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A Bridge Back to the Future: Public Health Ethics, Bioethics, and Environmental Ethics

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Contemporary biomedical ethics and environmental ethics share a common ancestry in Aldo Leopold's and Van Rensselaer Potter's initial broad visions of a connected biosphere. Over the past five decades, the two fields have become strangers. Public health ethics, a new subfield of bioethics, emerged from the belly of contemporary biomedical ethics and has evolved over the past 25 years. It has moved from its traditional concern with the tension between individual autonomy and community health to a wider focus on social justice and solidarity. Public health has a broad focus that includes individual, community, and environmental health. Public health ethics attends to these broad commitments reflected in the increasing concern with the connectedness of health of individuals to the health of populations, to the health of animals, to the health of the environment; it is well situated to reconnect all three "fields" of ethics to promote a healthier planet.

Keywords: environmental ethics, bioethics, medicine, public health

Contemporary biomedical ethics and environmental ethics share a common ancestry in the work of Aldo Leopold and Van Rensselaer Potter (Leopold 1949; Potter 1971). Co-located in time—theoretically in the 1940s with Leopold's initial work and practically in the early 1970s with Potter's vision of joining science and the humanities—modern bioethics and environmental ethics have evolved into two distinct and distant fields.

Coined in 1927 by German pastor and theologian, Fritz Jahr (Jahr 1927, Lolas 2008), the term "bioethics" was introduced to America in 1971 by Van Rensselaer Potter, who described it as a discipline that serves as a bridge between two cultures—science and humanities—that seem unable to speak to each other (Potter 1971). He thought that our future as a species was in doubt because of this lack of communication. Surely both scientists and scholars-of-the-humanities want a bright future for ourselves and our progeny. And if this is the case, Potter stated, we must understand that "ethical values cannot be separated from biological facts." He stated, "We are in great need of a Land Ethic, a Wild Life Ethic, a Population Ethic, a Consumption Ethic, an Urban Ethic, an International Ethic, a Geriatric Ethic, and so on" (Potter 1971, vii). This inclusive vision of bioethics could serve, he posited, as a bridge to connect science and the humanities and save our future.

Since the initial broad vision of a connected bioethics, biomedical ethics and environmental ethics have parted ways. Environmental ethics has developed in various ways—from an emphasis on sustainability and population, toward and then away from animal ethics, to deep and social ecology, to ecofeminism, and more. The field of contemporary biomedical ethics in the United States quickly narrowed to a focus on clinical ethics—also called medical or biomedical ethics—and research ethics, influenced by a long history of ethics in medical practice, as well as by post World War II ethical lapses in medical research.

While the growing separation of biomedical ethics and environmental ethics has helped to open the ethics conversation in many scientific fields over the past 40 years, it also has led to an increasing distance from the initial conceptualization of bioethics. The two fields—biomedical ethics and environmental ethics—that started as one in the eyes of Leopold and Potter are now strangers.

From the perspective of a public health ethicist and scientist, it is hard to understate the importance of both biomedical ethics and environmental ethics in the work and practice of public health. Public health ethics, a relatively new subfield of bioethics that emerged initially from the belly of contemporary biomedical ethics, has evolved over the past 25 years. As it continues its evolution, public health ethics is well positioned to reconnect biomedical ethics and environmental ethics in a practical and meaningful way to improve our collective experience on this planet. My focus

here is on health as the common denominator, though I mean health in the broadest sense, not just as the absence of disease, but as the World Health Organization (WHO) described it over a half century ago: "a complete state of physical, mental and social well-being, and not merely the absence of disease or infirmity" (WHO 1948).

The health problems we face in 21st-century America are a complex combination of individual-level factors such as genetic predisposition and health-harming behavior, community- and population-level factors such as income and health infrastructure inequities, and environmental factors such as habitat and climate. The ethics of public health considers a broad range of moral justifications at the micro (person), meso (community), and macro (environment) levels. It clearly reflects the "bioethics" that Potter envisioned. These micro-, meso-, and macro-level effects on health form an interrelated system in which a change to one factor has an effect on the others. The lead crisis in Flint, Michigan, that began in 2014 provides a tragic example. Following a century of industrial and wastewater pollution, the Flint River suffered severe degradation. In a 2001 report, the Michigan Department of Natural Resources identified numerous toxic substances, including fecal chloroform bacteria, industrial oils, phosphorus, and ammonia, and deemed the water's quality "a high priority concern" (Leonardi and Gruhn 2001, 4). Despite knowledge of the poor water quality, state and county officials made a series of ill-motivated decisions that culminated in switching the city's water source to the Flint River in 2014. The water was chemically treated to rid it of bacteria and render it potable. Chlorine caused the water to become highly corrosive, resulting in lead being leached from the community's aging water and sewer infrastructure. As the community consumed the contaminated water, blood lead levels rose and many adults and children were left with lifelong health and cognitive complications (Carmody 2016). While outlining the complex causal web is beyond the scope of this article, the example provides an illustration of the importance of a holistic, integrated approach to solving health problems. An attempt to solve one problem by removing bacteria from the polluted Flint River to make it potable resulted in another—the poisoning of the economically underserved community of Flint. An ill river led to an ill community.

The answer to the question of how we should solve a complex health problem requires both scientific information to guide what we can do and ethical analysis to guide what we should do. And because of the interrelated nature of health solutions, we must answer these questions at the individual, community, and environmental levels.

ENVIRONMENTAL ETHICS

In the 1970s, ecologists and other life scientists began to question the developed world's assumption that the natural world—the environment of all things nonhuman—existed as an instrument for human well-being. This deeply rooted anthropocentrism was described in the late

1960s as a threat to the existence of the planet and the field of modern environmental ethics began (White 1967; Ehrlich 1968). Questions about the relationship between the health of human beings and the health of the rest of the natural world have occupied the field since.

The basic tension in the early decades revolved around two differing perspectives on the value of—and thus our responsibility to—the natural world. Preservationists, armed with the writings of John Muir and Aldo Leopold, and deep ecologists, led by Arne Naess, reflected the belief that nature is intrinsically valuable and worthy of our respect quite separate from its use to us as humans (Cronon 1997; Leopold 1949; Drengson and Naess 2005). As a part of the connected natural world, preservationists and deep ecologists challenged a growing human population to develop ways to live within the entire natural system, of which humans are just one part, without impinging upon and exploiting the remainder of the planet. The belief that all natural things are connected gave rise to concerns about the health of ecological systems, rather than specific problems related to particular plants, animals, or other resources. This required environmental ethicists to develop an ethic that would consider the moral standing of the nonhuman natural world writ large to be similar or even equal to that of human beings.

On the other end of the environmental ethics spectrum lay conservationists, who sought to manage and respect nature in a way that was useful to humans. Also referred to as anthropocentrists and shallow ecologists, conservationists were concerned with the health of the environment and our impact on it, rooted in a human-centric perspective. The motivation for addressing discrete environmental problems (such as air pollution or clear-cutting forests to create land for food production) stemmed from the belief that nature exists for human benefit and if our behaviors were risking future access to natural goods, we must alter our behavior. Our ability to "live with" the rest of the planet was based in our making the best use of natural resources for the advancement of the species. The ethics of this approach prioritized the human condition, and the rapid development of science that supports and improves it.

The many shades between these two extremes have occupied environmental ethicists for decades. Two axes are important to where the field goes next: the egocentric–ecocentric axis and the system–individual axis. Are humans at the center of the biosphere or are we one of many important components? Is our unit of concern the ecosystem or individual beings within that system? Answers to these questions will help us determine possible solutions to such contemporary environmental impacts as increasing urbanization, poverty and inequitable consumption of natural resources, food production, human health and the built environment, and climate change.

BIOMEDICAL ETHICS

In the same year when Potter described his new vision for bioethics while at the University of Wisconsin–Madison,

Andre Hellegers was working with Sargent Shriver and Georgetown University to create what would come to dominate the field and be known as "the Georgetown model" of bioethics (Reich 1995). The Georgetown model focused the field on resolving practical ethical dilemmas related to clinical care and clinical research, largely leaving aside ethical considerations related to nonhuman animals and the natural environment. Shortly after the founding of the Institute for Bioethics (later renamed the Kennedy Institute of Ethics) at Georgetown in 1971, a 40-year U.S. Public Health Service study of 399 poor black men with untreated syphilis in Macon County, Alabama—known as the "Tuskegee study"—came to the attention of the nation, causing a series of events that reinforced Hellegers's vision of bioethics (Jones 1993). Senator Edward Kennedy led Congressional hearings on the Tuskegee syphilis study, which resulted in an ad hoc advisory panel to investigate (Tuskegee Syphilis Study Ad Hoc Advisory Panel 1973). The ad hoc panel recommended the creation of what ultimately became the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (National Commission), the first contemporary national bioethics advisory body in the United States. The primary charge to the National Commission was to identify the basic ethical principles and develop guidelines for the conduct of biomedical and behavioral research involving human subjects, including delineation of the boundaries between clinical care and biomedical research (National Research Act 1974). It was to consider the appropriateness of its guidelines for the delivery of health services as well.

Modern biomedical ethics was born. And its emphasis echoed Hellegers's vision for a focus on dilemmas in clinical care and research ethics. Potter's broad vision for a bridge between science and the humanities—one that included all living things—went unfunded and remained largely unknown.

Today, nearly 50 years after Potter's initial broad and inclusive description, the term "bioethics" typically implies a constellation of principles and values that inform clinical and research ethics, and a set of tools to reason through situations when two or more of the principles conflict. While there have been efforts to highlight alternative ways of reasoning through clinical ethics questions—feminist ethics, ethics of care, human rights, just distribution of resources, among others—clinical ethics tends to focus on two things: conflicts of interest and ethical conflicts with respect to patient care (Jonsen, Siegler, and Winslade 2015). Research ethics focuses on the ethical protections of participants in biomedical research—both animal and human—via ethics review boards and compliance with research regulations. These ethical concerns tend to be approached in two ways: through virtue ethics and professionalism, through principlism, or both.

Virtue ethics and professionalism in modern medicine were largely developed in the latter third of the 20th century by the late Edmund Pellegrino, a physician philosopher who spent his career training physicians in medicine and ethics, and who led the Kennedy Institute of Ethics in the early 1980s. Pellegrino focused on the ethics of clinical medicine, dignity, and the physician's duty to the patient's well-being (Sulmasy 2001). Today, physician training on professionalism, ethics, and virtue varies by medical school, but both undergraduate and graduate medical education accreditation and program requirements include competence in medical ethics, including compassion, respect, and ethical behavior (Liaison Committee on Medical Education 2017; Accreditation Council for Graduate Medical Education 2017).

Principlism was developed in response to the call for a practical and applied method to resolve ethical conflicts in medicine and research. Its focus, in conjunction with virtue ethics' emphasis on *how to be*, was on *what to do*. The foundational bioethics principles initially outlined by the National Commission's *Belmont Report*, include respect for persons, beneficence, and justice as the ethical drivers for biomedical and behavioral research (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research 1979). The principle respect for persons emphasizes an individual's autonomy and requires that persons make their own considered choices about engaging in a research activity or accepting a treatment plan. Beneficence and its corollary, nonmaleficence, create a duty on the part of the clinician and researcher to maximize benefit and minimize harm to patients and participants. Justice, at the time of the drafting of the *Belmont Report* in the 1970s, had not previously been articulated as a primary concern with respect to clinical care or research. It was characterized by the National Commission as fair distribution of burdens and benefits. While justice generally plays a smaller role in the fiduciary duty of a clinician to an individual patient, it has important implications in research for both individual projects and the overall research enterprise. Individuals ought not to bear the risks of research if the resulting benefits are unavailable to the group from which they were selected (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research 1979).

The majority of physicians and researchers in this country learn to address ethical dilemmas with a set of four principles made ubiquitous by Tom Beauchamp, who staffed the National Commission and drafted much of the *Belmont Report*, and James Childress. In their text *Principles of Biomedical Ethics*, now in its seventh edition, they outline four prima facie principles to guide ethical decision making in patient care (Beauchamp and Childress 2013). Beauchamp and Childress separated out nonmaleficence from beneficence, defined the four principles—respect for autonomy, beneficence, nonmaleficence, and justice—and provided context and guidance for how to use the principles to approach ethical dilemmas. Although these were intended to be prima facie principles unless the specifics of the case demand that one principle outrank another, autonomy has become the primary principle in American medicine.

Interest in biomedical ethics has grown since the first bioethics committee was authorized. Six additional

bioethics advisory bodies have advised sitting presidents since the 1970s. Over the past 15 years, bioethics degree programs have emerged at the bachelor's, master's, and doctoral levels (Lee and McCarty 2016). The majority of growth has occurred at the master's level, suggesting that bioethics credentials are augmenting training in other disciplines, including medicine, nursing, law, and science. Subspecialties have developed—from the predominant areas of clinical, research, and professional ethics to, more recently, niche areas such as nanoethics, genethics, and neuroethics. In this mix, around the late 1990s, public health ethics emerged in the United States.

PUBLIC HEALTH ETHICS

Public health and clinical medicine are quite separate in the United States, unlike most other countries—both high-income and lower income. In most countries, a single payer or integrated health systems address both individual clinical health and community public health. In the United States, however, these systems exist as separate entities. One—the clinical health system—focuses on illness and the patient–provider interaction. It is overwhelmingly for-profit and in 1980 was dubbed the "medical–industrial complex" by Arnold Relman, the then editor of the *New England Journal of Medicine* (Relman 1980). Relman described medicine as an expansive for-profit enterprise that "creates problems of overuse and fragmentation of services, overemphasis on technology … and it may … exercise undue influence on national health policy" (Relman 1980, 963). The other—the public health system—focuses on prevention and populations in addition to individuals. It is dramatically underfunded and overtaxed, with the responsibilities for both population health and being a provider of last resort for many persons who are not covered by traditional employer-based medical insurance (Galea and Annas 2016). As these very different domains of care arose, so did very different ethical bases for their practice.

Public health ethics is a newer field, coming into its own in the early 2000s. Initially the field borrowed heavily from the principle-based approach of clinical ethics, but added a clear focus on justice—social justice and distributive justice—and on public beneficence—doing good for the community. Numerous public health ethics frameworks have been published. While there is no single agreed-upon approach, the common foundational values shared by the majority of these early frameworks reflect the tension in public health between individual autonomy and the common good (Lee 2012). Most frameworks include values that stem from a clinical or individual orientation, such as autonomy, noninterference, individual liberty, respect for persons, and rights, as well as values that stem from a community or collective orientation such as obligation, producing benefits, preventing harms, protecting trust, confidentiality, population utility,

justice, transparency, relationships, equity, disparities, and participation.

Recently, several public health ethicists have shifted away from the focus on individual autonomy versus the common good, moving toward recognition of the complexity and interconnection of our place among social and ecological systems. The recognition of social determinants of health, largely championed by Sir Michael Marmot of the United Kingdom, and recent calls for the development of a global health ethic have converged to call for incorporating social responsibility into—or back into—bioethics (Marmot 2004; Goldberg and Patz 2015). Much of the emphasis in public health ethics is on equity, social justice, and how we live a good life together. Madison Powers and Ruth Faden have emphasized the role of social justice in public health ethics, ensuring a minimal level of opportunity and health for all (Powers and Faden 2006). Angus Dawson and Bruce Jennings have brought attention to the role of solidarity and interrelatedness into our formulation of public health ethics (Dawson and Jennings 2012; Jennings 2015). These important ethical drivers in public health differ from the drivers of clinical ethics in large part to embrace the "public" in public health.

The "public" in public health comprises both the collection of individuals and the natural and human-created systems that impact health. In a concrete and practical way, public health's commitment to climate change as a public health issue, for example, is connected to the One Health initiative, which recognizes that the health of animals is intricately related to the health of humans (Frumkin et al. 2008; Rubin et al. 2015). These broad commitments reflect public health's increasing concern with the connectedness of health of individuals to the health of populations, to the health of animals, to the health of the environment, to the health of the planet.

BRIDGING TO POTTER'S VISION OF BIOETHICS

The Role of Public Health Ethics

Several authors have described the distance between clinical and environmental ethics, implicitly calling for a return to Potter's more inclusive vision of bioethics. David Resnik (2009) describes the conflict facing policymakers that results from the failure of health care ethics to account for the environment and the failure of environmental ethics to consider human health. He suggests an environmental health ethics approach to help policymakers resolve the inherent value conflicts between promoting human health and protecting the environment. Cheryl Cox MacPherson (2013) calls on the field of bioethics to address climate change as a health issue. Her case is convincing, but contemporary biomedically focused bioethics is ill-equipped to address the ethical dimensions of responsibility and justice that she calls for. James Dwyer (2009) explicitly calls for attention to Potter's desire to include health, survival, and the environment in the field of bioethics. He proposes an empirical approach to assess population health,

environmental sustainability, and just distribution of natural resources. In all of these cases, the authors call for a bridge between individual-focused biomedical ethics and a weak anthropometric-focused environmental ethic to solve the environmental problems that affect human health. I'm suggesting that that bridge, in many cases, could be public health ethics, a field that overlaps on one hand with biomedical ethics—with its focus on health of individuals—and on the other with environmental ethics—with its focus on the relationship between the health of the environment and the health of humans. Public health ethics, with its broad and inclusive framework, can help us recognize how the health of humans is intricately linked to the health of the planet.

The overlap between biomedical ethics and public health ethics has increased with the recent recognition that community health is essential for individual health and that individual health affects the health of the community, locally and globally (Lane et al. 2000; Williams 2008; Dawson 2010; O'Neill 2002). Coincidentally, there has been a call to reassess the role of primary, secondary, and tertiary prevention in clinical care, which would transform the "illness" care system into a true "health" care system (Koh and Sebelius 2010). These factors have brought clinical medicine and public health together to focus on primordial prevention, which addresses the broadest and most distal level of preventing risk factors associated with disease and disability.

The overlap of public health ethics and environmental ethics also has evolved recently as global climate change and devastation of habitat have exacerbated new and neglected infectious diseases that are transmitted from animals and insects and take a toll on population health. Public health concerns about zoonotic diseases—from bat-borne Ebola to tick-borne Lyme to various mosquito-borne encephalitic diseases—make it clear that the health of people depends on the health of other life on the planet. Most recently, in response to the appearance of microcephaly in newborns resulting from the mosquito-borne Zika virus, scientists have used innovative genetic engineering technologies to alter mosquitoes and remove the risk of transmission of many mosquito-borne illnesses (Yakob and Walker 2016). These lifesaving techniques have raised many ethical questions about how altering mosquitoes to prevent infection might impact our environment (Sikka et al. 2016; Kaebnick 2015). The overlap of public health ethics and environmental ethics plays an important role in public health nutrition as well, where issues must be addressed at the level of the individual, the community, and the biosphere (Sabete, Harwatt, and Soret 2016). These discussions bring ethical questions to the table—the kinds of questions that must be considered from a public health ethics and environmental ethics perspective.

Although a nascent field, public health ethics is rooted in the concerns of individual, community, and environmental health. It provides a broader view of what values are at stake in decisions about what we ought to do in our efforts to improve health. Public health ethics requires us to address head-on the numerous conflicts that arise in the values that motivate our work through pluralistic engagement of affected communities and deliberative decision making. It straddles the highly individual focus of contemporary biomedical ethics and the broad ecosystem focus of contemporary environmental ethics, supporting public health's goal to improve the health and lives of all of the planet's inhabitants by integrating medicine, veterinary medicine, and environmental sciences.

Public health ethics, with its broad framework, is not suitable for all biomedical or environmental ethics questions. Not all individual-level biomedical ethics questions involve the environment, and not all environmental ethics questions impact health. The fields of biomedical ethics and environmental ethics will continue to guide "should" questions in each of these areas. Where there is overlap, however, public health ethics can provide a useful framework to address the wide breadth of ethical concerns. Public health ethics does not resolve the issues of and limitations to anthropocentrism in environmental ethics, but recent work by Resnik and others in the environmental health ethics movement reveals that ethical dilemmas set up as humans' health versus the environment provide a false choice (Resnik 2012). Environmental health ethicists are developing methods for considering ethical dimensions of human health and the health of the environment simultaneously, suggesting an approach that includes both instead of preferencing one over the other (Jennings 2016).

Public health practice is based on the recognition that communities are greater than the sum of individuals, that our physical (and financial) health is most efficiently achieved from broad-based prevention. It is also based on an understanding that our context—quite literally our environment—has an impact on our health across the life span. Public Health 3.0, a recent call to equip the field to address the increasingly complex determinants of health, has emphasized the importance of cross-sector engagement and systems-level action (DeSalvo et al. 2016). Three important partners of a comprehensive system that focuses on health instead of illness are clinical medicine, community health, and environmental wellness. Unsatisfied with the false dichotomy of individual rights versus community health, public health ethics has begun to articulate and act upon values based on our connectedness with each other, animals, and the environment.

Public health ethics emphasizes values that overlap the two now distant fields of biomedical ethics on one end and environmental ethics on the other. This is in large part due to the role of public health as a field that must address individual health and the environment in order to maximize the health of the population. From this position, public health ethics can reach out to reintroduce the strangers on both sides to support a more thorough consideration of the complex ethical dimensions that connect individual, community, and environmental health. From this position, public health ethics can serve as a bridge back to Potter's

broad vision and reacquaint us with an integrated bio-ethic that values and considers all living things.

GETTING THERE

Bridging the gap between the ethics of health and the environment will require at least three things: recognition of the ways human health is connected to the health of animals and the environment, awareness of the theory and practice of public health ethics, and application of the deliberative problem-solving methods used by public health. From a practical perspective, it will require policymakers to address a wider set of value considerations in both health and environmental policy. Efforts such as "health in all policies" that include concepts like health promotion, equity, and sustainability; intersectoral collaboration; ensuring widespread benefits; stakeholder engagement; and structural change are critical to informing local, state, and federal policymakers of the interconnectedness of health and well-being (Rudolph et al. 2013; WHO 2015). It will require that decision makers in medicine, public health, environmental health, and public policy be trained in and have access to experts in public health ethics and deliberative decision making (Gutmann and Thompson 1997; Lee 2014). Adding ethics decision making training into medical, public health, and public policy training is essential (Presidential Commission for the Study of Bioethical Issue 2016). From a philosophical perspective, bringing about a more inclusive bioethics will require the continued development of public health ethics theory with the inclusion of biomedical and environmental ethics perspectives. Informal cross pollination efforts continue between ethics professionals in the three fields, and these individual efforts might be augmented by structural opportunities for collaborations—shared sessions at professional conferences and meetings, for example, could stimulate new ways of thinking about how to find a way forward on challenging health problems while considering the values and principles in medicine, public health, and environmental science, especially when they conflict.

CONCLUSION

We are facing increasingly complex health problems that are exacerbated by a web of distal and proximate determinants from the molecular to the atmospheric. As we search for solutions to these multifactorial health impacts, we must consider what we ought to do to mitigate health risks at the individual, community, and environmental levels. Public health ethics can help us bridge the gap between individual-based biomedical ethics and environmental ethics by bringing into the conversation the diverse range of values it embraces—from individual autonomy and the principle of least infringement to solidarity, interrelatedness, and the connection of human health to the health of the planet. Public health ethics is concerned with communities, as well as individuals and the environment (both natural and built). It is concerned with justice and solidarity, health protection, and social engagement. As such, public health ethics is well situated to reconnect all three "fields" of ethics to promote a healthier planet.

While additional work remains, public health ethics has the potential to serve as a bridge back to the future, connecting 21st-century ideas of biomedical ethics, public health ethics, and environmental ethics to Leopold's and Potter's visions for an ethic that moves all of Earth's inhabitants toward a good life. Health, social, and ecological justice demands this of us.

DISCLAIMER

REFERENCES

Accreditation Council for Graduate Medical Education. 2017. *ACGME common program requirements*. Available at: http://www.acgme.org/What-We-Do/Accreditation/Common-Program-Requirements

Beauchamp, T. L., and J. F. Childress. 2013. *Principles of biomedical ethics*, 7th ed. New York, NY: Oxford University Press.

Carmody, T. 2016. How the Flint River got so toxic. *The Verge*, February 26. Available at: http://www.theverge.com/2016/2/26/11117022/flint-michigan-water-crisis-lead-pollution-history

Cronon, W. (Ed.) 1997. *John Muir: Nature writings: The story of my boyhood and youth; My first summer in the Sierra; The mountains of California; Stickeen; Essays*. New York, NY: Library of America.

Dawson, A. 2010. The future of bioethics: Three dogmas and a cup of hemlock. *Bioethics* 24 (5):218–25.

Dawson, A., and B. Jennings. 2012. The place of solidarity in public health ethics. *Public Health Reviews* 34:65–79.

DeSalvo, K. B., P. W. O'Carroll, D. Koo, J. M. Auerbach, and J. A. Monroe. 2016. Public health 3.0: Time for an upgrade. *American Journal of Public Health* 106 (4):621–622.

Drengson, A., and A. Naess. 2005. *The selected works of Arne Naess*, Vols. 1–10. Dordrecht, The Netherlands: Springer.

Dwyer, J. 2009. How to connect bioethics and environmental ethics: Health, sustainability, and justice. *Bioethics* 23 (9):497–502.

Ehrlich, P. R. 1968. *The population bomb*. New York, NY: Ballantine Books.

Frumkin, H., J. Hess, G. Luber, J. Malilay, and M. McGeehin. 2008. Climate change: The public health response. *American Journal of Public Health* 98 (3):435–45. https://doi.org/10.2105/AJPH.2007.119362.

Galea, S., and G. J. Annas. 2016. Aspirations and strategies for public health. *Journal of the American Medical Association* 315 (7):655–56. https://doi.org/10.1001/jama.2016.0198.

Goldberg, T. L., and J. A. Patz. 2015. The need for a global health ethic. *Lancet*. 386 (10007):e37-e39. https://doi.org/10.1016/S0140-6736(15)60757-7.

Gutmann, A., and D. Thompson. 1997. Deliberating about bioethics. *Hastings Center Report* 27 (3):38–41.

Jahr, F. 1927. Bio-Ethik. Eine Umschau uber die ethischen Beziehungen des Menschen zu Tier und Pflanze. Kosmos. *Handweiser fur Naturfreunde* 24 (1):2–4.

Jennings, B. 2015. Relational liberty revisited: Membership, solidarity and a public health ethics of place. *Public Health Ethics* 8 (1):7–17.

Jennings, B. 2016. Putting the bios back into bioethics: Prospects for health and climate justice. In *Bioethical insights into values and policy: Public health ethics analysis*, ed. C. C. Macpherson, chap. 2. Geneva, Switzerland: Springer International.

Jones, J. H. 1993. *Bad blood: The Tuskegee syphilis experiment*. New York, NY: Free Press.

Jonsen, A., M. Siegler, and W. J. Winslade. 2015. *Clinical ethics: A practical approach to ethical decisions in clinical medicine*, 8th ed. New York, NY: McGraw-Hill Education.

Kaebnick, G. 2015. GM mosquitoes: Risks and emotions. *The Bioethics Forum*, February 20. Available at: http://www.thehastings center.org/Bioethicsforum/Post.aspx?id =7295&amp%3Bblogid= 140&terms=kaebnick+mosquito+and+%23filename+%2A.html# ixzz423BYIPtO

Koh, H. K., and K. G. Sebelius. 2010. Promoting prevention through the Affordable Care Act. *New England Journal of Medicine* 363 (14):1296–99.

Lane, S. D., R. A. Rubinstein, D. Cibula, and N. Webster. 2000. Towards a public health approach to bioethics. *Annals of the New York Academy of Sciences* 925:25–36.

Lee, L. M. 2012. Public health ethics theory: Review and path to convergence. *Journal of Law, Medicine & Ethics* 40 (1):85–98.

Lee, L. M. 2014. My moral compass and ethical decision making in public health. *Public Health* 128 (6):579–81. https://doi.org/10.1016/j.puhe.2014.04.001.

Lee, L. M., and F. A. McCarty. 2016. Emergence of a discipline? Growth in U.S. postsecondary bioethics degrees. *Hastings Center Report* 46 (2):19–21.

Leonardi, J. M., and W. J. Gruhn. 2001. Flint River assessment. Ann Arbor, MI: Michigan Department of Natural Resources, Fisheries Division, Special Report 27.

Leopold, A. A. 1949. *Sand County Almanac and sketches here and there*. New York, NY: Oxford University Press.

Liaison Committee on Medical Education. 2017. *Functions and structure of a medical school: Standards for accreditation of medical education programs leading to the M.D. degree.* Available at: http://lcme.org/publications/

Lolas, F. 2008. Bioethics and animal research: A personal perspective and a note on the contribution of Fritz Jahr. *Biological Research* 41 (1):119–23.

MacPherson, C. C. 2013. Climate change is a bioethics problem. *Bioethics* 27 (6):305–8.

Marmot, M. 2004. *The status syndrome*. New York, NY: Owl Books.

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. 1979. *The Belmont report: Ethical principles and guidelines for the protection of human subjects of research.* Washington, DC: Government Printing Office.

National Research Act. 1974. 42 U.S.C. 289. Available at: https://www.gpo.gov/fdsys/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap6A-subchapIII-partH.htm

O'Neill, O. 2002. Public health or clinical ethics: Thinking beyond borders. *Ethics and International Affairs* 16 (2):35–45.

Potter, V. R. 1971. *Bioethics: Bridge to the future*. Englewood Cliffs, NJ: Prentice Hall.

Powers, M., and R. Faden. 2006. *Social justice: The moral foundations of public health and health policy*. New York, NY: Oxford University Press.

Presidential Commission for the Study of Bioethical Issues. 2016. *Bioethics for every generation: Deliberation and education in health, science, and technology*. Washington, DC: PCSBI.

Reich, W. T. 1995. The word "bioethics": The struggle over its earliest meanings. *Kennedy Institute of Ethics Journal* 5 (1):19–34.

Relman, A. S. 1980. The new medical–industrial complex. *New England Journal of Medicine* 303:963–70.

Resnik, D. B. 2009. Human health and the environment: In harmony of in conflict? *Health Care Analysis* 17 (3):261–76.

Resnik, D. B. 2012. *Environmental health ethics*. Cambridge, MA: Oxford University Press.

Rudolph, L., J. Caplan, K. Ben-Moshe, and L. Dillon. 2013. *Health in all policies: A guide for state and local governments*. Washington, DC, and Oakland, CA: American Public Health Association and Public Health Institute.

Rubin, C. S., R. Kunkel, C. Grigg, and L. King. 2015. Evolution of the One Health movement in the USA. In *One health: The theory and practice of integrated health approaches*, ed. J. Zinsstag, E. Schelling, D. Waltner-Toews, M. Whittaker, and M. Tanner, 318–31. London, UK: CAB International.

Sabete, J., H. Harwatt, and S. Soret. 2016. Environmental nutrition: A new frontier for public health. *American Journal of Public Health* 106 (5):815–21. https://doi.org/10.2105/AJPH.2016.303046

Sikka, V., V. K. Chattu, and R. K. Popli, et al. 2016. The emergence of Zika virus as a global health security threat: A review and a consensus statement of the INDUSEM Joint working Group (JWG). *Journal of Global Infectious Diseases* 8 (1):3–15. https://doi.org/10.4103/0974-777X.176140.

Sulmasy, D. P. 2001. Foreword: The essentialist medical ethics of Edmund Pellegrino: Analysis and critique. In *Physician philosopher: The philosophical foundation of medicine: Essays by Dr. Edmund Pellegrino*, ed. R. J. Bulger and J. P. McGovern, xvii–xxx. Charlottesville, VA: Carden Jennings.

Tuskegee Syphilis Study Ad Hoc Advisory Panel. 1973. *Final report of the Tuskegee Syphilis Study Ad Hoc Advisory Panel*. April 28.

Washington, DC: U.S. Department of Health, Education, and Welfare. Available at: http://biotech.law.lsu.edu/cphl/history/reports/tuskegee/tuskegee.htm

White, L. 1967. The historical roots of our ecologic crisis. *Science* 155 (3767):1203–7.

Williams, J. R. 2008. The Declaration of Helsinki and public health. *Bulletin of the World Health Organization* 86 (8): 650–52.

World Health Organization. 1948. WHO definition of health. Preamble to the Constitution of the World Health Organization. *Official Records of the World Health Organization* 2:100.

World Health Organization. 2015. *Health in all policies: Training manual*. Geneva, Switzerland: WHO.

Yakob, L, and T. Walker. 2016. Zika virus outbreak in the Americas: The need for novel mosquito control methods. *Lancet Global Health* 4 (3):e148–49. https://doi.org/10.1016/S2214-109X(16)00048-6.