A Vision of Nurses and Doctors as Critical Links between Good Science and Community Action for Environmental Health Solutions

Jane K. Dixon, PhD, John P. Dixon, PhD, Elizabeth Ercolano, RN, MSN, DNSc, Karrie C. Hendrickson, RN, MSN, Therese W. Harrison, RN, MSN

Perhaps the most difficult challenges today in environmental health science involve bridging the gaps between the explosion in scientific understanding of environmental toxins and health effects, concerns about justice for the populations most affected, the knowledge that the average citizen has of environmental toxins, and actions that people in a community should take collaboratively for mitigating negative health effects. Health care providers would seem to be the most logical leaders for bridging these gaps, because they combine a relatively sophisticated knowledge of the biological sciences together with direct daily connections with the wider population of people whose health is compromised – and they have an obligation to act for the benefit of their patients. In fact, nurses are even more strategically positioned than are most other health professionals because of their roles providing health care in schools and workplaces; as visiting nurses who care for elderly and homebound people in their homes; and also as nurse practitioners who have taken up much of the role of providing face-to-face time with patients.

In spite of this logical potential for health care providers, and especially nurses, to play a crucial role in bridging the gaps in the wise use of environmental health information, there is

Jane Dixon teaches research methods to nursing graduate students at Yale University School of Nursing, where she also teaches an elective course in environmental health. Her research focuses on environmental health promotion and engagement in environmental health. John Dixon is a research psychologist involved in many environmental organizations. He is Commissioner on the Environmental Council of the City of New Haven and is on the Board of Directors of Connecticut Coalition for Environmental Justice. Elizabeth Ercolano is a Research Nurse/Project Coordinator at the Yale University School of Nursing. Karrie Hendrickson is a doctoral student at Yale University School of Nursing and is developing research on pediatric palliative care. Therese W. Harrison graduated from Yale University School of Nursing as a nurse practitioner in school-based health care. She now is a doctoral student at Yale University School of Nursing.

dramatic evidence that this ideal is very far from being realized. One example of this disconnect comes from a survey research project which we are now completing. People were asked to respond to various questions about environment and health, including pollution in their neighborhood, how environment affects health, and things that they do to protect health. The survey was completed by 433 people living in New Haven, Connecticut. Responses were obtained on a zero-to-ten scale for each question, with ten always indicating the highest level of agreement. Based on responses obtained, the forty-six questions were grouped into subscales. Twelve of the questions comprised the "Pollution-causes-illness" subscale. This consisted of statements which indicate that polluted conditions lead to illness, such as "When people get sick, it is often because of pollution in the environment." The mean score on this subscale was 5.3 (sd=1.86) on our zero-to-ten scale, indicating a moderate level of agreement with the statements. The item with the highest mean (8.4) was "asthma is often made worse by pollution in the air."

Another nine of the items comprised the Personal Environmental Action subscale. This consisted of statements reflecting precautions which individuals may take to protect themselves from pollution. The mean score on this subscale was 5.8 (sd=1.83) indicating that people were taking personal precautions. The item with the highest mean (7.7) was "I do what is necessary to make sure my home is free of toxins, like lead and radon." People also reported that they avoid exposure to air pollution by "stay[ing] away from a place" (6.4), closing windows (4.9), and "avoid[ing] being around people who are smoking" (6.4). However, of the nine items about personal actions, one item stood out as distinctly low. This item was "I talk to my doctor or nurse about how to reduce the effect of pollution on my health." The mean for this item was just 2.6 (sd=3.54). In fact, 49% of our respondents rated this item as zero on the zero-to-ten scale, indicating that they never talk to health care providers about environment and health. Yet, answers to the other questions indicated a deep concern – and that people are making decisions about actions to take to protect themselves from health damage due to pollution. They just are not talking to their health care providers about these concerns or what to do about them.

When we presented this finding at a statewide meeting of nurses, it seemed not to elicit any surprise; yet, it seems to represent a missed opportunity. Health care providers should be available to advise people about their exposures to environmental toxins. This availability should be known to their patients. In fact, health care providers should be questioning their patients about their environmental exposures and any relationship to symptoms being experienced. If neither health care providers nor their patients are initiating such discussions, this represents a failure to connect what is known scientifically with what can be done clinically. Such conversations, if they occurred, would provide an opportunity to improve care. They would also enable health care providers to take the first step toward playing a leadership role in identifying sources of environmental health problems so that these could be addressed through community decision-making.

Integrative Model for Environmental Health

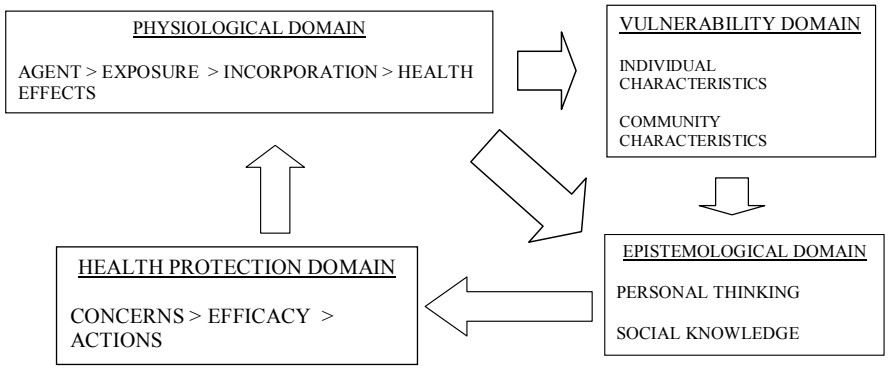
For bridging these gaps between scientific research, vulnerability of specific populations, public knowledge (or lack of knowledge), and potential for protective actions, we have cre-

ated a model for depicting how these areas should be brought together by health care providers and others (Figure 1).[1] We call it the Integrative Model for Environmental Health. Our model is designed to facilitate looking at environmental health problems in a comprehensive way. Thus, the model spans physiological research on health effects of toxic agents to actions which people may take individually and collectively to reduce their risks of adverse health effects. Ideally, these actions would be undertaken collaboratively between people in the community and health care providers. The model has four domains. These are the physiological domain, vulnerability domain, epistemological domain, and health protection domain.

- The physiological domain concerns chemical and physiological processes through which toxins in the environment have effects on people's health. It needs to be remembered that scientific knowledge about these effects will have varying levels of certainty.
- The vulnerability domain concerns variation between people in environmental health risks experienced and, thus, health disparities. This variation in risks may be due to different levels of exposure. Alternatively, the variation may be due to differing levels of susceptibility to similar exposures.
- The epistemological domain concerns processes of personal thought and social knowledge by which people come to their understanding of the effects of the environment on health – what people "know" – and whether or not public knowledge is consistent with scientific knowledge.
- The health protection domain concerns engagement with environmental health, including actions that people may take to reduce their own environmental health risks. This domain also encompasses the way people might collaborate in order to transform environmental conditions in their community. Ideally, health care providers should take a leadership role in both advising individuals and consulting with community groups for improving environmental conditions.

We have devised a set of general questions by which we have analyzed different environ-

Figure 1. Integrative Model for Environmental Health
(from Dixon, J.K. & Dixon, J.P. (2002). Advances in Nursing Science, 24, 43-57)



mental threats to make clearer what the essence is for each of these four domains. These questions can be seen in Table 1.

The following is a specific example of an attempt to move in the direction of this kind of integration. Air pollution has clear effects on health, including outcomes such as reduced lung function, respiratory or cardiac symptoms, increased use of health services, such as hospitalization, and elevated mortality rates.[2,3] People who live in places with high levels of air pollution are at risk for experiencing health effects. This raises the issues of environmental justice, because it is common for the population of areas with high pollution to include disproportionate numbers of ethnic and racial minorities and people with low income.[4,5] In New Haven, Connecticut, one side of the city is particularly impacted by air pollution. This is because two major New England interstate highways merge in that part of the city and also because this area of the city is home to old industrial sites and various other polluting facilities: power plants, sewer sludge incinerator, waste transfer stations, oil terminal with fuel tank farm. The population of this area is diverse, including a large proportion of African-American and Hispanic people.

To address this heavy impact, the Sierra Club initiated an environmental justice proj-

Table 1. Working List of Questions for Analyzing an Environmental Health Problem

Domain	*Core Questions and Example Sub-Questions*
Physiological	What is the problem? • What are actual or potential health effects? • What are the biological, chemical and physical properties of the agent? • How do people get exposed? • What happens in the body – that is, is there any accumulation in body tissue or measurable physiological changes?
Vulnerability	Who is affected? • Are there groups of special concern, such as children, elderly, or people living in poor communities? • Are there individual characteristics (such as age, gender, health status) which may put people as special risk? • Are there community, socio-demographic, or cultural characteristics (such as race, ethnicity, SES, residence location) which may put people at special risk? • Do public policies allow or even promote different levels of risk?
Epistemological	How does everyone know about this? • What is the common knowledge and level of public concern? • What messages come from corporations, environmental organizations, the media, health professionals, etc.? • How do these messages relate to what is known or not known through science? • How might affected people acquire their sense of what is true?
Health Protection	What do people do about it? • What do concerned people do to avoid exposure to the hazard or reduce own risk? • What do people do collectively to reduce the hazard and improve the healthiness of the environment for the community? • What can health care providers do?

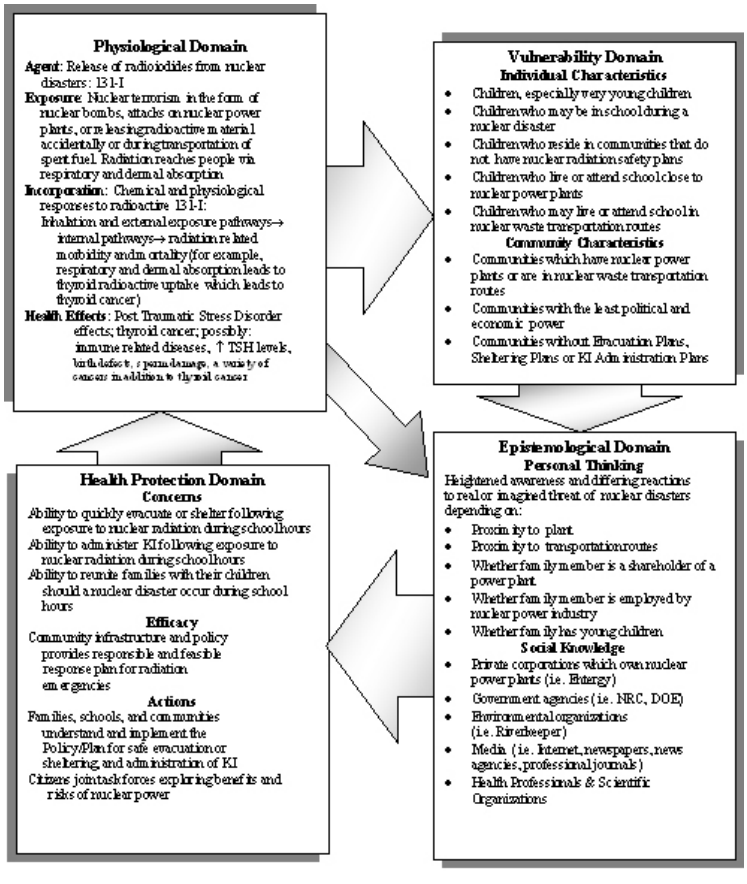
ect which became a part of the statewide efforts of the Connecticut Coalition for Environmental Justice. Yale University School of Nursing is now playing a role in these efforts through the Air Monitoring Project which we have developed. In this project, information is being collected from the residents about their perception of air quality and about their views of how air pollution affects their health. In addition, we have obtained equipment for measuring particulate matter in the air, so that we can monitor levels at different locations in the city corresponding to the neighborhoods of the people being surveyed. We are also looking at data from the United States census which describe characteristics of the population of these various areas. This effort pairs technical air quality monitoring with people's experiences of their environment—with the intention of raising the level of focus on these issues in the community. At the same time, it makes a connection to a school of nursing so that the link between professional care and people's perception of environmental health can be made.

Almost all health-related research on air pollution focuses on the physiological domain—how specific types of air pollution leads to specific health effects. Knowledge about these effects is, indeed, critical. However, knowledge of the physiological domain cannot, by itself, provide a basis for effective problem-solving about air pollution. Knowledge corresponding to the other domains is also needed if the problem of air pollution is to be effectively addressed through the actions of people.

This effort in New Haven is just one small example of the way we have been trying to stimulate the involvement of health professionals through the Integrative Model for Environmental Health. The model has been used in analyzing a variety of situations. For example, the model provided a framework for thinking about the role of the school nurse in the case of a radiation disaster (such as contamination from a nuclear power plant).[6] If such a disaster occurs during school hours, the school nurse may be faced with a conundrum of huge proportions. Radiation exposure leads to high risk of thyroid cancer, especially in children. However, this link can be interrupted by a medication (potassium iodine) which blocks uptake of the radioactive iodine into the thyroid. To be effective, however, the medication must be taken before the radiation exposure occurs. The school nurse will face the challenge of administering this medication to most of the children in the school (excluding those with iodine allergy or sensitivity, and, perhaps, those whose parents have not given permission), simultaneous to their boarding of buses to be evacuated to a safer location. It is anticipated that the evacuation may be chaotic as roadways become jammed with cars, further complicating the role of the nurse. Analysis of this problem was led by a school-based nurse practitioner who was living near New York City in the shadow of Indian Point Power Plant. Figure 2 depicts her use of the Integrative Model for Environmental Health in this analysis.

In a very different environment of rural western United States, Butterfield and associates are using the model to help guide an intervention to reduce environmental risks experienced by young children in low income, rural families.[7] Focusing on five areas of potential risk (lead, environmental tobacco smoke, radon, carbon monoxide and well water contaminants), public health nurses collect information from each family regarding each domain and use this assessment information in a targeted approach to reduce the risks identified. This is a challenging undertaking, as many of these poor young families are renters who feel powerless to improve their housing condi-

Figure 2. Model for Environmental Health -- Radiation Exposure during Nuclear Disasters



Created by Therese Harrison, 2003
Adapted from Dixon, J.K., Dixon, J.P. (2002). Advances in Nursing Science, 24 ,43-57.

tions. So identifying risks is not enough. The support of public health nurses may be critical in implementing low-cost strategies to reduce the child's environmental risks. These strategies may include such steps as adults removing work clothes before entering the home, guidance on disinfecting the household well, or enlisting law enforcement to pressure neighbors to clean up illegal dumps.

Effects of environment on health can occur on a scale as small as the individual person experiencing a personal toxic exposure or as broad as ecological changes on the globe which all humans share. Greving and Santacroce used the Integrative Model to organize findings on how children who survive childhood cancer are at risk for experiencing later health problems, especially damage to the cardiovascular system, due to the toxic effects of their treatments.[8] That is, the radiation or chemotherapy treatments which enabled survival from cancer have their own toxic effects,

leading to long-term health risks. The lay understanding of this might be that to cure the cancer, we poison the child – a risk that most parents will choose for their children, given the alternatives. Thinking of this problem in environmental terms, organized via the Integrative Model, proved useful in explicating the role of the nurse in promoting cardiovascular health for youth with cancer. This would include life long monitoring through annual clinical assessment and also anticipatory guidance to encourage healthy lifestyle behaviors among childhood cancer survivors – regular exercise, good diet, no smoking.

McDonald pointed out that worldwide infectious diseases kill 144 million people a year, twice as many as are killed by cancer.[9] She used the Integrative Model for Environmental Health in analyzing the outbreak of SARS, which occurred in Toronto in 2003, apparently originating in China and transported to Toronto via Hong Kong. Focus on the physiological and epistemological domains reveals substantial weaknesses in Toronto's response. These weaknesses contributed to a "second wave" outbreak of this emerging disease. McDonald proposes the need for an additional domain, "an ecological domain that necessitates professionals and the public knowing the current status of the world's environment so that all communities are acting locally and putting systems in place to prevent or minimize exposure to emerging disease" (548).[9] Communication between elements of this system, locally and across the world, would be key to the effective inclusion of this domain. An example would be a system in which health care providers immediately notify colleagues throughout the world of emerging new diseases.

Practice and Advocacy

Nationally, a small cadre of nurses has been leading the initiative to increase focus on environmental health as a routine part of clinical practice.[10] Butterfield describes these daily efforts as distributive actions "that extend nurses' understanding of environmental health risks and the dynamic nature of those risks….Overall distributive actions help build environmental health capacity within the profession and are, for the most part, ongoing activities that are integrated into nursing practice." (42)[11] For example, this occurred when a nurse midwife in California identified that symptoms of her farm worker patient resulted from pesticide exposure.[12] In this case, the nurse-midwife called the local health department and the Office of the County Agricultural Commissioner, and she submitted a Pesticide Illness Report to the Department of Environmental Health. Such contacts set in motion a regulatory process which led to investigation of the incident and, hopefully, reduced likelihood of similar incidents, while helping secure better conditions for farmworkers in the future. This occurred because the patient and the nurse-midwife communicated with each other, not only about the patient's unusual symptoms, but also about the pesticide mist that engulfed her while at her job on a farm.

Health providers must ask the questions that elicit this information. Butterfield points out that although distributive actions may seem to focus on tasks, there is also a change in thinking that "allows environmental health issues to be recognized, named and integrated" (42).[11] As health providers increase their focus on the environment as a factor in health, their patients will learn that it is useful to bring up their environmental concerns.

In addition to such responsibilities of daily

good practice, concerned health care providers must also initiate strategic projects for advocacy and discovery to improve environmental health for all. For example, the American Nurses Association has adopted the Precautionary Principle, pointing to nurses' responsibility in acting to reduce risks when there is strong basis for suspicion of harm, even in the absence of full scientific proof – especially if the suspected effects are serious or irreversible.[13] Had such an approach been successfully implemented by health care professionals and public health officials in the last century, the addition of lead to gasoline and paint would not have been allowed, and an epidemic of childhood lead poisoning would not have occurred.[14-16] Medical use of X-rays to diagnose pregnancy could also have been curtailed early in the twentieth century, based on beginning evidence of potential for harm to the unborn child.[17]

Currently, there is urgent need for health professionals to look beyond relationships between specific toxic agents and their health effects and also to provide leadership regarding community decisions, such as those concerning land development and placement of public facilities like schools. Urban sprawl has numerous health effects, including more sedentary lifestyles (less walking and biking), thus contributing to the national epidemic of obesity.[18] Farsighted health professionals also understand that global climate change has critical implications for health, including health risks due to heat-related illness, storms and floods, increased air pollution and allergens, infectious diseases, and changes in food supplies.[19] These effects are expected to strike hardest at those who are most vulnerable due to poverty, preexisting illness, or age (both the elderly and the young), once again raising issues of environmental justice.[20] Health professionals who invoke the Precautionary Principle will call for – and participate in – public decision-making, which takes these threats seriously.

A group of representatives from state nurses associations has been collaborating to develop a template for the creation of Environmental Task Forces for advocacy in coalition with other professional and citizen groups. This effort has been led by the Maryland Nurses Association, with nurses associations of nine other states collaborating. In Connecticut this takes the form of partnership with established environmental groups, such as Connecticut Fund for the Environment and Clean Water Action. Focus is on engaging the membership of nurses in current legislative issues, such as diesel emissions and protection of natural resources, so that nurses can articulate the health implications of proposed bills. In a small pilot study conducted in Massachusetts, Perry has demonstrated that legislators' opinions about pending legislation can be influenced by health-based presentations.[21]

For young people looking for a vital profession, nursing is becoming a strategic position from which those who are concerned about environmental health can help to create vital linkages between good science, concern for the most vulnerable populations, raising public understanding, and organizing for finding real world solutions. This work has begun. However, there is much to do in order to achieve the goal of a world in which the environment supports people's health, rather than a world in which environmental pollution often compromises health. This involvement of nursing (and health care professionals generally) in policy issues and the creation of models based on work with people in their communities can, perhaps, help ground policy in a fundamental level of understanding and care for human life.

Acknowledgements

Work described in this paper has been supported by grant R15ES012396 from the National Institute for Environmental Science (NIEHS) and grant P20NR08349 from the National Institute for Nursing Research (NINR), both of the National Institute of Health (NIH). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIEHS, NIH or NINR.

References

1. Dixon, J.K. & Dixon, J.P. (2001). An integrative model for environmental health research. Advances in Nursing Science, 24, 43-57.
2. Dixon, J.K. (2002). Kids need clean air: Air pollution and children's health. Family and Community Health, 24, 9-26.
3. Pope, C.A., Burnett, R.T., Thun, M.J., Calle, E.E., Krewski, D., Ito, K., & Thurston, G.D. (2002) Lung cancer, cardiopulmonary mortality and long-term exposure to fine particulate air pollution. JAMA, 287, 1132-1141.
4. Institute of medicine. (1999). Toward environmental justice: Research, education and policy needs. Washington DC: National Academy Press.
5. Black, T. & Stewart, J.A. (2001). Burying and burning in Connecticut: Are regional solutions to environmental health equitable? New England Journal of Public Policy, 16, 15-34.
6. Harrison, T.W. Gustafson, E.M. & Dixon, J. K. (2003). Radiologic emergency: Protecting schoolchildren and the public. American Journal of Nursing, 103, 41-49.
7. Hill W. Penniman M. Butterfield P. & Bufferfield P. (2004). ERRNIE: an environmental risk reduction study with rural families: parental risk perceptions of childhood environmental exposures... Environmental Risk Reduction through Nursing Interventions and Education. Communicating Nursing Research, 37, 132.
8. Greving, D.M & Santcroce, S.J. (2005). Cardiovascular late effects. Journal of Pediatric Oncology Nursing, 22, 38-47.
9. Macdonald, M.T. (2004). From SARS to stragegic actions reframing systems. Journal of Advanced Nursing, 47, 544-550.
10. Sattler, B. & Lipscomb, J. (2003). Environmental health and nursing practice. Springer, New York.
11. Butterfield, P.G. (2002). Upstream reflections on environmental health: An abbreviated history and framework for action. Advances in Nursing Science, 25, 32-49.
12. Quackenbush, R., Hackley, B., & Dixon, J. (2006). Screening for pesticide exposure: A case study. Journal of Midwifery and Women's Health, 51, 3-11.
13. Brody, C. & Melamed, A. (2004). The precautionary approach: Thinking like a nurse. American Journal of Nursing, 104, 104-5.
14. Needleman, H.L. (1997). Clamped in a straitjacket: The insertion of lead into gasoline. Environmental Research, 74, 95-103.
15. Markowitz, G. & Rosner, D. (2000). "Cater to the children": The role of the lead industry in a public health tragedy, 1900-1955. American Journal of Public health, 90, 36-46.
16. Rabin, R. (1989). Warnings unheeded: A history of childhood lead poisoning. American Journal of Public Health, 79, 1668-1674.
17. Lambert, B. (2002). Radiation: Early warnings; late effects. In Late lessons from early warnings: The Precautionary Principle, 1896-2000. (Environmental Issue Report, Number 22). European Environment Agency, Copenhagen, Denmark. Pps. 31-37. http://reports.eea.eu.int/environmental_issue_report_2001_22/en/tab_abstract_RLR
18. Frumkin, H. (2002). Urban sprawl and public health. Public Health Reports, 117, 201-217.
19. Haines, A. & Patz, J.A. (2004). Health effects of climate change. JAMA, 291, 99-103.
20. Longstreth, J. (1999). Public health consequences of global climate change in the United States – Some regions may suffer disproportionately. Environmental Health Perspectives, 107 (Supplement 1), 169-178.
21. Perry, D. (2005). Transcendent pluralism and the influence of nursing testimony on environmental justice legistlation. Policy, Politics and Nursing Practice, 6, 60-71.