of health. HIAs have also been classified as broad (holistic, qualitative, participatory, sociologic approach) or tight (quantitative, epidemiologically focused, limited scope) (Cole and Fielding, 2007; Kemm, 2000).

A prevalent concern regarding HIA is the question of the predictive validity and accuracy, given the complex determinants of health and illness and the lack of standardization of HIA methodology (Kemm, 2000; Parry and Stevens, 2001; Cole and Fielding, 2007). It has been argued that establishing the predictive validity of an HIA is seldom feasible because of the complex influences on disease outcomes and because if the HIA is successful in its ultimate goal of protecting health, predicted adverse outcomes will

Table 1. Steps in the HIA Process^a

1. Screening	Determines whether an HIA is necessary, and whether it is likely to be useful
2. Scoping	Establish: <ul style="list-style-type: none"> ○ the population to which the HIA applies ○ the scope of health problems to be analyzed ○ the HIA team ○ methods to be used in the assessment ○ data sources
3. Assessment	Two steps: <ol style="list-style-type: none"> 1. Scaling: describe the baseline health status and determinants of health in the population 2. Assessment of likely impacts: literature review, qualitative or quantitative analysis
4. Decision/Recommendations	Based on the impacts projected, develop recommendations to minimize adverse impacts, maximize benefits
5. Reporting	Report results to stakeholders; in some cases formal public input is sought, and the draft assessment revised based on this input
6. Monitoring and Reassessment	Select a set of outcomes likely to be sensitive/accurate indicators of the changes predicted. May include health outcomes or determinants of health. Monitor for the duration of planned activities and reassess accuracy of predictions; may also involve adapting management based on observed outcomes

^a Adapted from World Health Organization, 2007.

be prevented (Veerman et al., 2007). Others advocate an adaptive monitoring and management approach to address this concern (Steinemann, 2000).

A six-step process can be described for HIA (Table 1). Below we outline our adaptation of HIA to work within the NEPA process, and address the questions of accuracy and validity.

1. Screening

The NSB adopted a common and simple standard: any project large enough to warrant an EIS should also undergo an HIA.

2. Scoping

We relied on a combination of public input and a review of other pertinent sections of the Amended EIS (addressing air and water quality, sociocultural, and subsistence effects). Public input was obtained from several sources. First, we held a series of public meetings (unstructured EIS hearing format) regarding proposed leasing in the adjacent South NPR-A region (BLM had initiated an EIS for this region but halted the process in order to begin the Supplemental EIS once the Northeast NPR-A case was

decided). This testimony was pertinent to Northeast NPR-A because the regions are contiguous, and residents tended to express health concerns in terms of ecosystem-based impacts generalized over the entire area. Second, we reviewed transcribed public testimony from the Amended EIS. Third, we had discussions with local public health professionals, wildlife experts, and BLM NEPA analysts.

3. Assessment

We began with a description of baseline health status and determinants of health, accomplished through a search of published data pertaining to the North Slope, unpublished data sources (internal tribal health agency reports; arrest records; statewide disease registries, and vital statistics), and conversations with local public health officials.

To assess potential health effects, we employed a simple, qualitative approach: based on the issues identified in scoping, we reviewed pertinent literature and identified potential associations between development-related disturbances, health determinants, and health outcomes. Project-related disturbances may have conflicting influences on health, making it difficult to model the degree or even at times the direction of a given health outcome. For example, data suggest that acculturative stress and

economic development—both predicted disturbances associated with oil development—exert opposing influences on suicide rates in Inupiat communities (Travis, 1984). Furthermore, the EIS acknowledges substantial uncertainty regarding many of the disturbances on which health outcomes depend, such as the degree to which subsistence activities might be disrupted. Consequently, our approach emphasized the description of relationships between oil and gas activities, health determinants, and health outcomes, and we avoided predictions regarding the likelihood or direction of health outcomes unless the available data strongly supported the conclusion. This approach allows the identification of measures that might not only minimize harm but might maximize benefits as well.

4. Decision/Recommendations, and 6. Monitoring/Reassessment

We drafted a series of health-based mitigation measures that we recommended for inclusion as requirements for developers in the region. To address the question of predictive uncertainty, we drew on what has been termed “adaptive management,” and attempted to build provisions for monitoring health outcomes and health determinants, and reassessment and modification of mitigation measures predicated on outcome data.

5. Reporting

Results are being reported in three forms. First, the HIA subsections were submitted to Alaskan public health officials and HIA experts for peer review. Second, the draft Supplemental EIS was published in summer 2007 and will be subject to a public review process and modification to produce a final EIS. This article is the final means through which our results will be reported.

Legal Process: Implementing HIA under NEPA

The provisions for public participation under NEPA provided an avenue through which to advocate for the inclusion of public health. This approach may be broadly applicable elsewhere in the U.S.

The most common form of public participation in the EIS process involves written comments or verbal testimony submitted during official comment periods. Agencies have the statutory obligation to address any salient issue raised by someone with a legitimate stake in the outcome. Through written comments we were recently able to

include a brief HIA in the Minerals Management Service’s (MMS) 5-Year OCS Oil and Gas Leasing Program (MMS, 2007). Second, direct “government-to-government” consultation is an option available to Tribes, and allows high-level discussions with the regulatory agencies at every step of the process. Finally, local agencies, governments, or Tribes may opt to become “cooperating agencies.” Cooperating agencies take part in writing and editing the EIS. The staff time, financial resources, and scientific expertise required for participation at this level can prove overwhelming for small communities, but in some cases cooperating agencies are able to negotiate with the “lead” agency for funding to help defray expenses.

The North Slope Borough (NSB), the regional government, negotiated with BLM to become a cooperating agency on the Supplemental EIS. Through the working relationship that developed between the NSB and BLM, the NSB was able to assert the statutory requirement and ethical imperative to address the public health concerns in the Supplemental EIS, and was invited to draft subsections on public health. The lead agency maintains ultimate editorial authority over the EIS, but the entire HIA becomes part of a public administrative record and the lead agency must justify any editing or changes.

RESULTS

Baseline Health Status

Although general markers of population health in the North Slope have improved substantially in the last 50 years, current health status among the North Slope Inupiat reflects significant disparities when compared with the U.S. population. The pattern of illness has shifted from high mortality secondary from infectious diseases to reduced all-cause mortality with rapidly increasing rates of cancer, social pathology, and chronic illness. Table 2 summarizes our description of baseline health status.

Projected Public Health Effects of Development in Northeast NPR-A

Table 3 summarizes the disturbances projected under the Northeast NPR-A development scenario, and BLM’s analysis of effects on other aspects of the “affected environment.” We discuss potential relationships between EIS predictions and health outcomes below. Our choice of outcome categories grew out of the prevalent health

Table 2. Baseline Health Status and Determinants of Health

Health Status ^{a,b}	Discussion/Determinants
<u>General Measures</u>	<u>General Measures</u>
<ol style="list-style-type: none"> 1. Life expectancy: 1950: 46.6 years (68.2) 1998: 69.5 years (76.7) 2. Mortality: 1124/100,000 (834/100,000 U.S. whites) 3. Infant Mortality: 1960: 90/100,000 (25/100,000) 2000: 7/100,000 (7/100,000) 	<ul style="list-style-type: none"> ● Improvements largely attributed to declining infectious disease/effective TB control, and decreasing injury rates ● Economic standard of living, housing conditions, infrastructure, and access to health care have improved dramatically since 1950 ● Current disparities are mainly attributed to continuing high rates of injury and cancer
<u>Cancer</u>	<u>Cancer</u>
<ol style="list-style-type: none"> 1. Incidence: 579/100,000 (461/100,000) 2. Mortality: 303/100,000 (163/100,000) 	<ul style="list-style-type: none"> ● 50% increase in incidence and mortality since 1969. ● Largest increase: breast, lung, and colon cancer. ● Cancer now the leading cause of death on the North Slope. ● Smoking prevalence >40%. ● Although incomplete, North Slope data suggest relative safety of subsistence foods compared to Greenland and Canada.
<u>Psychological and Social Problems</u>	<u>Psychological and Social Problems</u>
<ol style="list-style-type: none"> 1. Suicide rates: 45/100,000 (11.1/100,000) 2. Violence (rape, assault, domestic violence, homicide): arrest rates 8–15 times U.S. rate (unprocessed data) 3. High prevalence of alcohol abuse 	<ul style="list-style-type: none"> ● Data link rapid sociocultural change to social and psychological pathology in Inuit communities. ● Prohibition (in effect over most of North Slope) reduces alcohol-related morbidity and mortality ● Economic development may mitigate sociocultural change
<u>Injury</u>	<u>Injury</u>
<ol style="list-style-type: none"> 1. Mortality rate over 3.5 times U.S. rate 2. Unintentional injury mortality: 112/100,000 (36.6/100,000) 3. Unintentional injury down 43% since 1979 	<ul style="list-style-type: none"> ● High injury rates reflect, in part, the inherent dangers of subsistence life in the Arctic. ● Injury rates highly correlated with alcohol abuse ● Decline related to effective injury prevention programs, improved trauma care, and better hunting equipment.
<u>Diabetes, Obesity, and Hypertension</u>	<u>Diabetes, Obesity, and Hypertension</u>
<ol style="list-style-type: none"> 1. Type 2 diabetes mellitus was extremely rare in Alaska Natives prior to 1960. 2. North Slope prevalence: approx. 2.4% (7%) 3. 110% increase between 1990 and 2001 (3 times the incidence in general U.S.) 4. Obesity prevalence roughly equivalent to U.S. rate in men, higher in women 	<ul style="list-style-type: none"> ● Abundant data demonstrate that subsistence diet and active lifestyle are the dominant protective factors against diabetes and complications of diabetes. ● Obesity high relative to low prevalence of diabetes. ● Youth and markers of modernization correlate with lower consumption of subsistence foods.
<u>Chronic Pulmonary Disease</u>	<u>Chronic Pulmonary Disease</u>
<ol style="list-style-type: none"> 1. 192% increase in mortality rates in Alaska Natives since 1979 2. North Slope mortality rate: 130/100,000 (45/100,000 U.S. whites) – highest in state 	<ul style="list-style-type: none"> ● Behavioral Risk Factor Surveillance System (BRFSS): >40% prevalence of smoking in Alaska Natives ● North Slope residents concerned that emissions from oil development may be contributing to this problem Minimal monitoring data available to allow determination of the potential contribution of regional emissions.

^a All rates age-adjusted. Rates in parentheses are rates in the general U.S., unless otherwise specified.

^b Sources: Day et al., 2007; ANMC Diabetes Program; ANTHC, 2006; Goldsmith, 2004; Alaska Department of Vital Statistics, 2006; U.S. Department of Health and Human Services, 2006; Lanier et al., 2002.

problems, concerns expressed in public testimony, and the impacts predicted in other sections of the EIS.

1. Psychological and Social Pathology (alcohol and drug abuse, depression, anxiety, child abuse, domestic violence, suicide)

Analysis

The EIS predicts sociocultural and subsistence effects as outlined in Table 3. Rapid sociocultural change and strain are well-documented and central determinants of social pathology in circumpolar Inuit communities (Curtis et al., 2005; Bjerregaard, 2001; Shepard and Rode, 1996). Impacts to subsistence, as a subset of cultural change, are strongly linked with social pathology, as highlighted by public testimony. For example:

We had seismic activity in Camden Bay that caused us to lose two whaling boats. We did not harvest whale two seasons in a row. We went without whale those winters. Those were the deepest, darkest winters I faced as a community health aide. We saw an increase to the social ills, we saw domestic violence, we saw drug and alcohol abuse, we saw all the bad things that come when we are not able to maintain our traditional life activities. (BLM, 2004)

Alcohol prohibition has been shown to reduce social pathology and injury rates in Alaska Native communities, and alcohol is prohibited in most North Slope villages (Chiu and Perez, 1988; Wood and Gruenewald, 2006). The EIS predicts a large influx of temporary oil workers and the possible construction of new access routes to villages. Increased numbers of transient workers coupled with new access routes to communities may result in increased access to drugs and alcohol. Resident testimony confirms that this has been a problem with existing development (Ahtuanguaruak, 2001).

Development would create a modest increase in employment and would help to stabilize current economic inputs to the communities, both of which correlate inversely with social problems. One recent study noted that, paradoxically, employment in Inupiat communities actually can be a source of stress when it reduces the time available for

subsistence (Martin, 2005). Unemployment and economic depression (predicted during the abandonment phase) are associated with social pathology (Travis, 1984).

Overall, we reasoned that the project carried a high risk of adverse impacts on rates of social pathology because of planned development in a region of great cultural and practical importance to the surrounding communities. Economic and employment effects might mitigate this impact to some extent, but would not likely negate it. Furthermore, these protective benefits would be lost at the conclusion of development activities.

Projected Outcome

Increase likely; extent dependent on intensity of impacts on subsistence, culture, and potential increases in drug/alcohol trafficking.

2. Injury

Analysis

Injury rates on the North Slope are high (Table 2). The determinants of injury include high rates of social pathology and the extreme environmental conditions in which subsistence activities occur. Social pathology has been discussed above. The EIS also predicts that hunters may have to travel longer distances to encounter subsistence resources, which would increase the risk of injury as well.

Projected Impact

Increased injury rates likely; extent dependent on the increased distance and difficulty involved in hunting and on the potential increase in social pathology.

3. Type 2 Diabetes Mellitus and Related Metabolic Disorders (hypertension, hyperlipidemia, obesity)

Analysis

The EIS predicts possible disruptions of harvests. At present, North Slope villages harvest between 300 and 800 pounds of subsistence foods per capita annually, among the highest harvest figures in Alaska. The consumption of subsistence foods has been estimated to provide roughly 50% of caloric needs (Alaska Department of Fish and Game, 2000). Studies in Alaska Natives and circumpolar Inuit have demonstrated

Table 3. Summary of Impacts Predicted Under Northeast NPR-A EIS^a

Project Disturbances	Predicted Effects
<ul style="list-style-type: none"> ● Seismic activity ● Increased ground and air traffic ● Pipelines, roads, ice roads ● Oil facilities (wells, processing facilities) ● Staging areas ● Airborne discharges (flaring, exhaust, volatile organics) ● Oil spills, other contaminant spills ● Local employment opportunity ● Employment decline at termination of project ● Influx of non-Native workers ● Oil camps ● Revenue (taxation, Native corporation, employment) 	<p>1. <u>Subsistence</u></p> <p><i>Likely:</i></p> <ul style="list-style-type: none"> -Displacement of hunters away from productive areas -Displacement/dispersion of animals <p><i>Possible:</i></p> <ul style="list-style-type: none"> -Reduced populations of subsistence species <p>2. <u>Sociocultural</u></p> <ul style="list-style-type: none"> -Loss/degradation of traditional subsistence areas -Fear of contaminants -Subsistence impacts lead to breakdown of kinship/community sharing networks -Subsistence impacts lead to difficulty in transmitting cultural axioms to youth -Increasing economic disparities within villages -Acculturation from intense exposure to large numbers of transient outside workers -Alcohol and drug trafficking via new access routes <p>3. <u>Economy</u></p> <ul style="list-style-type: none"> -Taxation of oil facilities allows continuing NSB services, balancing declining revenues from other oil development -Native corporations provide dividends to shareholders -Increased income from employment -Large loss of revenue sources at conclusion of project <p>4. <u>Air Quality</u></p> <p><i>Likely:</i></p> <ul style="list-style-type: none"> -Episodic localized decreased air quality events near oil development facilities <p><i>Possible:</i></p> <ul style="list-style-type: none"> Incremental degradation of air quality in/near subsistence camps <p>5. <u>Water Quality</u></p> <ul style="list-style-type: none"> -Small inadvertent discharges: spills, etc -Occasional large spills

^a Effects described in Table 1 are derived from the Final Amended EIS. The Supplemental EIS will reflect the increased price of oil, and therefore possible increases in some predicted disturbances because of the increased volume of “economically recoverable oil.”

that the risk of developing metabolic health problems increases with decreasing intake of subsistence foods (Murphy et al., 1995; Murphy et al., 1997; Young et al., 1992; Bjerregaard et al., 2004a, 2004b). The degree of risk, therefore, would depend on the degree to which impacts to subsistence activities occur, and whether hunters are able to replace losses from this area by hunting elsewhere (which would be hampered by expanding development in regions not considered in the Northeast NPR-A EIS).

The general contribution of oil and gas activities to cultural change (as outlined in Table 3) may also encourage a trend toward store-bought foods. Several studies have

demonstrated that the degree of modernization correlates inversely with the amount of subsistence foods consumed (Young et al., 1992; Schraer et al., 1993). The quality of food available in village stores is low, and the cost of choosing more healthful foods is often prohibitive (Bersamin et al., 2006), thereby increasing the risk of metabolic disorders.

Projected Impact

Increased risk of diabetes and related metabolic disorders; degree of impact proportional to the impacts to

subsistence and to the degree to which the project contributes to the ongoing acculturative transition to store-bought food.

4. *Food Insecurity and Hunger*

Analysis

The EIS predicts possible impacts to subsistence harvests. Subsistence foods account for roughly 50% of the caloric intake; the monetary value of the subsistence harvest has been estimated at between \$31 million and \$51 million (Alaska Department of Fish and Game, 2000), representing a prohibitive cost if calories had to be replaced with store-bought foods. Frank malnutrition is unlikely because of community sharing networks and state and federal income and nutritional support programs

Projected Impact

Likely increase in food insecurity; risk of hunger in case of severe impacts to subsistence; malnutrition unlikely.

5. *Health Problems Related to EPA Criteria Pollutants*

Analysis

EPA criteria pollutants (oxides of sulfur and nitrogen, carbon monoxide, and particulate matter) are associated with pulmonary disease, exacerbated coronary artery disease, and excess mortality among vulnerable groups (EPA, 2007); Neher and Koenig (1994). The proposed development would involve new emissions sources (machinery, gas flares, traffic, road dust, and oil-processing facilities). Although still relatively distant from population centers, these emissions sources will occur closer to villages and subsistence areas than previous major sources.

The BLM's air quality analysis notes that North Slope air quality is generally pristine, and predicts little or no degradation in air quality in villages; sporadic decreases in air quality near development could occur. We questioned the adequacy of this analysis because it is based primarily on models not well-validated in Arctic conditions, with very little monitoring data to confirm the predictions.

Our analysis, therefore, highlighted two concerns: (1) The Inupiat have high baseline rates of pulmonary disease

and are therefore particularly vulnerable to the health effects of airborne pollution. (2) The air quality analysis is based on models and includes no monitoring data from within the planning area.

Projected Impact

Potential exacerbation of pulmonary and cardiovascular disease related to intermittent low-air-quality events. Unlikely that chronic degradation of air quality would increase baseline prevalence of these problems. Projection based on questionable EIS analysis.

6. *Health Problems Related to Other Environmental Contaminants*

Analysis

Locally harvested fish, game, and whales are estimated to account for roughly 50% of the caloric intake of North Slope residents. Data to date, though incomplete, have indicated that North Slope subsistence resources harbor relatively low levels of contaminants compared with similar resources in Greenland and Northern Canada (Arctic Monitoring and Assessment Program, 2003; O'Hara et al., 2005).

The Northeast NPR-A region is one of the most productive areas for subsistence; the proposed activity would bring oil and gas emissions into close proximity with these resources. By-products of oil and gas production and processing are emitted through combustion ("hazardous air pollutants," or HAP), spills, and liquid-based effluents. These substances have an array of health effects, including carcinogenesis, endocrine disruption, and neurodevelopmental delay (EPA, 2006; Arctic Monitoring and Assessment Program, 2003). Many HAP bioaccumulate in mammals.

Oil and gas producers on the North Slope operate under reporting exemptions for HAP, and there has been no monitoring of HAP on the North Slope. It is therefore not possible to predict with certainty what level of exposure the local population may incur as a result of the proposed development, nor what health outcomes may result.

Our analysis highlighted two issues: (1) given the high consumption of fish and game from Northeast NPR-A, there is reason for concern that emissions here could expose residents to unacceptable levels of contaminants; (2)

this risk should be evaluated in the context of the disparate incidence, prevalence, and mortality from cancer.

Predicted Outcome

Increased exposure through direct contact or bioaccumulation in subsistence fish and game could contribute to the risk of certain malignancies, neurodevelopmental delay, and endocrine disruption; data inadequate to determine degree of risk.

7. Infectious Diseases

Analysis

HIV and syphilis rates are lower in the North Slope than most parts of the U.S.; the rate of HIV and syphilis in Alaskan oil workers has not been reported. Chlamydia is highly prevalent on the North Slope; chronic pulmonary disease and severe pulmonary infections are prevalent (Alaska Department of Public Health, 2002, 2005, 2006). Contact between oil workers and previously isolated Inupiat villages could result in increased rates of HIV and syphilis and more frequent and severe respiratory infections. Diarrheal illnesses are common in oil encampments and could also pose a risk to local communities.

Projected Impact

Potential for increased exposure to a wide variety of pathogens; potential increased incidence of HIV and syphilis infections.

Health Mitigation Measures

Based on the findings of our analysis, we recommended a series of mitigation measures (Table 4). The BLM noted that its authority to regulate developers' activities solely on the basis of health is limited because its governing statutes confer authority for land management only. BLM therefore agreed to include measures that it believed lie within its statutory authority; these would be evaluated, refined, and ultimately accepted or rejected through subsequent stages of the EIS process. BLM further agreed to consider a measure that would require BLM and developers to work with a Health Advisory Board (HAB; see mitigation measure 1), once established, to further delineate impacts and identify and institute appropriate mitigation for health impacts identified.

DISCUSSION

Evident in years of testimony by Inupiat residents of the North Slope is the concern that industrial development is causing health problems, and a growing fear that burgeoning development may ultimately engulf the subsistence way of life, with profound implications for health and well-being. This fear has become one of the dominant sources of strain and tension in Inupiat communities, as expressed by this elder:

And hearing that this impact is going to be more and more and more each year and each time is telling me I have to try 100% more harder to get food on my table. And I just keep wondering, how am I going to survive if these animals are being impacted? What is it going to take for me to make a supper? What is it going to take to find something to eat? And the animals that I depend on are being impacted and these are things that I depend on daily. And I just want you guys to know that subsistence is a big thing in my life and that's what I depend on each day to survive. Thank you. (Tukle, 2004)

The feelings of disempowerment that result when developments are approved repeatedly over such objections compound the problem.

Although we believed NEPA provided strong legal footing to argue for the inclusion of health, we anticipated challenges because of the political division that often develops within local communities on issues of resource development as people struggle to find an acceptable balance between potential economic gains and the inevitable impacts. However, we found that the issue of health transcended political divisions in the Inupiat community, and community participation in the HIA engendered cooperation and unity. The key to achieving integration of health issues into the EIS was intensive, high-level participation in the process by the Inupiat communities; public testimony such as that cited in this article was central not only to the analysis of potential impacts, but to convincing the regulatory agencies to address the issue of health. HIA offered a means to blend indigenous perspectives with public health data, and to present the results in a form that was both informative and compelling for planners and regulators.

Table 4. Mitigation

Suggested Mitigation Measures	Targeted Health Outcome
<i>1. Health Advisory Board</i> BLM would fund and convene an advisory board comprising 6 professional public health members. The board would meet semiannually to review current projects, would oversee future HIA activities and monitoring, and would make management/mitigation recommendations.	General health; facilitate adaptive management of project-related health problems as they arise in the future
<i>2. Public Health Monitoring</i> Require developer to fund baseline and ongoing monitoring of a selected set of health indicators	Same as Health Advisory Board
<i>3. Subsistence Measures</i>	<input type="radio"/> Diabetes/metabolic diseases <input type="radio"/> Hunger and food insecurity
a. <u>Harvest study</u> : baseline and ongoing monitoring to determine amount of each subsistence species	<input type="radio"/> Social pathology
b. <u>Intake study</u> : intake might provide a more sensitive indicator of dietary/metabolic impacts than harvest	<input type="radio"/> Injury
c. <u>Management</u> : measures to support subsistence intake, including financial support for community hunters, construction of community freezers, and programs to ensure adequate healthful food choices in village stores, would be required ^a .	<input type="radio"/> Cancer, endocrine disorders, learning disability
<i>4. Control of Contaminants</i>	<input type="radio"/> Diabetes/metabolic diseases (through preventing fear of consumption of subsistence foods)
a. <u>Monitoring</u> : developer would undertake baseline and ongoing monitoring of levels of expected contaminants in subsistence species and the regional habitat	<input type="radio"/> Injury rates
b. <u>Mitigation of contaminants</u> : developers would be required to use the best available control technology on all emissions sources in the planning area	<input type="radio"/> Social/psychological pathology
<i>5. Public Safety</i>	<input type="radio"/> Sexually transmitted infections
a. Developer would be responsible for funding the additional police and emergency service personnel required to cover anticipated influx of workers ^b	<input type="radio"/> Respiratory infections
b. Developer would develop a program to reduce the potential of drug/alcohol trafficking into villages	<input type="radio"/> GI infections
c. Developer would collaborate with community to develop plan for how workers would be allowed to enter communities ^c	<input type="radio"/> Acute toxicity
<i>6. Infectious Disease^d</i>	<input type="radio"/> Diabetes/metabolic diseases
a. Employee health protocol and testing for communicable diseases would be established.	<input type="radio"/> Social pathology/injury
b. Employee education program regarding infectious disease prevention, including safe sexual practices.	
<i>7. Oil Spills</i> In case of a large spill, developers would fund a independent review panel to monitor effects on populations and consumption of subsistence resources, health outcomes, and recommend remediation.	

In this way, HIA may prove useful for indigenous communities outside the U.S.: even though statutory requirements for EIS vary greatly between nations, a clear, evidence-based description of the potential human impacts

of a project can provide a compelling policy lever even outside of the stringent requirements of NEPA. Moreover, a growing number of large lending institutions (including the World Bank and the signatories to the Equator

Table 4. continued

Suggested Mitigation Measures	Targeted Health Outcome
<p>8. <i>Sustainable Development Management Plan</i></p> <p>This measure would require a comprehensive plan to address the anticipated sociocultural and economic changes. The World Bank Operational Policy 4.10 (World Bank, 2005), for example, provides guidelines for such measures. Other plans have included, for example:</p> <ul style="list-style-type: none"> ■ Sustainable savings and investment plans targeting long-term fiscal stability^e ■ Economic diversification/strengthening locally sustainable businesses ■ Cultural stewardship/preservation initiatives ■ Hunter support programs (as discussed above) ■ Education financing 	○ General health

^a See, e.g., Aarluk Consulting Inc. (2006); Ho et al. (2006); Chan et al. (2006).

^b An example of this type of program comes from offshore oil development in Santa Barbara, California. The local government instituted a Socio-economic Monitoring Program, which developed a model to determine the additional costs (social services/public safety/school/infrastructure) incurred by having operations based in the region, and charged developers based on a complex formula.

^c An example of such a plan is described in this evaluation of Shell's Camisea proposal. The initial exploration program was controversial because of its impacts on local communities. This plan was developed in an effort to address some of the concerns raised (see May et al., 1999).

^d May et al. (1999).

^e Examples of such strategies and principles that might guide them include Sakhalin Energy Investment Company (2006) and Max-Neef (1991).

Principles, see <http://www.equatorprinciples.com>) and, increasingly, multinational developers themselves, now have explicit policies requiring the consideration of health impacts. Royal Dutch/Shell and the International Association of Oil and Gas Producers, for example, now espouse HIA (Krieger and Balge, 2005). The application of a community-based approach such as we used on the North Slope could allow indigenous communities outside the U.S. to use these emerging requirements for health analysis in the planning, evaluation, and funding cycle, and to ensure that decision-makers accurately and fully consider local health and environmental justice concerns in the planning and approval of development projects.

Our work also contributes a new perspective on questions raised by other authors regarding both the statutory requirements for addressing health under NEPA, and the risk that the confines of the EIS process would force an overly narrow consideration of public health (Cole et al., 2004; Bronson and Noble, 2006; Cole and Fielding, 2007). Our collaboration with agencies of the U.S. Department of the Interior culminated in a clear acknowledgment that public health analysis is indeed required by NEPA. Furthermore, we found that because the typical spectrum of effects discussed in an EIS includes disturbances to health determinants, such as changes in economy, employment, culture, environmental quality, and subsistence, the range of health issues we were able to address was quite broad.

The extent to which these results can be generalized to other NEPA actions and other federal agencies is worthy of further investigation.

There are three ways in which health information can be used to influence the EIS process: (1) developing health-focused mitigation, (2) shaping alternative development scenarios, and (3) influencing ultimate decisions about whether to permit development. Because the alternative development scenarios were already defined, we focused on mitigation. Between the draft EIS and final EIS, however, the NSB will have the opportunity to suggest other development scenarios, if any can be found that might better protect community health. Ultimately, however, much of the North Slope community may oppose any form of development in the region because of the deep cultural importance of the TLSA. In this regard, the HIA may provide an advocacy tool to help the Inupiat ensure that their concerns are adequately weighed in the ultimate decision as to whether to permit TLSA development.

CONCLUSIONS

There is an imperative for collaboration between communities, environmental planners and regulators, and public health to address the growing burden of disease attributable to human-mediated environmental change. McMichael

(2006) presents a compelling argument for the expansion of traditional environmental health to address the fundamental relationships between population health and ecosystem sustainability; he further notes the importance of finding ways to communicate this information effectively to the public and policy-makers. The challenges are formidable. The evidence-driven field of public health is not accustomed to making recommendations based on incomplete data, and environmental planning and policy tend to move at the pace dictated by political and economic priorities and often do not welcome new concerns that might slow the process. HIA has shown promising results as a means to engage other sectors in considering the impacts of their decisions on public health (Cole and Fielding, 2007). If our early results prove generalizable to other agencies, integrated HIA/EIS—because it operates within a formalized process that guides federal policy—may provide an avenue through which to pursue policies that address the environmental and social determinants of health from a cross-sectoral perspective.

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