Motivated by the actions of the new administration, this commentary addresses the primacy of scientific evidence in guiding environmental management and the threat posed to this critical role of research findings.
I write this commentary from the perspective of a physician and senior environmental health researcher who has actively participated in committees and other activities at the science-policy interface, including committees of the U.S. Environmental Protection Agency (EPA), the U.S. Department of Energy, the World Health Organization, and the National Academies of Science, Engineering, and Medicine. This experience has convinced me that evidence-based decision-making has worked and that effective frameworks are in place for the translation of scientific evidence in regulations and other policy activities.

While some elements of these frameworks have remained constant (e.g., hazard identification, characterizing the dose–response relationship, and assessing exposures), advances in scientific methods have been incorporated over time. For example, I recently chaired a highly multidisciplinary committee of the National Academies of Science, Engineering, and Medicine that was charged with addressing emerging streams of “omics” (various methodologies used to generate rich data sets on biological indicators, e.g., genomics with reference to the genome and metabolomics with reference to chemical species in biological tissues) and other data on toxicity and exposure and showing how the new data could be used in addressing contemporary issues related to risk. The resulting report, Using 21st Century Science to Improve Risk-Related Evaluations, reviewed advances in exposure sciences, toxicology, and epidemiology and then provided examples of how the 21st century data, coming largely from new “omics” technologies, could be used in real-world scenarios.

For over three decades, I have interacted with EPA as an investigator carrying out research directly relevant to the agency’s mission, and some with EPA support, on: outdoor air pollution (primarily the “criteria pollutants”) and indoor air pollution (nitrogen dioxide, secondhand smoke, and radon). Because of this research, I have served on various committees of the Science Advisory Board and chaired the Clean Air Scientific Advisory Committee (CASAC), an experience that provided an understanding of how scientific findings need to be shaped to support EPA’s regulatory approaches. For example, with my colleagues at the Johns Hopkins Bloomberg School of Public Health (Drs. Francesca Dominici and Scott Zeger) we carried out the National Morbidity, Mortality and Air Pollution Study (NMMAPS), which provided a national picture of the risks of particulate matter air pollution.

I chaired the National Research Council’s Committee on Research Priorities for Airborne Particulate Matter (PM), which developed a research agenda that guided EPA and the research community generally in addressing the most critical uncertainties around the PM National Ambient Air Quality Standard (NAAQS). And, as Chair of CASAC, I was involved in a dialogue with the EPA staff about refining the approach for NAAQS review in order to assure a transparent review of all relevant evidence. Similar refinements of the Integrated Risk Information System (IRIS) Program were initiated with guidance from other National Research Council committees that I chaired.

These experiences have offered insights into the critical roles that scientists and the evidence that they generate play in advancing environmental management and hence in improving environmental quality. This commentary, motivated by the actions of the new administration, addresses the primacy of scientific evidence in guiding environmental management and the threat posed to this critical role of research findings.

I first describe some general frameworks that have proved successful for advancing evidence-based actions and then turn to the threats to this paradigm that began with the rising displacement of scientific evidence by belief over the last decade and the acceleration and even the dismissal of scientific evidence with the current administration of President Trump.

**How Research Guides Policy**

Research on the environment and human health may be directed at several questions:

1. Does an agent cause one or more adverse health effects in people?
2. How does it cause the adverse health effect(s)?
3. What is the distribution of human exposure and what are the determinants of exposure?
4. How does risk vary with exposure?
5. Is there a range of susceptibility to the exposure and what determines exposure?
6. What is the impact of the exposure on the health of the population, and what can be anticipated from various interventions?

These questions are embodied in risk assessment, which is often used as a bridge from scientific research to policy. In the “Red Book” paradigm, referring to the 1983 National Research Council report that proposed the still-used framework, there are four elements that are intertwined with these questions: hazard identification, exposure, dose–response, and risk characterization. A full evidence-based risk assessment provides an invaluable starting point for environmental management.

One useful and familiar example is the “criteria pollutants” regulated under Sections 108 and 109 of the U.S. Clean Air Act (CAA). “Criteria” refers to scientific evidence, and the CAA requires review of the accumulating evidence on the criteria pollutants—currently, PM, ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide, and lead—every five years.
As guidance for risk management, the EPA Administrator is required to set a standard sufficient “to protect public health with an adequate margin of safety”. The need for research to support decision-making is evident. EPA needs information that will describe whether there is a risk from an agent and how risk varies with exposure. As evidence on the criteria air pollutants has evolved, adverse effects have been observed at ever lower levels and risk assessment has been used to provide guidance on the burden of disease that can be avoided and the residual risk that remains under various scenarios of air quality management. The current framework is shown in Figure 1, which captures the fundamental role of research as the starting point and the role of scientists in carrying out research and in advising the agency through participation in drafting documents and in serving on the CASAC, which provides peer review for EPA as it generates and revises the cornerstone documents.

For the criteria and other pollutants, the research is carried out by a broad array of environmental scientists. For air pollution, for example, the relevant disciplines include atmospheric chemistry and meteorology, environmental engineering, exposure sciences, toxicology, and epidemiology. There is a robust research enterprise housed in universities, government laboratories, the private sector, and elsewhere. This enterprise is sustained by funding that comes primarily from the government; it also provides the platform for training the next generations of environmental scientists.

**The Trump Administration and Environmental Health**

This commentary is written as the Trump Administration has completed its first six months, giving an ample window to gain impressions of its intent around environmental protection. As is well known, the news is not good. An Administrator (Scott Pruitt) has been appointed to head the EPA, who has a long record of suing the agency and a clear agenda of reducing EPA’s scope and impact. EPA’s Office of Research and Development, which drives much research related to the agency’s mission, is at particular risk. Looking beyond EPA, the indications related to the environment are similarly gloomy. Budget cuts are anticipated for agencies that carry out and fund research on climate; even routine monitoring for data related to the atmosphere is threatened. At the policy level, the United States, via Presidential Order, has withdrawn from the Paris Climate Agreement. The President’s budget, taken symbolically, is very troubling in its proposed cuts to research generally; even the National Institutes of Health, which almost never has a proposed budget reduction, is recommended to have a substantial decrease.

Much is at risk with the new administration. Since the passage of groundbreaking and foundational environmental legislation (e.g., the Clean Air Act) almost a half century ago, we have made great progress as a nation on many indicators of environmental quality. That legislation was sparked by the terribly poor condition of the air and water, and the recognition that
there was a wide legacy of highly contaminated waste sites, some in cities and residential neighborhoods. The past health consequences of environmental pollution were sometimes dramatic, as with the obvious peaks of excess deaths in the pollution episode in Donora, PA, in 1948 and the London (UK) Fog of 1952. In Southern California, smog alerts kept children indoors and the pollution regularly obscured the mountains and caused respiratory and eye irritation. Such problems are increasingly remote and with the steady gains in environmental quality, some politicians and perhaps some of the public no longer understand why environmental regulation is needed and, for some pollutants, scientific evidence indicates that there are still risks at current levels (e.g., particulate air pollution).

With the current administration, further progress in improving environmental quality is threatened and there is a worrisome potential for deterioration, even over the four-year span of the Trump Administration. At the least, progress in abating emissions of greenhouse gases will be slowed.

Fortunately, there are checks and balances within the government. Budget cuts proposed by the President are messages only and the Congress, which actually sets the nation’s budget, is unlikely to agree to all of the proposed cuts to the nation’s support of research. Additionally, the courts are a critical mechanism for assuring that the requirements of environmental laws are met.

What Is at Risk?

In a recent commentary in the New England Journal of Medicine, co-authored with two former heads of the EPA’s Office of Research and Development (Drs. Bernard Goldstein and Tom Burke, serving, respectively under Presidents Reagan and Obama), we explored the potential course of the present administration, anticipating much of what has already taken place. To reiterate, much is at risk: the research enterprise on the environment and health, both human and ecosystem health; the role of science in decision-making; and the use of expert judgment from the scientific community to guide decision-making. The capacity to respond to inevitable environmental emergencies is also potentially threatened; experience speaks to the inevitability of further disasters, like the Deepwater Horizon oil spill.

Among the most troubling signals is the displacement and dismissal of evidence as the starting point for decision-making. Acknowledging that scientific evidence provides a starting point for regulation and environmental management, there are numerous other considerations that figure in, depending on the problem, the relevant regulations or other policies, costs and benefits, and technological feasibility. Stakeholder interests figure in as well, as may litigation and political considerations; with regard to politics, climate change has become unnecessarily linked to our two parties: the Democratic Party for giving priority to addressing the problem and Republican Party for being opposed to doing so. Some national leaders, including

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In Next Month’s Issue…

Ozone Depleting Substances—New Regulations, New Challenges

The September issue will feature articles on the new U.S. Environmental Protection Agency (EPA) regulations impacting equipment containing ozone depleting substances or substitutes. The EPA regulations were written with the objective of reducing emissions of both ozone depleting substances and greenhouse gases. The regulations are far-reaching and impact not only industrial, commercial, and residential sources, but schools, hospitals, and grocery stores.
President Trump, state that they do not “believe” in climate change, contrary to abundant evidence and a consensus among thousands of scientists, as documented repeatedly in the reports of the Intergovernmental Panel on Climate Change (IPCC). However, beliefs alone are an inadequate basis for decision-making.

A broad structure of environmental management based on scientific research, guidance from scientific experts, environmental monitoring, and informed decision-making is in jeopardy. Bills have been written by the House Science Committee that have the potential to exclude some researchers from participating in the EPA Science Advisory Board (i.e., those funded by the EPA), and to further discourage participation by requiring a five-year lag between serving on the SAB and receiving EPA funding. At the same time, participation would be opened to those employed in the industrial sector with in-depth consideration of potential conflict-of-interest. The so-called “HONEST Act” would drastically limit the scientific foundation for decision-making through its requirement for access to research data and other materials at a level that cannot be readily achieved.

What’s Next?

In closing our recent commentary in the *New England Journal of Medicine,* Goldstein, Burke, and I offered guidance to the Trump Administration. Quoting directly from the commentary,

- “Evidence-based decision-making on the environment should not be abandoned. Reasoned action and acknowledgment of scientific truth are fundamental to democracy, public health, and economic growth. Scientific evidence is unchanged when the administration changes.
- The Administration needs to continue to engage and seek advice from the broad community of scientists. Abraham Lincoln created the National Academy of Sciences to provide advice to the government, acknowledging the necessary role of science for our government.
- Research funding and scientific capacity related to the environment should be enhanced so as to be able to grapple with ongoing and emerging problems, and to reduce the uncertainties as to whether adverse effects result from environmental challenges.
- Environmental monitoring and surveillance need to be sustained and at the ready to address the inevitable emerging problems and disasters, both foreseen and unforeseen.
- As it is abundantly evident that environmental processes related to globalization and to the scientifically indisputable effects of greenhouse gases will play a growing role in causing disasters and other challenges to human health, it would be inappropriate and potentially disastrous to pause action on mitigation, particularly in concert with the wider community of nations.
- The Administration should not abandon the majority and most critical stakeholder, the American people, for a coterie of special-interest stakeholders.”

References