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GUEST EDITORIAL

Climate Change, Global Health, and Nursing Scholarship

According to the World Health Organization (2014), global climate has significant effects on the social and environmental determinants of health through threats to clean air, safe drinking water, sufficient food, rising temperatures, and secure shelter. Threats to health as a result of climate change are a worldwide phenomenon having global repercussions for individuals and populations, including infectious and chronic disease, mental health, entomology, food security, disaster planning, and social disparities.

Nursing's international organizations, the International Council of Nursing and Sigma Theta Tau International (STTI), recognize the importance of the United Nations Sustainable Development Goals including climate change, particularly in relationship to healthcare workforce development and health improvement of vulnerable groups (International Council of Nursing, 2017; STTI, 2005). In 2008, the American Nurses Association (ANA) published a resolution regarding climate change, stating that challenges faced as a result of global climate change are unprecedented in human history. Therefore, per ANA, nurses should support local public policies endorsing sustainable energy sources and reduce greenhouse gas emissions. The ANA also resolved support for initiatives to decrease the contribution to global warming by the healthcare industry. The American Association of Colleges of Nursing (AACN, 2011) has identified ways that institutions of learning and schools of nursing could address sustainability in buildings, classrooms, and imbed sustainability within the practice of nursing. Issues of social and environmental justice along with disparities related to social determinants of health are all intertwined with climate change and health. Such complexity requires the development of theoretical frameworks for nursing that can guide nursing's approach to climate change and health.

In June 2015, President Barack Obama convened a White House Summit on Climate Change and Health, inviting deans of U.S. schools of nursing, public health, and medicine to commit to the development of curricula and research addressing climate change and health. Somewhat due to crowded content in curricula and lack of dedicated research funding for climate change and health, development of health professionals who are experts on this topic is lacking. Recognizing this need, the deans attending the summit agreed upon a

commitment to improving this situation by promoting curricular changes and supporting research related to climate change.

Scientists are clear that the planet is experiencing extremes in climate change, but political debate lingers regarding the cause, human or otherwise, for climate change. Calls for commissions to address this debate are seen as both a way to address the divide but also as a lack of willingness to accept scientific evidence (Koonin, 2017). Regardless, it is clear that climate is changing, and nursing needs to rise above this debate to address the issue as part of our scope of a discipline that focuses on health promotion, disease prevention, and environment measures within the interrelated concepts of person, environment, health, and nursing (ANA, 2010; Fawcett & DeSanto-Madeya, 2013). Nursing organizations are developing climate change guidelines and principles especially focused on teaching health professionals about climate change, vulnerability, and prevention of illness due to exposures to extreme weather events including heat, air pollution, and exposure to solar radiation. Downstream issues of responding to disasters associated with climate change and health is historically the most common way that nursing is visible in climate change issues, yet it is increasingly important for nursing and nursing science to address not only mitigation of climate change health issues but also engagement in prevention of climate change through environmental sustainability. Worldwide, movement of populations due to drought, civil unrest, and food insecurity can give way to epidemics and health deterioration, particularly in underdeveloped countries and among vulnerable groups, including the aged, children under 5 years of age, and women of childbearing age.

Climate change is believed to be one of the largest threats to human health that the planet has ever experienced. The potential impact on human health is highly variable, depending on where one lives and works and the resources or social support available to communities. A recent paper in *Lancet* described that tackling climate change could be the greatest global health opportunity of the 21st century (Watts et al., 2015). The investigators pointed out that the effects of climate change are being felt today with severe weather events across our globe, but more importantly, the future projections represent an unacceptably high and potentially catastrophic risk

to human health. Under the Obama administration, the U.S. Global Change Research Program produced a large report summarizing the impacts of climate change on human health in the United States (Crimmins et al., 2016). In this special issue of the *Journal of Nursing Scholarship*, nursing scholars present papers addressing the multitude of challenges that health providers face related to climate change and address compelling issues in the United States and globally.

The U.S. health sector is a leading emitter of greenhouse gas and non-greenhouse gas pollution. Watts et al. (2015) reported that the U.S. healthcare sector produces 10% of all greenhouse gas emissions, more than many countries throughout the world. These emissions are associated with increases that are being observed in conditions related to climate change, including respiratory and cardiac morbidity and mortality. The nursing profession has been engaged for many years advocating for the healthcare industry to reduce its carbon footprint through the adoption of practices to increase efficiency and decrease the impact on the environment. In this issue, Kurth (2017) presents a broad perspective on the importance of nursing in protecting planetary health and the significance of the contribution the healthcare industry can make in reducing greenhouse emissions.

Nursing has historically addressed the health needs and care of the nation's most vulnerable individuals. Climate change will have the capacity to affect all of the earth's inhabitants, but groups particularly vulnerable include those with low income, some communities of color, immigrant groups, indigenous peoples, children and pregnant women, older adults, vulnerable occupational groups, persons with disabilities, and persons with preexisting or chronic medical conditions. Several papers in this issue address these vulnerable populations and the important role that nursing can play in protecting their health.

This issue also highlights the important role that nursing educators can play in preparing the workforce of the future to care for populations experiencing uncertain climate change. Nursing's role in addressing climate change cannot be done in a silo, but is dependent on interprofessional collaboration. Universities are working together to address the climate change challenge. The Global Consortium on Climate and Health Education funded by the Rockefeller Foundation and housed in the Columbia University's Mailman School of Public Health is designed to bring educators together to share best scientific and educational practices and to design model curricula on the health impacts of climate change for academic and nonacademic audiences. This initiative began at the 2015 COP-21 conference in Paris, followed

by the World Health Organization's 2016 Second Global Conference on Health and Climate and addresses the need to mainstream climate change and health topics into medical, nursing, and public health training. With this initiative, 115 medical, nursing, and public health schools across the world have signed a pledge to add climate and health to their curricula in order to equip their students to face the climate change issues of the future. This will ensure a cadre of well-trained health professionals to serve as leaders for nations and businesses to address the challenges that we face. In addition, the Consortium will support the development of academic partnerships to assist under-resourced countries that face a disproportionate share of the burden of climate-related illness. We present in this special issue several papers that discuss curricular maps or frameworks for integrating climate change content into health professional education, nursing's role in disaster preparedness, and prevention of illness related to climate change. Hopefully, the papers in this issue will serve to lay a beginning foundation for future engagement of nursing scholarship in addressing climate change globally.

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Eileen Sullivan-Marx
Guest Editor
 and Linda McCauley
Guest Editor

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COMMENTARY

Impact of Climate Change on Health From the Perspective of Catholic Relief Services

Albeit on a much larger scale, climate change reminds me of how I felt in March 2014 when I heard about the first case of Ebola virus disease (EVD) in Guinea. Having spent many years in West Africa, I could only begin to imagine the breadth of destruction it would have on the lives of thousands. At the early stage of the EVD outbreak, the world struggled to respond appropriately because we had never experienced such a large outbreak of this disease. Climate change feels the same way, except that we have much better advance knowledge that if the world does not make drastic changes immediately, climate change will have a devastating health effect on countries across the globe.

For more than seven decades, Catholic Relief Services (CRS) has responded to both sudden-onset or short-term and slow-onset or long-term emergencies, as a result of both natural disasters and conflict. In 2015, we worked in 101 countries and reached more than 100 million people. Our programming in agriculture, health, and emergency response—our three main areas of intervention—engages a wide range of partners, from civil society and governments to private companies and universities, working with community health workers as well as local health facility and district hospital staff and Ministry of Health representatives. While climate change has an impact on many areas of human health, this commentary is grounded in my expertise in mosquito-borne diseases.

The Problem or Challenge From a Public Health Point of View

From a public health perspective, change in the climate means changes in precipitation levels, which may cause flooding and impact health and nonhealth sectors alike. For instance, flooded lands make it difficult or impossible for farmers to cultivate their land, which in turn means reduced nutritious foods for families, affecting the health of pregnant women and children, among others. Flooding also means an upsurge in water-borne diseases and an increase in standing water, which forms a perfect breeding ground for mosquitos, thereby increasing vector-borne diseases such as malaria and Zika.

Rising temperatures also means the (re)introduction of malaria in what are currently malaria-free areas. Conversely, this could also mean that there might no longer

be malaria in current areas. However, the likelihood of the former could have a dramatic negative effect on the loss of human life and the health burden to humans. This would lead to a rise in malaria epidemics, since such communities would not have acquired natural immunity from the ongoing presence of the malaria parasite (and perhaps would not have the knowledge to prevent malaria) and would be hit with the disease just as hard as foreigners traveling to malaria-endemic countries. In countries with less developed health systems than those in Europe or the United States, this could unfortunately mean many lives lost.

In CRS, we see climate change as undermining our investment in supporting national malaria control programs in developing countries to prevent and control malaria activities, such as seasonal malaria chemoprevention, which aims to eliminate malaria from a specific geographic area by providing prophylactic drugs to children 3 to 59 months of age. In addition, in the last few months of 2015, areas as diverse as India and Zimbabwe have struggled with sudden outbreaks of dengue fever, a disease also transmitted by a mosquito. This might forecast the rise of a broad spectrum of vector-borne diseases in the near future, just like we have recently seen with the Zika virus.

The Solution From an International Nongovernmental Organization Point of View

Climate change jeopardizes health for millions, and in turn will affect the way international agencies such as CRS respond to its effects. Since CRS works across sectors that include health and water management, we can contribute to reducing the negative health impacts caused by climate change and in mitigating the impact of climate change on the environment and agriculture and therefore livelihoods.

According to the United National Development Program, "Africa is expected to be the hardest-hit continent by climate change . . . with one in four people in Sub-Saharan Africa living in poverty." With the sustainable development goals (<http://www.un.org/sustainabledevelopment/sustainable-development-goals/>) focusing on equity ending hunger and poverty, climate

change is a very important issue because those living in Sub-Saharan Africa with a low social economic status will have the least ability to adapt and be resilient in the face of change. CRS' President and CEO, Dr. Carolyn Woo, testified in October 2015 to the House Subcommittee on Africa, Global Health, Global Human Rights, and International Organizations Committee on Foreign Affairs about a hearing on food security and nutrition programs in Africa. Dr. Woo stated that "additional resources [need to be] directed to the most vulnerable" and that pro-poor approaches need to be taken to reduce the impact of climate change on this segment of the population.

CRS is actively engaging U.S. Catholics on climate change issues following Pope Francis' call to address the complex problems of poverty and climate change in his groundbreaking encyclical *Laudato Si*. With events such as El Niño, which are thought to be more intense in 2016 as a result of climate change, CRS issued regional guidance to countries where we have ongoing programming to support governments' adaptation strategies. Similarly, CRS encourages other humanitarian organizations to continue supporting governments through advocacy and on-the-ground efforts to prevent possible health consequences of climate change. Some of the strategies encouraged include:

- Prepositioning food, nutrition, and other health commodities and supplies to meet immediate or future needs. For instance, increased severe weather events can lead to communities being forced to move, and if we ensure that mosquito nets are easily accessible to these displaced populations, or that these nets are easily accessible in areas that may not have malaria presently, but are on the front lines of endemic malaria areas, we will help reduce cases of malaria.
- Developing health messages to ensure that communities can identify changes in their living environment that might trigger a catastrophic event. Messages might address unexpected or increased rains

and standing water, leading to increased mosquito populations. This preventive messaging can enable them to protect themselves before the event.

- Supporting Ministries of Health to ensure their surveillance sites and activities include factors that may be triggered by climate change patterns (such as sudden storms during unexpected seasons, or changes in the range of vectors that carry diseases) to enable them to send time-sensitive messages throughout their country to prepare communities for a possible adverse event.

Concluding Remarks

Whilst agencies such as CRS can support governments to reduce the number of people exposed to catastrophic events and the consequences of climate change, much more needs to be done. The World Health Organization estimates that if we do not act now to reverse the negative trends from climate change, we could see an additional 250,000 deaths each year from malaria, diarrheal disease, heat stress, and undernutrition (World Health Organization, 2015). Of course, the consequences of climate change don't stop with health, but impact agriculture, food security, water security and just about every other facet of our lives. It has become blatantly clear that to ensure our own health, we must also restore the health of our planet.

Suzanne Van Hulle

Senior Technical Advisor for Malaria, Catholic Relief Services, 228 W
Lexington Street, Baltimore, MD 21201
E-mail: suzanne.vanhulle@crs.org

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SPECIAL ISSUE ARTICLES

Planetary Health and the Role of Nursing: A Call to Action

Ann E. Kurth, PhD, CNM, MPH, FAAN

Dean and Linda Koch Lorimer Professor, Yale University School of Nursing, West Haven, CT, USA

Key words

Communication, environmental health, health disparities, international health/global health, nurse-midwifery

Correspondence

Dr. Ann E. Kurth, Yale University School of Nursing, PO Box 27399, West Haven, CT 06516, USA. E-mail: ann.kurth@yale.edu

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Abstract

Purpose: To discuss the drivers of planetary health, responses, and the role of nursing in making health systems more resilient in an era of increasing stresses. As health providers, scientists, educators, and leaders, nurses have an obligation to prepare for climate change and other impacts of ecosystem strain on human health.

Design and Methods: Review of literature relevant to a planetary health framework.

Findings: Population displacement, new disease patterns and health needs, stresses on air quality, food production and water systems, and equity concerns, as well as the generation of sustainable energy, are all intimately related to health.

Conclusions: Nurses are key to achieving the sustainable development goals that, like the planetary health framework, focus on environmental sustainability and human well-being. Nurses contribute to resilient health systems, as trusted leaders and providers of health care, and as advocates and change makers impacting the world.

Clinical Relevance: It is critical that nurses and other health professionals consider the multiple effects of ecosystem strain on human health, and anticipate population health and health system planning and response.

The concept of human endeavor grouped under the rubric of global health has evolved over time. Following a quasicolonial model of tropical medicine that tended to focus on single diseases and achievements such as the eradication of smallpox, in the mid-20th century the term became international health—arguably still an “us and them” framing (Brown, Cueto, & Fee, 2006). By the 2000s there was a move to define global health in a way that embraced the interconnectedness of human communities, as “. . . an area for study, research, and practice that places a priority on improving health and achieving equity in health for all people worldwide” (Koplan et al., 2009, p. 1995).

Health Improvements and Consequences

The United Nations’ (UN) millennium development goals (MDGs) were a further milestone in the evolution of global health. MDGs were established with focused,

quantifiable health goals, though their conceptual focus was only on low-income countries (Office of the High Commissioner for Human Rights [OHCHR], n.d.). By 2015, all 193 UN member countries transitioned from the MDG framework into sustainable development goals (SDGs) that are much broader (17 goals, 169 targets), intersectoral (beyond health), and apply to all countries, whether high-income country (HIC) or low- or middle-income country (LMIC) status (World Health Organization [WHO], 2015).

SDG 3, good health and well-being, includes newborn and maternal mortality goals, targets for reduction of noncommunicable diseases (NCDs), universal access to sexual and reproductive healthcare services, health workforce goals, and reduction of deaths and illness from environmental pollutants, among others (UN, n.d.).

Growing concern that economic development gains are undermined by humans’ transformation of the planet brought focus within the SDG framework to the coupled

priorities of environmental protection and poverty reduction (Griggs et al., 2013). The 17 SDGs in total outline goals for climate action, reduced inequalities, clean energy, and the achievement of equality and justice. Tacit recognition of health as a human right has driven a focus within the framework on equity, economics, and ecology (OHCHR, n.d.).

The One Health Initiative, a “worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals, and the environment,” is a milestone coalition and movement built upon older concepts of zoonotic disease and the connection between public health and the environment (One Health Initiative, n.d., para.1). And now many have begun to talk about planetary health, an organizing focus on health that considers both the benefits and the untoward consequences of economic development.

These organizing frameworks are occurring in the context of major global health trends. NCDs continue to grow at an alarming, rapid rate, including in LMICs. Urbanization is another clear trend. In 2007, more humans around the globe lived in cities than in rural areas, and predictions are that by 2050 another 2.5 billion people will live in cities, with 90% of this change occurring in Asia and Africa. By mid-century, 66% of the world’s population will be urban (UN, 2014). The number of people living in slums now approaches 1 billion, with projections indicating that number will double by 2030. If that prediction holds, most of the growth in human population in the next 15 years will be into urban slums through migration and natural growth (United Nations Human Settlements Programme, n.d.).

Global urbanization trends suggest growth in social and health inequality. Data from urban health researchers consistently demonstrate a monotonic positive association between measures of concentrated disadvantage and poor health outcomes (Vlahov et al., 2007). Urban areas are at the center of globalization, with the transmission of capital and innovation, but also at the center of transmission of energy use, infectious disease transmission, and pollution. Cities are both the main drivers of climate change (estimated to account for 60%–80% of energy consumption and 70% of human-induced greenhouse gas emissions) as well as the recipients of deleterious climate impacts (Bank, 2010).

The good news is that overall human health, in aggregate, is better than ever before, and poverty has been substantially reduced. Over the past three decades, most poverty reduction has occurred in China and India, with real increases in overall wealth and not only redistribution of wealth (Ortiz & Cummins, 2011). Despite real economic gains for many, however, growth has occurred

at disparate rates, and overall income inequality is increasing (Dabla-Norris, Kochhar, Suphaphiphat, Ricka, & Tsounta, 2015).

Health impacts of income inequality and social stratification are clear regardless of the country (Chetty et al., 2016). In the United States, the mean lifespan of the wealthiest 1% of males is 15 years longer than the poorest 1%. The wealthiest 1% of women in the United States live, on average, a decade longer. This gap has grown over the past 20 years (Chetty et al., 2016). Recent data show declines in all life expectancy for all ages for the first time in the United States since 1993. Unexpected mortality increases in the diseases marking distress (overdose, alcoholism, and suicide) among white middle-aged Americans are also occurring with substantial social and political implications (Case & Deaton, 2015). Despite these alarming trends in the United States, it is important to note that the global burden of disease is still vastly and disproportionately borne by LMICs in the developing world (Murray & Lopez, 2013).

Ecosystem strain is a key global trend that may be less visible but that will have an increasing and profound impact on health. Due to climate system complexity and system justification bias—the human tendency to find comfort in the status quo (Jost, 2015)—ecosystem strain tends to be difficult to recognize. But in the longer term, trends of these patterns as a kind of slower-moving disaster are clear. Because of human-induced ecosystem effects like pollution, climate change, eutrophication of water systems, species elimination, and habitat destruction, human civilization will encounter new and serious threats to the systems and practices that provide access to resources required for individual and social survival (Whitmee et al., 2015).

The emission of greenhouse gases, primarily CO₂ (and also methane, nitrous oxide, and other agents), are strong drivers of global warming leading to cryosphere melt and rising sea levels (Wei et al., 2016). The impact of climate change is creating forced migration of select populations (e.g., Alaska straits) in HICs like the United States. The Bulletin of the Atomic Scientists’ Science and Security Board publishes annually an assessment of long-term trends that may pose existential threats to humanity, and in 2017 set the so-called Doomsday clock to 2½ minutes to midnight—global catastrophe—the second closest approach to midnight since the clock was introduced in 1947 (Science and Security Board, 2017).

Unambiguous evidence of ecosystem impact is offered by geologists, who propose the termination of the Holocene epoch and the beginning of the Anthropocene era (Crutzen, 2006). This new interval started approximately in 1950 during the great acceleration period of shifting from Industrial Revolution coal use to

multiple fossil fuel use in the 20th century, leading to human-induced processes like global warming, ocean acidification, air pollution, and other effects. These impacts are clearly geologically identifiable in soil, ice, and rock samples (Zalasiewicz, Williams, Steffen, & Crutzen, 2010). Overwhelmingly, the scientific consensus is that the current global climate change warming trend is due to human activity (National Aeronautics and Space Administration, 2017). Globally, each of the past 3 years were the hottest ever recorded, with 2016 and 2017 measured as the warmest ever years in the 21st century (National Centers for Environmental Information, 2017). Likewise, the rise in global ocean surface temperature continues to accelerate (Reid & Beaugrand, 2012).

By the year 2100, at the present rate of climate change, we can expect mean temperature increases of 1°C to 6°C (Intergovernmental Panel on Climate Change, 2007) and concomitant expected sea level rise of between 7 and 23 inches. That amount of sea level rise will displace 100 million people, triggering global migration and local relocation of displaced persons. Sea level rise will further disrupt agriculture, water systems, tourism, and the disappearance of small island nations (Wong et al., 2014). Even with a hypothetical present-day global reduction in the emission of greenhouse gases, climate changes are time lagged: greenhouse gas emitted in 2016 will not be identifiable in changed climate until 2030. In short, temperature rise and some of its unstoppable consequences are already “baked in” to our system and future.

Climate change brings with it more frequent extreme weather events. In 2012, Hurricane Sandy (the largest diameter Atlantic hurricane ever recorded) made landfall just northeast of Atlantic City, New Jersey, bringing record rain, wind, and storm surges to the densely populated northeastern United States. In total, Sandy was the second-costliest natural disaster in U.S. history, with costs estimated well over \$50 billion (Blake, Kimberlain, Berg, Cangialosi, & Beven, 2012). The risks posed by extreme weather events, climate change, and anthropogenic impacts are societal as well as economic. Social cohesion itself can be undermined: “The fall of the Roman Empire, Mayan, and [others] are all testimony to the fact that advanced, sophisticated, complex, and creative civilizations can be both fragile and impermanent” (Motescharra, Rivasb, & Kalnayc, 2014, p. 91). Far from a new problem, human history is marked by both progress and innovation, as well as periods of strife and forced migration.

Actuarial modeling of uncertainty and risk provides a view into the accelerating stress of global carrying capacity using math, statistics, and financial theory to study future events. A U.K. government taskforce recently assessed the actuarial risk of civilization collapse by 2040, weighing the combined risk elements affecting

food shortage due to climate change, water scarcity, and political and energy system instability (Ahmed, 2015).

In 2015, the Rockefeller Foundation and Lancet commission on Planetary Health released a special report, “Safeguarding Human Health in the Anthropocene Epoch” (Whitmee et al., 2015). The organizing premise of planetary health is that, while the global human population is healthier than ever before, the ecological cost to attain this standard has required an unprecedented and unsustainable exploitation of the planet. The Lancet report summarized concerns that, on our current unsustainable trajectory, we could see a reversal of health progress made as well as destabilized governments due to resource scarcity and inequities.

The complexity of global systems, natural and human, as well as the unprecedented changes underway make difficult predictions of the exact relationship between isolated measures of ecosystem change and health impact. Nonetheless, we can anticipate some of the expected patterns. Planetary health encompasses broad aspects of the accelerating pressure on the global environment. Climate change—global warming and related atmospheric phenomena—is only one parameter, but other ecosystem changes and impairments, as summarized in **Figure S1**, also have significant health impacts. The effects related to the impairment of ecosystems may be divided into direct, ecosystem-mediated, and indirect health impacts.

Direct health impacts of ecosystem impairment follow acute or long-term environmental changes. Increased flooding is expected due to combined factors of rising sea level and cryosphere loss, extreme weather events, and changes in precipitation. Globally, 50% of the population lives within 37 miles of the coast. In the United States, 50% of the population is within 50 miles (Toro, 2012). Droughts of increased severity and frequency are affecting food production as well as water systems of all types. Direct heat especially affects the elderly and vulnerable. A 2003 heatwave in Paris caused 15,000 deaths (Canoui-Poitaine, Cadot, Spira, & Groupe Régional Canicule, 2006). Air pollutants are now responsible for 5.5 million excess deaths globally in 2016 (University of British Columbia, 2016).

All regions in the United States are already experiencing these direct impacts. Coastal areas are threatened by rising sea levels and more intense storms. Midwest farmlands routinely experience more crop-damaging heat waves and new or persistent pests. The U.S. West and Southwest experience drought and wildfires.

Trends related to ecosystem-mediated health impacts include the spread of vector-borne diseases like dengue fever and malaria as mean temperatures climb. Lyme disease is newly endemic in mid-latitudes. Mental health and psychiatric issues, including trauma and

post-traumatic stress disorder, anxiety, and depression, may increase as individuals and social networks experience stress brought about by these changes.

Changes in food availability, cost, and quality may result in new and widespread malnutrition (undernutrition, micronutrient deficiency, and metabolic disease). Nutrition is vulnerable and subject to change as the systems that deliver food are deeply interconnected and dependent on many factors. Expected challenges to nutrition include climate change, population displacement, collapse of fisheries, decline of pollinators and other wildlife, arable land degradation, and water scarcity (S. Meyers, personal communication, 2016). These not-entirely-predictable interactions may include process inflection points with effects that quickly cascade throughout systems of food production.

Indirect impacts are composed of the anthropogenic environmental effects that lead to other health consequences. New conflicts arise (Kelley, Mohtadi, Cane, Seager, & Kushnir, 2015) or local conditions force migration. Displaced populations shift to urban areas (often to slums, and frequently across national borders), straining health services. Globally, at present there are more than 65 million refugees—more than ever before—with predictions that another 60 million in arid zones could migrate by 2020. Increasingly, global conflicts are not based on religious differences, but on water scarcity: a study on the impact of heat and drought on human behavior, inclusive of economic productivity as well as violence, found that for each standard deviation in temperature and rainfall, there was a 14% increase in violence between groups, and a 4% increase in violence between individuals (Hsiang, Burke, & Miguel, 2013).

These changes will have a disproportionate impact on the poorest individuals, amplifying health inequities. It has been estimated that 88% of persons facing health consequences due to environmental threats reside in LMICs, though HICs contribute to the problem to a much larger extent. This is a foundational ethical problem: the most vulnerable are the most affected. Women, children, the elderly, marginalized communities, and those suffering from mental disorders—more broadly, LMICs—are feeling these pressures sooner and more intensely than HICs. Improving health for vulnerable people is a goal that is foundational to nursing.

Health System Resilience

A green economy and health system are not only necessary but economically viable. The shift toward clean energy and the sustainable use of life-giving resources and systems would bring benefits to the world and

the United States. Clean energy can create competitive advantage and create jobs: China, for instance, is the world's leading producer of renewable energy, with double the generation of the United States (Forsythe, 2017). These changes can result in improved health and other financial savings. Broad agreement among countries in the Paris Climate Agreement (with the notable exceptions of Syria, Nicaragua, and the United States) indicates growing understanding of the importance of this issue (United Nations Framework Convention on Climate Change [UNFCCC], n.d.). Some economic models indicate that countries can experience a net gain in economic terms from almost all actions needed to meet the Paris Climate Agreement's global warming limit of no more than 2°C above pre-industrial levels (Green, 2015).

Hallmarks of health system resiliency include “the capacity of health actors, institutions, and populations to prepare for and effectively respond to crises; maintain core functions when a crisis hits; and, informed by lessons learned during the crisis, re-organize if conditions require it” (Kruk, Myers, Varpilah, & Dahn, 2015, p. 1910). Models of resiliency provide a framework for the design and implementation of the healthcare system, given anticipated planetary health stresses. The healthcare workforce, especially nurses and midwives, are central to this framework of resilient and strengthened health systems. The opportunity is significant, with employment in the health sector viewed as counterforce to the world's growing inequalities in income (Chan, 2015).

As ecosystem-stress-induced changes occur, health systems need to anticipate and plan for them (e.g., see **Figure S2**). Questions to ask include how intersectoral your health system is (e.g., does it work closely with health departments?); how well defined and reachable and teachable are the patients in the health system catchment area (e.g., can older or chronically ill patients who might need cooling center support during a heatwave be mobilized?); and how might some of the coming changes look in daily work life in health systems? Nurses as leaders should consider their own health system settings for each of the direct, indirect, and ecosystem-mediated health factors, outline impacts, and develop anticipatory plans (Crimmins et al., 2016).

Nurses can lead local and regional adaptation efforts, partnering with local decision makers in the identification of at-risk populations, the creation of emergency plans, and monitoring. In the clinical environment, as well as in community health roles, nurses provide direct guidance to patients and families. Nurses manage and prepare health facilities and can lead efforts to anticipate surges in demand in emergency departments and outpatient facilities, as well as to make emergency action plans to develop ready access to generators and

emergency transport (Sayre, Rhazi, Carpenter, & Hughes, 2010).

Nurses and midwives can lead efforts for sustainability in the healthcare industry as well, identifying and encouraging sustainable practices within their practice domains and hospitals (e.g., Healthier Hospitals Initiative, Global Green and Healthy Hospitals, Health Care Without Harm, Alliance of Nurses for Healthy Environments). Sattler has written on nurses' leadership in lessening the significant ecological footprint of medical centers and the establishment of nurse-led "green teams" (Choiniere, 2011). Improvements in efficiency of food service (less meat, locally sourced), waste management (reduce-reuse-recycle or incineration alternatives), or transportation (avoidance of unnecessary trips, use of local suppliers) by leadership of nurses and midwives in local health systems can be effective (Sayre et al., 2010). Finally, accrediting bodies could significantly encourage widespread adoption by incorporating these standards in their review work.

Within a resilient healthcare system, individual actors themselves also must develop resiliency. Resilient nurses (International Council of Nurses, 2016) possess adaptability, confidence, purposefulness, and social support (Cooper, 2012). Nurses and midwives take care of the health system, but also need to take care of themselves, before, during, and after health crises.

Though planetary health as a multidisciplinary area of research is relatively new, nursing has been thinking about and leading in this area generally (see **Table S1**). Environmental nursing offers an important legacy, though planetary health issues are now broader than health solely in one's workplace or immediate environs.

The powerful Precautionary Principle from the American Nurses Association (ANA) "challenges nurses to protect those who are most vulnerable, those who are least powerful, and those who are the earth's future generations" (ANA, 2007, p. 19). The current mode of thinking about environmental matters asks, "How much harm is allowable?" but the precautionary approach asks to consider instead, "How can we meet our goals in the least harmful way? How can we protect public health and the environment?" (ANA, 2003).

A Call to Action

It falls to nurses and midwives, the most numerous and arguably most patient-centered component of the health workforce, to assume a leadership role in addressing planetary health. Leadership begins with educating ourselves, students, staff, patients, and communities. Engagement in political and policy processes are

needed—and can take many forms. Even small measures may have impact. Local level sustainability and readiness is meaningful at one's university, hospital, and or health system levels.

- Learning—and teaching—about planetary health is a key productive action. The collective changes possible with law and policy changes—in short, better governance—are necessary to limit further harm.
- Communication about planetary health matters requires special care to keep emotions even keeled and avoid an apocalyptic focus. Just as gain-framed messages are demonstrably more effective in health prevention strategies for individuals, prevention in the planetary health domain can include emphasis on improved economies, jobs, population health, and social justice.
- Finding common ground (leveraging beliefs, telling personal stories; see Figure S3) with an audience improves message receptivity. New research indicates "that it is possible to pre-emptively protect ('inoculate') public attitudes about climate change against real-world misinformation" (van der Linden, Leiserowitz, Rosenthal, & Maibach, 2017, p. 1). Nurses in educational, community, and clinical leadership roles can provide listeners with information about the nature of disinformation campaigns and why certain parties seek to confuse their audiences. This is the sort of health promotion ("inoculation") work in which nurses and midwives excel.
- The formal and continuing education of nurses and midwives must keep pace with the changing conditions, evolving science, and higher levels of engagement from populations and patients in planetary health matters. Medical and public health curricula have made shifts to include climate change and health matters. Nursing curricula are arriving: the Global Consortium on Climate and Health Education (n.d.), a collaborative of nursing, public health, and medical schools formed in 2017, is developing interprofessional curricula on climate change and health.
- Survey data show that Americans are concerned about global warming. A Yale survey in late 2016 shows the proportion of Americans "alarmed" about climate change has grown, and the proportion of "dismissives" has shrunk, such that alarmed individuals are now double the number of dismissives (see Figure S4; Yale Program on Climate Change Communication, 2016).
- Green technology is an economic growth area. Economies based on wisely used, sustainable, and renewable sources of energy appear ready to thrive. Fossil fuel availability will peak then decline, creating potential market gaps for prepared leaders and nations

to lead the green energy transition, enhancing the resiliency of cities, and making food and water systems sustainable. Embracing a planetary health mindset can challenge, renew, and unite us.

- Pay attention to what narratives and stories we tell ourselves: “If we don’t transition quickly to a sustainable way of life, humanity is doomed!” or rather, “We are transitioning to a more sustainable and resilient way of life that will offer tremendous benefits to humanity” (Frumkin, 2017; Hunter, Frumkin, & Jha, 2017).

Nurses are essential to every solution that will improve the health of the planet, with implications for the development and use of the global healthcare workforce, for research, and for practice. Nurses help plan and build resilient health systems, but in order to develop health beyond health care, nurses must move into expanded roles, working with other sectors and individuals, to support the development of resilient communities.

The science, techniques, and interventions useful in patient-level health promotion are uniquely understood by nurses and midwives. These selfsame tools can inspire and illuminate health promotion of the planet and the critical systems on which human existence depends. Safeguarding human health requires a healthy planet. The changes we make as individuals are useful, though as trusted clinicians, scholars, and leaders, those changes also can inspire and educate others (Whitmee et al., 2015). The magnitude of our jewel of a planet’s health crisis is enormous. But the timeliness, impact, and scale of the solutions that nurses and midwives will muster could evince the very best of our professional—and human—potential.

Clinical Resources

- Health Care Without Harm. <https://www.noharm.org/>
- Alliance of Nurses for Healthy Environments. <http://www.envirn.org>

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher’s web site:

Figure S1. Planetary health effects. Reproduced by permission of the WHO from Millennium Ecosystem Assessment (2005).

Figure S2. Climate change and how health systems might respond (adapted from Crimmins et al., 2016).

Figure S3. Communicating about planetary health (adapted from van der Linden, Maibach, Leiserowitz, 2015).

Figure S4. Survey data, Yale program on climate change communication, 2016.

Table S1. Policy Statements on Environment, Resilience

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SPECIAL ISSUE ARTICLES

Climate Change, Climate Justice, and Environmental Health: Implications for the Nursing Profession

Patrice K. Nicholas, DNSc, DHL(Hon.), MPH, MS, RN, ANP, FAAN¹, & Suellen Breakey, PhD, RN²

¹ Director, Global Health and Academic Partnerships, Brigham and Women's Hospital, Division of Global Health Equity and Center for Nursing Excellence, and Professor, MGH Institute of Health Professions School of Nursing, Boston, MA, USA

² Assistant Professor, MGH Institute of Health Professions School of Nursing, Boston, MA, USA

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Climate change, climate justice, environmental health, global warming, health policy, social justice

Correspondence

Dr. Patrice K. Nicholas, MGH Institute of Health Professions - Graduate Program in Nursing, 36 1st Ave., Boston, MA 02129. E-mail: Nicholas.patrice@mgh.harvard.edu

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Abstract

Purpose: Climate change is an emerging challenge linked to negative outcomes for the environment and human health. Since the 1960s, there has been a growing recognition of the need to address climate change and the impact of greenhouse gas emissions implicated in the warming of our planet. There are also deleterious health outcomes linked to complex climate changes that are emerging in the 21st century. This article addresses the social justice issues associated with climate change and human health and discussion of climate justice.

Organizing Construct: Discussion paper.

Methods: A literature search of electronic databases was conducted for articles, texts, and documents related to climate change, climate justice, and human health.

Findings: The literature suggests that those who contribute least to global warming are those who will disproportionately be affected by the negative health outcomes of climate change. The concept of climate justice and the role of the Mary Robinson Foundation—Climate Justice are discussed within a framework of nursing's professional responsibility and the importance of social justice for the world's people. The nursing profession must take a leadership role in engaging in policy and advocacy discussions in addressing the looming problems associated with climate change.

Conclusions: Nursing organizations have adopted resolutions and engaged in leadership roles to address climate change at the local, regional, national, and global level. It is essential that nurses embrace concepts related to social justice and engage in the policy debate regarding the deleterious effects on human health related to global warming and climate change. Nursing's commitment to social justice offers an opportunity to offer significant global leadership in addressing the health implications related to climate change.

Clinical Relevance: Recognizing the negative impacts of climate change on well-being and the underlying socioeconomic reasons for their disproportionate and inequitable distribution can expand and optimize the profession's role in education, practice, research, and policy-making efforts to address climate change.

Climate change represents an urgent global health and environmental health challenge that requires the engagement, advocacy, and leadership of the nursing profession to mitigate the health effects on the world's people.

As Lemery, Williams, and Farmer (2014) note regarding climate change and its deleterious impact on our global community:

The people who will suffer most are those who were most vulnerable to begin with, living in regions of the world with perilous human security, pervasive poverty, little fulfillment of human rights, geographic disadvantage, and contributing the least to greenhouse gas emissions. It is in these places that the threat-multiplying effects of climate change will denigrate human dignity, health, and potential the most. It is in these same disadvantaged settings that fragile health systems are least able to cope with the increased demands they will face. (p. 2)

In 1992, the World Health Organization (WHO) developed a report, *Our Planet, Our Health: Report of the WHO Commission on Health and the Environment*. This report suggested that environmental health is linked with human health, quality of life, and physical, chemical, biological, and social as well as psychological problems in the environment; environmental health is aimed at addressing the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially adversely affect the health conditions of current and future populations. More recently, the WHO (2012) noted that there is overwhelming evidence linking human activities to climate change, which in turn has serious implications for public and environmental health. Globally, the nursing profession has a leading policy and advocacy role in addressing the sequelae of climate change due to extreme weather events, climatic changes that affect food and water supplies, and ecosystem changes. The WHO (2012) notes that climate and weather have a serious impact on health. As a result, increased deaths in heat waves and in natural disasters as a result of more volatile weather patterns, as well as changing patterns of life-threatening vector-borne diseases such as malaria, are occurring. In addition, these changes have increased the prevalence of existing and emerging infectious diseases.

Climate change is well known to adversely affect the social and environmental determinants of health—particularly access to food, clean air, and water. Nightingale's (1859) prescient views on the importance of pure air, water, light, drainage, and cleanliness are as important in the 21st century as when her ideas were first introduced in *Notes on Nursing* over 150 years ago. Most notably, Nightingale understood that areas with weak health infrastructure and areas of conflict were particularly vulnerable to negative health consequences. In our contemporary global community, we are witnessing the negative sequelae of the anthropogenic effects of greenhouse gas emissions and resulting global warming. Moreover, as Levy and Patz (2015) note, "climate change—the global climate crisis—may be the defining moral

issue of the 21st century" (p. 311). Thus, the purpose of this article is to summarize selected nursing policy positions on climate change and climate justice and examine the role of nursing in developing a climate justice agenda.

From a nursing perspective, leading nurse experts have discussed the essential role of nurses in addressing climate change. Goodman (2013) urged that nurses must engage in a personal commitment to environmental issues and further the understanding of climate change and its health consequences. Anåker, Nilsson, Holmner, and Elf (2015), in a qualitative study examining nurses' perceptions of climate change and their role in sustainable development, found that there is an incongruence between climate and environmental issues and nurses' daily work; and that public health work is regarded as a health co-benefit of climate change mitigation and is an important role for all nursing professionals.

Overview of Climate Change

Environmental and Health Consequences of Climate Change

The WHO (2014a, 2014b) estimated that climate change is expected to cause approximately 250,000 additional deaths per year between 2030 and 2050: 38,000 due to heat exposure in elderly people; 48,000 due to diarrheal disease; 60,000 due to malaria; and 95,000 due to childhood undernutrition. Additional negative outcomes include unintentional injuries related to coastal and inland flooding, droughts, and fires, with the greatest areas impacted in resource-limited countries. The health impacts of climate change occur in several key areas: exposure to temperature extremes; extreme weather events and related disasters; the effects of air pollution; lack of access to food and water; vector-borne and zoonotic diseases; and ozone depletion. The resulting deleterious effects are detrimental to the social, economic, and health circumstances of populations worldwide. The Intergovernmental Panel on Climate Change (IPCC, 2007a, 2007b, 2007c, 2007d) projected that the future burden of disease related to climate change will include increases in diarrheal diseases and malnutrition as global warming affects access to clean water and less available arable land. Vector-borne diseases such as malaria, dengue, and Zika are sensitive to climate change and are expected to increase in tropical areas. The effects of air pollution are a major health threat in numerous countries and are directly linked to deleterious effects on cardiac and respiratory health.

With regard to exposure to temperature extremes, the most vulnerable, including the young, elderly, and those living in areas of the world without the ability to mitigate the effects of extreme high or low temperatures, are disproportionately affected. Extreme weather events, including floods, droughts, fires, hurricanes, typhoons, and severe storms, have increased due to climate change and global warming. These disasters lead to health-related consequences for communities worldwide; namely access to food and water, one of the most fundamental human needs, has been critically impacted by global warming and climate change. In addition, droughts and lack of access to water have affected the ability to support agriculture and livestock farming. Salt water intrusion poses an enormous threat for island nations and coastal communities, while communities along rivers also struggle with water intrusion worldwide. These critical problems leave communities struggling to support their populations and are linked with conflict and war globally. **Table 1** presents an overview of health concerns related to climate change developed by the Canadian Nurses Association (Canadian Nurses Association [CAN], 2008a, 2008b).

The Political Landscape of Climate Change

Climate change emerged as a concern in the 1960s, when greenhouse gases were found to contribute to air pollution and warming of the planet, and were linked to negative sequelae for human health. On December 12, 2015, the parties to the United Nations (UN) Framework Convention on Climate Change (UNFCCC) attending the UN Climate Change Conference in Paris reached a landmark agreement in the two decade-long efforts to address global climate change. The agreement, known as the 21st session of the UNFCCC Conference of the Parties or COP 21, was reached with the presence of 150 presidents and prime ministers—the largest ever gathering of heads of state in Paris. The Paris Agreement was the most recent step in the evolution of the UN's role in climate change, which began in 1992 with the adoption of the Climate Change Framework Convention. Subsequently, in 1997, the Kyoto Protocol was developed and included binding emissions targets for developed countries; however, several countries, including the United States, did not sign on to binding emissions. In 2009, the Copenhagen Accord, and in 2010, the Cancun Agreements were promulgated. Thus, progress was made toward wider participation of countries in setting binding targets to keep average warming no more than 2°C above pre-industrial levels. The Durban Platform for Enhanced Action in 2011 led to further progress toward the

Table 1. Health Concerns Related to Climate Change

Health concern	Examples of health vulnerabilities
Temperature-related morbidity and mortality	Cold and heat-related illness Respiratory and cardiovascular illness Increased occupational health risks
Effects of extreme weather events	Damage to public health infrastructure Injuries and illnesses Social and mental health stress due to disasters Occupational health hazards Population displacement
Effects related to air pollution	Exposure to outdoor and indoor air pollutants and allergens Asthma and other respiratory diseases Heart attack, stroke and other cardiovascular diseases Cancer
Effects of water- and food-borne contamination	Diarrhea and intoxication caused by chemical and biological contaminants
Effects of exposure to ultraviolet rays	Skin damage and skin cancer Cataracts Disturbed immune function
Population vulnerabilities in rural and urban communities	Seniors Children Chronically ill people Low-income and homeless people Northern residents (Canadian north area) Disabled people People living on the land
Socio-economic impacts on community health and well-being	Loss of income and productivity Social disruption Diminished quality of life Increased costs for health care Health effects of mitigation technologies

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achievements made in Paris in 2015. A subsequent meeting in Warsaw sought to hold nations accountable for achievable goals to reduce global warming prior to the Paris conference. The outcomes of the Paris Agreement reaffirm the goal of keeping average warming below 2°C, while also urging countries to pursue efforts to limit at 1.5°C—a more ambitious goal that would further limit the vulnerability to climate

impacts of developing countries. The Paris Agreement also articulates two long-term emission goals: first, that all parties acknowledge a peaking of emissions as soon as possible; and second that a goal of net greenhouse gas neutrality be achieved. Unfortunately, U.S. President Donald Trump announced in January 2017 that the US would be withdrawing from the Paris Climate Agreement—one of only three countries that include the US, Syria, and Nicaragua—who will not abide by the agreement.

What Is Climate Justice?

Climate justice is a concept that refers to the ethical and human rights issues that occur as a result of climate change. The issues of justice—particularly social justice, environmental justice, and advocacy—are integrally linked to the movement to address climate change. Inherent in the concept of climate justice is the recognition that those least responsible for climate change experience the greatest negative impacts to their well-being. Lindley et al. (2011) noted that the impact of extreme climate events is not limited to loss of life, loss of income and property, and deleterious health consequences. They identify “important losses in central dimensions of well-being in themselves” (p.7), such as disruption of children’s education, loss of control of daily routines, and irreplaceable loss of memorabilia, that when not taken into consideration results in a serious underestimation of the loss of well-being in the broader sense.

As Preston et al. (2014) contend, vulnerability to negative impacts of climate change is unequally distributed and is influenced by a combination of personal (e.g., age, health status), social (gender, income, strength of social networks), and environmental factors. Moreover, they point out that those who are most vulnerable tend to have limited or no voice in policy decisions and pay more proportionally to implement policies that outline adaptive and mitigation strategies (Preston et al., 2014). This notion applies to people and places globally. While it is clear that the well-being of those living in resource-challenged countries is negatively affected by climate change, it is equally important to note that people and communities in resource-rich countries, for example, tribal communities and communities of color, are also vulnerable (Cleetus, 2015). Assessing for and understanding the nature of the vulnerabilities to climate change and extreme weather events as they relate to specific populations is essential to create socially just policies, which acknowledge and give voice to the most vulnerable (Preston et al., 2014) and strengthen climate resilience in vulnerable communities (Cleetus, 2015).

Mary Robinson Foundation—Climate Justice

Mary Robinson, former President of the Republic of Ireland from 1990 to 1997 and former UN High Commissioner for Human Rights from 1997 to 2002, launched global efforts to address the warming of the planet and the impact of climate change on health, development, and global communities. The vision of the Mary Roberson Foundation—Climate Justice (MRF CJ) is to engage in a people-centered, developmental approach, the bases for which are global justice and equity, to advance climate justice and effectively address the impact of climate change (MRF CJ, n.d.). The MRF CJ focuses on three key areas: human rights and climate change, women’s leadership on gender and climate change, and future generations. These areas are uniquely addressed by the foundation through the following activities.

Human rights and climate change. The MRF CJ suggests that energy is fundamental to achieving development goals related to poverty, health outcomes, and increased productivity and economic growth. This goal aims to achieve stabilization in climate change by addressing the impacts of climate change and the outcomes related to poverty, deleterious effects on health, and reduction in economic growth. These challenges are already occurring in many global areas due to warming of the planet, lack of access to water, and other negative outcomes. Global policies that are aimed at climate stabilization and increased access to sustainable energy are urgently needed so that the burden and benefits of our climate are shared equitably. The nursing profession should engage in efforts to advocate for sustainable energy and energy conservation. Increased emphasis on nursing’s role in becoming involved in and supporting conservation and energy sustainability is urgently needed.

Equity and climate justice. Equity and climate justice are inherently linked in considering how resource-rich countries profoundly impact climate change, while resource-poor countries disproportionately bear the burden and health consequences. Poverty, disenfranchisement, and gender are issues that we must confront and that the nursing profession is committed to on behalf of the world’s people and in seeking justice regarding climate change. Given the inter-relationship between health, equity, and the impacts of climate change, achieving global health equity requires that the nursing profession engage in seeking climate justice.

A major area of equity that the MRF CJ addresses is the basic human right to sufficient food for the world’s people. The foundation notes that current food production systems are not sustainable for the 21st century and

beyond. Food and nutrition security are addressed as critical in mitigation and adaptation to climate change and at the heart of equity and climate justice. The Foundation believes addressing climate change and achieving sustainability in the global food system must be recognized as dual imperatives (MRFCJ, n.d.).

Women’s leadership on gender and climate change. Women and young girls are disproportionately burdened by climate change, in large part because their basic human rights continue to be denied. Therefore, gender issues and gender equality are inextricably linking to climate justice. A recent WHO (2014a) document, “Gender, Climate Change, and Health,” discusses the evidence that many of the negative health consequences related to climate change show these gender differentials. In many societies, women and girls are responsible for providing food and obtaining water for the family. As such, a greater proportion of women and girls die as a result of extreme weather events and suffer from nutritional deficiencies and health burdens associated with traveling to fetch water than do men. Additionally, an increasing lack of access to water as a result of drought conditions necessitate lead girls to travel further distances to obtain potable water, which prevents them from going to school and obtaining an education.

The MRFCJ recognizes that women must be better represented in policy decision making related to climate change to insure that these policies are gender sensitive. Therefore, the Foundation’s work is focused on strengthening women’s leadership roles in climate justice discussions. The nursing profession has served as a vocal advocate of the issues of women throughout its history as well as in our contemporary society and should continue to advance the health and well-being of women and girls globally.

Future generations. The final focus of the work of the MRFCJ is the recognition and promotion of the principle of intergenerational equity, the idea that the action or inaction of the current generation can jeopardize the rights and well-being of future generations. Specific strategies were proposed: to create a UN institutional body whose main role would be to speak for future generations to ensure that welfare of those yet to be born is taken into consideration in future policy decisions and to avoid “myopic policy making” (MRFCJ, n.d.); to strengthen youth participation and ensure that youth from both resource-rich and resource-challenged countries are included; and that the concept of intergenerational equity is considered in all efforts since it is consistent with a climate justice approach linking human

Table 2. Mary Robinson Foundation—Climate Justice (n.d.)

Respect and protect human rights
Support the right to development
Share benefits and burdens equitably
Ensure that decisions on climate change are participatory, transparent and accountable
Highlight gender equality and equity
Harness the transformative power of education for climate stewardship
Use effective partnerships to secure climate justice

rights and development to safeguard the rights of the most vulnerable and sharing the burdens and benefits of climate change (MRFCJ, 2013). It is essential that efforts include the effective participation of young people—including our millennial generation of nurses—and engage their contributions to climate policy decision making and analyses of the health issues that are occurring due to climate change.

MRFCJ Principles of Climate Justice

The MRFCJ identified seven key principles of climate justice that have relevance for our global society and the nursing profession (MRFCJ, n.d.; **Table 2**). The principles of the MRFCJ provide a framework for the discussion of potential strategies to address climate injustice and advance the rights of global populations who are disproportionately affected by climate change. These principles can inform and advance the profession’s efforts to advocate for those affected by climate change. Specifically, their implications for health policy and for nursing’s response to the injustices associated with climate change are explored.

Principle One: Respect and protect human rights. The first principle focuses on advancing respect and protection of human rights. This principle is also embedded in the American Nurses Association (ANA, 2015) “Code of Ethics for Nurses with Interpretive Statements,” CNA (2008a) “Code of Ethics for Registered Nurses,” and the International Council of Nurses (2012) “Codes of Ethics for Nurses,” among others. Thus, the principle on advancing respect and human rights related to climate justice promulgated by the MRFCJ is an extension of a principle addressed globally by the nursing profession. The challenges that have emerged due to climate change pose new opportunities to address the environmental health issues that are occurring and which may limit human rights of the disenfranchised. Case in point: an increase in vector-borne illnesses due to climate change already poses health challenges that disproportionately affect the most poor. The increase

in chikungunya, which has now emerged in areas of the world where this mosquito-borne illness was never prevalent, is one example. An increase in malaria prevalence globally also is a growing challenge due to increases in mosquito-borne illness due to climate change. Most recently, the emergence of the Zika virus which is spread to people primarily through the bite of an infected *Aedes aegypti* species mosquito, has become a major public health challenge. Zika virus has evolved into a major health concern for women and neonates related to negative pregnancy outcomes, including neonatal microcephaly and other brain abnormalities. Recently both the Pan American Health Organization (PAHO, 2016) and the Centers for Disease Control and Prevention (CDC, 2016) have issued alerts regarding women and pregnancy due to dramatic increases in these negative birth outcomes—with the spread of the mosquito as a vector that may also be linked with climate change.

A second challenge that poses an enormous threat to human rights is the loss of arable land due to droughts and warming of the planet and the resultant lack of access to food and nutrition. A National Public Radio (2013) broadcast addressed the challenges of drought and food insecurity as a critical factor in the emergence of conflict and war in Syria's disenfranchised farming populations. Subsequently, farmers relocated to cities in Syria where lack of opportunity fueled both the Syrian conflict and the current migrant crisis across Europe. From a social justice perspective again, those least responsible for climate change were disproportionately affected and subsequently dislocated from homes and their livelihood and continue to suffer immeasurably.

Principle 2: Support the right to development.

The second principle urges support for the right to development and the intersection with climate justice. As the MRFCJ (n.d.) suggests:

The vast gulf in resources between rich and poor, evident in the gap between countries in the North and South and also within many countries (both North and South) is the deepest injustice of our age. This failure of resource-fairness makes it impossible for billions of humans to lead decent lives, the sort of life-opportunities that a commitment to true equality should make an absolute essential.

There are numerous nursing organizations that engage in the critical dialogue regarding global and public health issues, including the Honor Society of Nursing, Sigma Theta Tau International; the ANA; the CNA; and the International Council of Nurses, as well as the broader

efforts of the American Public Health Association, Physicians for Social Responsibility, the UN, and the WHO. More recently, religious leaders such as Pope Francis of the Roman Catholic Church have entered into the dialogue related to climate change. In his 2015 encyclical on the environment, *Laudato Si*, Pope Francis urges that humanity address the destruction to the environment and the world's people and the broad implications related to the burgeoning demands due to environmental degradation.

Third Principle: Share benefits and burdens equitably.

The third principle aims to share burdens and benefits of climate change and climate justice. For example, the populations of Africa are disproportionately affected by climate shifts and lack of access to water. As previously mentioned, this problem also affects the ability of women and girls to access educational opportunities, further burdening their societies and the health of families and communities. The impact of hurricanes, typhoons, floods, and droughts poses looming threats to the health of the world's populations. Flooding poses both emergency health consequences and long-term health threats as evidenced by Hurricane Katrina in New Orleans and recent flooding and typhoons in the Philippines, as examples. Island nations are well known to be at great risk due to salt water intrusion, which affects agriculture and other aspects of daily life. These environmental health disasters and challenges disproportionately affect the poor, vulnerable, and disenfranchised.

Fourth Principle: Ensure that decisions on climate change are participatory, transparent, and accountable.

The fourth principle of the MRFCJ aims to ensure that decisions on climate change are participatory, transparent, and accountable. The nursing profession can engage in this important effort by promulgating white papers and position statements about nursing's health policy work related to climate change. Nursing has a vital role in advancing the health of the world's people. When considering the future needs and health challenges of our global community and future generations, the profession must explicitly recognize climate change and identify and articulate its deleterious effects on human health and well-being. There are many areas of the world, for example, where environmental pollution from greenhouse gases is the leading cause of respiratory ailments and cardiovascular health issues. Nurses, who represent the largest group of healthcare workers worldwide, see these effects firsthand, often among those most vulnerable, such as the poor, young, elderly, or female, whose circumstances are often not considered in policy decisions. Nurses are in a key position to contribute to

just policy making by lending voice to those who suffer these inequities. In the 21st century and beyond, if climate change is not addressed in a participatory manner, then these health issues will continue to threaten the vast majority of the world's people, but particularly the most vulnerable—the poor, the young, and the elderly.

Principle Five: Highlight gender equality and equity. The fifth principle addresses the importance of gender equality and equity. Similar to the UN Millennium Development Goal 3: Promote Gender Equality and Empower Women, this principle links the lack of equality of women with the evolving challenges related to climate change and climate justice. According to the environmental website, Ecowatch (2015), since 2010, 20 million of the 26 million people worldwide who have been displaced by the effects of climate change are women and girls, who also make up the greatest percentage of the world's poor. Climate change is also leading to food insecurity and both undernutrition and obesity due to unhealthy food availability, thus contributing to increased rates of diabetes, cardiovascular disease, and other health issues. Further, Ecowatch (2015) noted that women farm 60% to 80% of household food in resource-limited countries where extreme climate conditions have led to lack of water and shortages of crops. However, although women continue to be disproportionately affected, they have the potential to be agents of change to address climate change. UN studies have demonstrated that strategies to mitigate or adapt to the effects of climate change are not successful without the support of women (Ecowatch, 2015). To that end, the MRFCJ seeks to strengthen women's leadership skills to optimize their role in achieving climate justice.

Principle Six: Harness the transformative power of education for climate stewardship. The sixth principle addresses the importance of harnessing the transformative power of education for climate stewardship. For the nursing profession, a collective response must be embraced to include climate justice, climate change, and climate stewardship as challenges for environmental and community health. These concepts, as well as health outcomes resulting from climate change, should be introduced into the curriculum at all levels of nursing education from baccalaureate through doctoral studies. Service opportunities locally, nationally, and internationally should introduce students, faculty, and practicing nurses to the challenges related to climate injustices and the various roles nurses can play in climate stewardship. Education and awareness are the essential

Table 3. United Nations Sustainable Development Goals

Goal 1: No poverty
Goal 2: Zero hunger
Goal 3: Good health and well-being
Goal 4: Quality education
Goal 5: Gender equality
Goal 6: Clean water and sanitation
Goal 7: Affordable and clean energy
Goal 8: Decent work and economic growth
Goal 9: Industry, innovation, and infrastructure
Goal 10: Reduced inequalities
Goal 11: Sustainable cities and communities
Goal 12: Responsible production and consumption
Goal 13: Climate action
Goal 14: Life below water
Goal 15: Life on land
Goal 16: Peace, justice, and strong institutions
Goal 17: Partnerships for the goals

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first steps to increase nursing's role and voice in the development of health policy related to climate change.

Principle Seven: Use effective partnerships to secure climate justice. The seventh principle addresses the urgent need for effective partnerships to secure climate justice. Nursing's global voice should be engaged in these partnerships aimed at securing climate justice. The early nursing leadership of Florence Nightingale, who embraced the environmental factors that affect health, led to the development of her framework that focused on access to clean air, water, light, and cleanliness for environmental health. Nursing organizations globally should embrace the emerging role of the nursing profession in developing effective partnerships and leadership aimed at securing climate justice.

Nursing Leadership in Climate Change, Climate Justice, and Environmental Health

The role of the nursing profession is critical in addressing climate change, climate justice, and environmental health. The public health consequences and well-established negative sequelae related to climate change are evident, and our profession must have a collective call to action. Leadership by nursing organizations has supported engagement with the UN's 17 Sustainable Development Goals (SDGs; UN, 2015), which build upon the earlier UN Millennium Development Goals (MDGs; UN, 2000). The MDGs included the following goals: (a) eradicate extreme poverty and hunger; (b) achieve universal primary education; (c) promote gender equality

Table 4. Canadian Nurses Association (CNA) Position Statement (CNA, 2009): Climate Change and Health and Canadian Nurses Association (CNA) Code of Ethics (CNA, 2008)

Excerpt from the CNA Position Statement (CNA, 2009):

The Canadian Nurses Association (CNA) believes that changes in our climate are occurring worldwide and that nurses have a role in supporting adaptation to and mitigation of climate change through nursing practice, research, administration, education, and policy. The most recent report of the Intergovernmental Panel on Climate Change (IPCC) concluded unequivocally that our climate is changing in response to human activities and that human health is being affected by these changes (IPCC, 2007a, 2007b, 2007c, 2007d).

The CNA *Code of Ethics for Registered Nurses* (CNA, 2008) supports nursing action on climate change:

There are broad aspects of social justice that are associated with health and well-being and that ethical nursing practice addresses. These aspects relate to the need for change in systems and societal structures in order to create greater equity for all. Nurses should endeavor as much as possible, individually and collectively, to advocate for and work toward eliminating social inequities by: . . . vi. Supporting environmental preservation and restoration and advocating for initiatives that reduce environmentally harmful practices in order to promote health and well-being. (p. 20)

CNA believes that Canadian nurses face a very real choice between getting involved now, by promoting climate change adaptation (that is, responding to the effects of climate change) and mitigation (that is, taking action to reduce climate changes), or waiting until the increasingly severe health effects of climate change are felt by the individuals, families and communities with whom they work.

Nurses are uniquely qualified to support adaptation to and mitigation of climate change. They have both the necessary scientific background and the communication skills to explain climate change to the public. Their expertise in health promotion and behaviour change also equips them to foster lifestyle choices, at the individual, family and community level, that support health under changing climatic conditions.

and empower women; (d) reduce childhood mortality; (e) improve maternal mortality; (f) combat HIV/AIDS, malaria, and other diseases; (g) ensure environmental sustainability; and (h) develop a global partnership for development. The aim was to achieve these goals by 2015, and although progress was made, not all goals were fully achieved.

Building on the goals of the MDGs, the SDGs aim to achieve specific targets that will improve the quality of life and well-being of the world's people by the year 2030 (**Table 3**). The SDGs include a specific goal aimed at taking urgent action to combat climate change and its impacts—particularly the impact on health. Other organizations, including the ANA, have adopted resolutions to address policy and advocacy. Patton and Seiple (2008) developed an action report that was submitted to the ANA that addressed the environmental impact on global climate change from anthropogenic causes. They noted that climate change is predicted to place additional demands on healthcare systems in resource-limited and resource-rich environments. Thus, the action report resulted in a resolution from the ANA that the organizations must recognize and acknowledge the health challenges that are unprecedented in human history and the need for nursing advocacy and policy efforts.

Further, the ANA (2007) developed “ANA’s Principles of Environmental Health for Nursing Practice With Implementation Strategies,” the purpose of which was to guide environmentally safe nursing care. These principles examined the role of nursing in environmental health and addressed global climate change and chemical burden with the associated negative health

outcomes. From this work, policy statements for safe environmental practices for nurses and recommendations for coalitions and partnerships were developed. Ten environmental health principles were promulgated based on the tenets of social justice. While critically important, these principles are aimed primarily at extending knowledge of environmental health concepts for nurses, addressing the nurse’s work environment, quality of work life, and the health environment and diversity. These principles represent efforts to address environmental health, embed these principles in nursing practice, and advocate for a healthier environment. However, the larger focus on global climate change and the policy and advocacy roles of nurses in addressing this challenge has been undertaken by other professional organizations.

The CNA has led in efforts regarding nursing’s role in policy and advocacy in addressing climate change and global warming. In the CNA’s 2009 position statement, “Climate Change and Health,” the organization notes that nurses have a role in practice, research, administration, education, and policy to address climate change (**Table 4**). Further, the “CNA Code of Ethics for Registered Nurses” (CNA, 2008a) urges that the nursing profession take action on climate change based on principles of social justice and the association with health and well-being and to address social inequities.

Among the CNA’s recommendations is that nursing must show leadership in addressing their own personal practices to reduce their own contributions to greenhouse gas emissions. Further, the CNA urges that nurses encourage their professional associations to support

policy efforts to reduce greenhouse gases and to work with governmental and nongovernmental organizations to offer support to climate change efforts globally. In 2008, the CNA promulgated a comprehensive report, "The Role of Nurses in Addressing Climate Change" (CNA, 2008a), which encompassed a framework of social justice, the global impact on health related to climate change, and the nursing role in adaptation to climate change and mitigation strategies. The CNA (2009) also endorses the importance of addressing environmental health and the climate by advancing awareness of broader global concerns, including human rights, war, world hunger, issues of women and girls, and pollution.

In summary, the nursing profession must engage in the policy debate regarding the deleterious effects on human health related to global warming and climate change. Nursing's commitment to social justice offers an opportunity to offer significant global leadership in addressing the health implications related to climate change. The nursing profession must address not only the health issues that are increasingly prevalent related to heat-related illnesses, respiratory and cardiovascular problems, malnutrition due to lack of available food, air pollution, and lack of water, but also assume a leading advocacy role regarding this urgent global health issue.

Nursing's policy and leadership roles offer a unique global opportunity for the largest group of health professionals worldwide to expand the profession's influence aimed at mitigating the health effects related to climate change and engaging in individual, community, and population-based efforts to reduce the negative health effects of climate change. Specific examples of leadership and advocacy efforts include efforts in nursing practice, education, research, administration, and policy. In nursing practice, advocating for products, technology, and practices that support a healthy environment, while focusing on recyclable materials, environmentally supportive disposal, and limiting negative sequelae for patients and healthcare providers. In nursing education, it is critical to integrate knowledge of environmental health concepts and offer content in baccalaureate and graduate education regarding global climate change and associated negative health outcomes and the policy and advocacy role of nursing worldwide. Nursing research must focus on investigating and documenting the link between climatic conditions and negative health outcomes as well as nursing efforts aimed at mitigation and adaptation to the health effects of climate change. Nursing administration should engage in local, regional, national, and global efforts to support environmentally friendly practices in healthcare organizations and proactively consider the role of nursing in the complex health

problems and prevention, education, and care of patients dealing with health challenges related to climate change. Thus, the nursing profession is positioned to lead in policy and advocacy efforts worldwide to address global climate change, human health, and the future of the world's people.

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Farmworker Vulnerability to Heat Hazards: A Conceptual Framework

Valerie Vi Thien Mac, RN, PhD¹, & Linda A. McCauley, RN, PhD, FAAN, FAAOHN²

¹ Postdoctoral Fellow, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, GA, USA

² Dean and Professor, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, GA, USA

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Correspondence

Dr. Valerie Mac, Nell Hodgson Woodruff School of Nursing, Emory University, 1520 Clifton Rd NE, Atlanta, GA 30322. E-mail: valerie.mac@emory.edu

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Abstract

Purpose: To review factors that impact the effect of hot environments on the human body in order to develop a conceptual model of human biological response.

Methods: The organizing concept for the model development was the multilevel integration of three major factors, exposure to heat, sensitivity and adaptive capacity, and the heat stress response. Exposure of a vulnerable occupational group was used to illustrate the components of the model.

Findings: Components of this framework include the hazard (environmental heat stress), vulnerability factors (workplace exposure, sensitivity and adaptive capacity), and the heat stress response. The combination of the vulnerability factors of workplace exposure (work intensity, duration), sensitivity (age, gender, etc.), and adaptive capacity (hydration, clothing, work hygiene) mediate a worker's heat stress response to the hazard. A worker's heat stress response can be classified as progressing towards two outcomes: physiologic equilibrium or physiologic disequilibrium.

Conclusions: This framework provides a starting point for the design and development of studies of heat-related illness (HRI) in farmworker and other vulnerable populations exposed to rising global temperatures.

Clinical Relevance: Identification of vulnerability factors to HRI, informs research designs which will lead to the development of public health interventions.

Now and in the future, global climate change will continue to be a persistent public health threat affecting all living spaces, including those where we live and work. Escalating trends in global warming place vulnerable worker populations at increased risk for heat-related illness (HRI; Lundgren, Kuklane, Chuansi, & Holmer, 2013; Roelofs & Wegman, 2014). HRI occurs when the body's innate compensatory mechanisms for combating heat stress are overpowered, leading to thermoregulatory imbalance. Agricultural workers are highly susceptible to heat stress and HRI, given routine occupational exposure to hot, humid, environments in which they have little opportunity to protect themselves. Every year agricultural workers continue to experience heat-related deaths. In 2016, Jean Francois Alcime of Immokalee, Florida, after exhibiting signs of HRI since earlier that day, died on the 2-hr return bus ride from the fields, the usual mode of

transportation for crop workers for the farms in Collier County (Perez, 2016). During the years between 2000 and 2009, an examination of observed annual record high maximum and record low minimum daily temperatures across the United States indicated that there were nearly twice as many daily record high temperatures as daily record low temperatures, and temperature models predict increasing ratios of record highs to record lows (Meehl, Tebaldi, Walton, Easterling, & McDaniel, 2009).

Several decades of research have examined physiologic responses to nonfatal heat strain in the general public (Schaffer, Muscatello, Broome, Corbett, & Smith, 2012; Semenza et al., 1996), athletes (Webborn, Price, Castle, & Goosey-Tolfrey, 2005), firefighters (McLellan & Selkirk, 2006), and military personnel (Sawka et al., 2001; Sawka, Young, Francesconi, Muza, & Pandolf, 1985; Sawka et al., 1992). Despite the history of research centered on other

Table 1. Heat stress response components defined

Key definitions
<p>Heat-related Illness (HRI) Symptoms – The clinical manifestations of heat-related illness that occur along a cascade from mild to critical that may include excessive sweating, cramps, headache, edema, fatigue, dizziness, fainting, nausea and vomiting (Becker & Stewart, 2011; Glazer, 2005; Jackson & Rosenberg, 2010).</p>
<p>Core body temperature (T_c) – The dynamic temperature of the vital organs in the body considered to be most accurate in the pulmonary artery (Bregelmann, 1987), but most accurately measured in field-based settings via the gastrointestinal tract (Byrne & Lim, 2007).</p>
<p>Physiological Strain Index (PSI) – The degree to which the body is unable to maintain core temperature prescribed by the hypothalamus described on a universal scale of 0–10 based upon heart rate and rectal temperature (T_{re}) (Moran, Shitzer, & Pandolf, 1998).</p>

groups, heat stress remains an understudied but important occupational hazard for agricultural workers (Flocks et al., 2013). Recently work has begun to characterize HRI in farmworkers utilizing surveys (Bethel & Harger, 2014; Fleischer et al., 2013; Mirabelli et al., 2010; Spector, Krenz, & Blank, 2015), analyses of a longitudinal database of visit records from community and migrant health centers (C/MHCs; Cooper et al., 2014; Zhang, Arauz, Chen, & Cooper, 2016), and field-based continuous biomonitoring (Hertzberg et al., 2017; Mac et al., 2017). Research exploring the relationship between personal physiologic factors and outdoor work in agricultural settings has the potential to advance the state of the science for climate adaptation, specifically human physiologic responses to environmental heat.

Given the complexity of the response of the human body to the exogenous factor of increasing environmental heat, models are needed to promote our understanding of the vulnerability and physiologic response. In this article, we propose a framework that can serve as a guide for nurses engaging in research, policy, and action in this vital area of public health. We first identify the inputs, mediators, and resulting outputs of this delicate system (Table 1), followed by an exploration of exemplars, and conclude with a discussion examining the dynamic functioning and application of this framework.

Framework Components

A framework describing the factors surrounding heat stress in farmworkers needs to conceptualize the physiologic processes occurring internally via the body’s attempt to maintain equilibrium in relation to heat stress sources and moderating factors. Romero-Lankao and Qin, building on others’ earlier work (Ionescu, Klein, Hinkle, Kavi

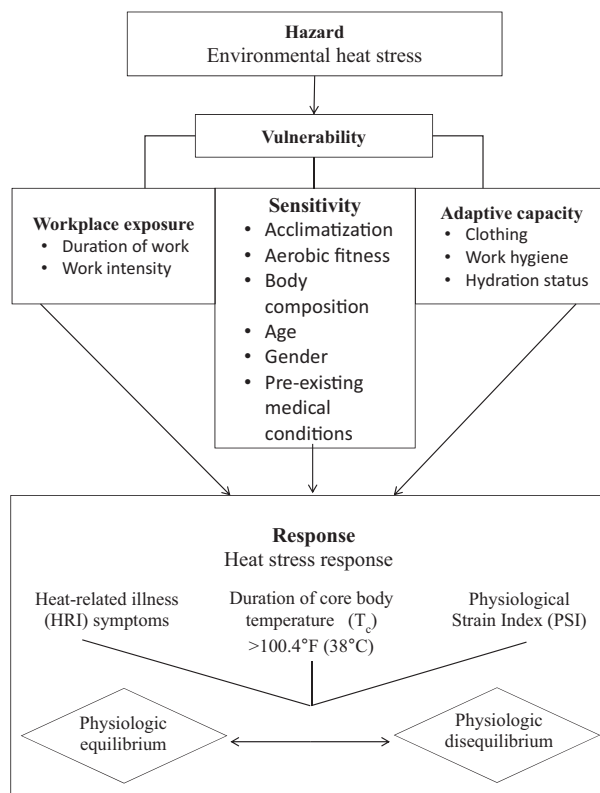


Figure 1. Farmworker Vulnerability to Heat Hazards Framework

Kumar, & Klein, 2009, p. 4, fig. 1; McCarthy, Canziani, Leary, Dokken, & White, 2001), proposed a conceptual model relating climate change to the health of urban environments (Romero-Lankao & Qin, 2011, p. 143, fig. 1). Their framework proposed vulnerability to climate change in terms of relationships among five key concepts: “hazard,” “exposure,” “sensitivity,” “adaptive capacity,” and “response.” In their framework, Romero-Lankao and Qin present vulnerability in the context of climate change resilience of cities as resulting from a dynamic interaction between the hazard itself and three separate but interrelated vulnerability factors (exposure, sensitivity, and adaptive capacity) rather than simply as a propensity to be harmed based solely upon the magnitude of the oncoming hazard. These macrolevel frameworks (Ionescu et al., 2009; McCarthy et al., 2001; Romero-Lankao & Qin, 2011) form the platform for our translation of ideas into one that can capture the dynamic circumstances surrounding an individual’s physiologic response to heat stress (Figure 1). Following, we discuss the individual components of our proposed framework.

Hazard

There are a variety of strategies for operationalizing and measuring the basic hazard in the model,

environmental heat stress. Wet-bulb globe temperature (WBGT), comprising natural wet bulb temperature (T_{nwb}), dry-bulb temperature (T_{db}), and black globe temperature (T_{bg}), is a primary index that describes heat stress in a given environment and that serves as a measurement of the hazard in this framework (Budd, 2008). WBGT can be measured in indoor environments and confined spaces as well as in outdoor environments. Ideally, microclimate WBGT measurements can be acquired at the worksite using standardized instrumentation and calibrated temperature equipment, but in lieu of on-site monitoring, estimating WBGT from local meteorological data is an option since these readings are widely accessible from local or regional weather services (Bernard & Barrow, 2013; Patel, Mullen, & Santee, 2013). With WBGT estimations, outdoor workers can be advised of acceptable work and rest cycles according to the level of environmental heat stress and the level of individual workload (light, moderate, or heavy), defined by the number of watts expended per hour (American Conference of Governmental Industrial Hygienists [ACGIH], 2014). For example, when the WBGT reaches 29°C, a worker engaging in a moderate workload, classified as an energy expenditure of 235 to 360 W/hr, should spend 25% of every hour in recovery to decrease the risk for developing HRI (ACGIH, 2014). If agricultural workers are employed in operations in which portions of the work take place inside partially enclosed, non-temperature-controlled areas like packing houses, greenhouses, or inside packing and loading trailers, WBGT from meteorological data may underestimate the actual conditions. In these cases, direct WBGT at the worksite is preferred to more accurately measure the level of environmental heat stress to guide the choice of the appropriate work–rest cycle.

Although, WBGT is the standard occupational environment temperature assessment, the National Weather Service calculates the heat index (Steadman, 1979a, 1979b) from meteorological data, specifically relative humidity and ambient temperature, to guide the issuance of heat warnings for communities that stratify the risk for HRI (National Institute for Occupational Safety and Health [NIOSH], 2016). This is a possible alternative to WBGT for capturing the degree of heat hazard.

The State of California has instated heat illness prevention regulations (CCR, section 8 §3395. Heat Illness Prevention) based upon guidance from the Occupational Health and Safety Administration (OSHA) to protect farmworkers. These regulations mandate employers to be aware of daily ambient temperatures and to follow situation-based recommendations based upon these readings on a given day. Specific actions include the provision of shade when ambient temperatures reach 80°F and mandatory rest breaks of 10 min in length every

2 hr when the environmental temperature exceeds 95°C. Community- and regionally-based weather monitoring can provide accurate and accessible information from which public health surveillance and situation-based recommendations can be developed in other regions of the country.

Vulnerability

An individual's vulnerability incorporates three interrelated factors: workplace exposure, sensitivity, and adaptive capacity. Workplace exposure represents the extent to which an individual (i.e., agricultural worker) quantitatively experiences a hazard (environmental heat stress). Of importance is the nature of the work that the individual is engaged in, the duration of the work, and the physical demands involved. Farmworkers may work long hours (Flocks et al., 2013); agricultural work is among the most demanding of all occupational classes (Hansen & Donohoe, 2003). In the Farmworker Vulnerability to Heat Hazards Framework, workplace exposure is the measure of the duration of work and the intensity of work. Of note, there are two sources of heat stress, including environmental heat stress (the hazard) and internal heat stress generated from the movement required to perform physical tasks. For this framework, internal heat stress is captured under workplace exposure because its magnitude is entirely dependent upon the amount of time working and the intensity of work. Environmental heat stress (the hazard) exists independently of workplace exposure, and the dose of the hazard is titrated by the degree of workplace exposure, which is why workplace exposure is a component of vulnerability in this framework.

The second component of vulnerability is sensitivity. Sensitivity consists of modifying factors that can have a positive or negative impact on an individual's vulnerability to heat hazards, including those defined in **Table 2**. In the context of this framework, sensitivity includes factors of acclimatization (Cheung, McLellan, & Tenaglia, 2000; Semenza et al., 1996), aerobic fitness (McLellan, Cheung, Selkirk, & Wright, 2012), body composition (Selkirk & McLellan, 2001; Yokota, Berglund, & Bathalon, 2012), age (Åström, Bertil, & Joacim, 2011), gender (Shapiro, Pandolf, Avellini, Pimental, & Goldman, 1980), pre-existing medical conditions and certain medications (Binkley, Beckett, Casa, Kleiner, & Plummer, 2002; Glazer, 2005; Howe & Boden, 2007; Kravchenko, Abernethy, Fawzy, & Lysterly, 2013), as well as other sociodemographic factors, such as housing (Quandt, Wiggins, Chen, Bischoff, & Arcury, 2013).

Adaptive capacity, the primary modifiable component of vulnerability, refers to the availability of resources to

Table 2. Sensitivity components defined

Key definitions

Aerobic Fitness – The level to which an individual can perform physically at a high level for an extended period of time which is dependent upon the degree of efficiency that the cardio-respiratory system can oxygenate the blood, transport that oxygenated blood to the muscles being used, and how efficiently the involved muscle cells can uptake and utilize that oxygen to create an output of power (Jones & Carter, 2000).

Acclimatization – The process by which individuals undergo physiologic adaptations to improve their ability to withstand strain placed on the body by heat stress. Acclimatization may include a decrease in heart rate, perceived exertion, increased plasma volume and decreased core temperature (Armstrong & Maresh, 1991).

counteract heat stress. These components vary and may be beyond the control of the worker, including workplace hygiene (e.g., availability of water and toileting facilities, and ability to take regular breaks; Bethel & Harger, 2014; Fleischer et al., 2013; Flocks et al., 2013). HRI prevention knowledge and practices, including the training of crew leaders, supervisors, and employers in HRI prevention and early action algorithms, could also be included as an adaptive capacity component as an aspect of workplace hygiene.

More research regarding heat stress experienced by agricultural workers will further illuminate components of sensitivity and adaptive capacity. Recent work examining grower-provided farmworker housing in North Carolina showed that workers often face high levels of heat and humidity even after leaving the worksite, during sleeping hours (Quandt et al., 2013). Quandt et al. (2013) cite the known detrimental impact of elevated heat and humidity in sleep environments on wakefulness, rapid-eye-movement sleep, and slow-wave sleep via a higher thermal load that inhibits the normal decreases in body temperature during sleep (Okamoto-Mizuno & Mizuno, 2012). This risk for impaired nighttime cooling and recovery could potentially affect an individual's response to heat at the worksite. Further research characterizing the physiologic effects of the documented high heat and humidity indices in grower-provided farmworker housing can elucidate the predicted health effects.

An individual's vulnerability to the hazard of environmental heat stress, expressed as the synergy among workplace exposure, sensitivity, and adaptive capacity, mediates that individual's response to the hazard (heat stress response). If the combination of workplace exposure and sensitivity exceeds an individual's adaptive capacity, then the heat stress response is in disequilibrium, leading to HRI. If an individual's adaptive capacity is high enough to offset his or her combination of sensi-

tivity and exposure to the hazard, then the compensatory heat stress response leads to physiologic equilibrium. In theory, vulnerability and adaptation can be fluid, with individuals oscillating between degrees of vulnerability related to changing adaptive capacity, workplace exposure, or sensitivity resulting in an oscillation between physiologic equilibrium and disequilibrium during the growing season or a single workday.

Heat Stress Response

An individual's heat stress response can be quantified using three metrics: (a) core body temperature; (b) the Physiological Strain Index (PSI); and (c) HRI symptoms. The ACGIH has set a physiologic limit for core body temperature at 38°C (100.4°F). This means that workers of unknown medical fitness for their specific work task are advised to cease work when their core body temperature exceeds this cap to avoid adverse effects from repeated or extended exposure. If multiple workers exceed the recommended limit, workplaces need to take steps to attenuate heat exposure (ACGIH, 2014). These recommendations are made to curtail HRI and injury in worker populations facing high heat exposure. In 2016, OSHA revised its NIOSH Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments (NIOSH, 2016); this document supports the use of the physiologic limits set by the ACGIH. These criteria also state that there may be exceptions to the 38°C (100.4°F) limit, noting that some workers may be safe to work as long as their core body temperature does not exceed 38.5°C (101.3°F). However, these individuals must be medically cleared, remain under medical supervision, and be acclimatized, directly supervised, and adequately hydrated (NIOSH, 2016).

The PSI utilizes simultaneous measurements of heart rate and core body temperature to quantify heat strain experienced by an individual; PSI employs a scaled value between 0 and 10, with a value of 10 indicating a physiologic state that is very strenuous (Moran, Shitzer, & Pandolf, 1998). Its inclusion as a component of an individual's heat stress response provides a more robust picture of what is occurring physiologically by capturing the cardiovascular and thermoregulatory response to heat stress (Moran et al., 1998). Lastly, including actual HRI symptoms experienced by an individual extends the characterization of the heat stress response beyond physiologic measurements of heart rate and core body temperature. HRI symptoms may not be tied to a specific core body temperature, and capturing these symptoms at earlier stages of the heat stress response can aid in the prevention of HRI progression (Becker & Stewart, 2011; Glazer, 2005; Howe & Boden, 2007).

Conceptual Framework Exemplars

Exemplar 1: Physiologic Equilibrium

A 28-year-old healthy farmworker with no chronic conditions who has been working in the tomato field since 6:30 a.m. is wearing a long sleeve white t-shirt and notices that she is beginning to feel disoriented and dizzy, indicating a shift towards physiologic disequilibrium in her heat stress response. It is a clear day in June with a WBGT of 28°C, and she has been making a moderate energy expenditure. She notifies her crew leader, who sends her to take a 20-min rest and water break, accompanied by another worker, the worker's designated "buddy." During this break, the affected farmworker sits down under the shade of a canopy cloth, refills her water bottle with cool water and adds an electrolyte replacement pill to her water. She also wets a bandana with cool water to place around her neck while resting. The "buddy" keeps talking to her throughout her rest break, asking how she is feeling. At the end of the break, the worker is feeling better and the dizziness and disorientation have subsided; the worker walks back with the buddy to the tomato row where the crew is now working and resumes picking.

In this example, the worker was young and did not have any chronic conditions that could have increased her sensitivity. Fortunately, she was also wearing single-layered, light-colored clothing and sought out water and an electrolyte supplementation, all of which bolster adaptive capacity. By taking a break she was able to temporarily decrease her work intensity, resulting in a temporary decrease in her workplace exposure. This combination of factors related to the actions she took to slow the HRI cascade, her personal characteristics, and clothing choices resulted in a decrease in her vulnerability, allowing her heat stress response to shift back towards equilibrium.

Exemplar 2: Physiologic Disequilibrium

In this scenario, a 36-year-old farmworker is picking watermelons in the month of June in Immokalee, Florida, and loading them into the truck as he and the other crew members follow the loading truck down the row. Even though he has worked in agriculture for decades, he is new to this crew and crop and he has been out of work for the last month. Six hours into the workday he is keeping up with the pace of the loading truck and is feeling fine overall, except for some muscle cramps that he attributes to not being accustomed to lifting the watermelons and a headache that he believes is from not sleeping well the night before. He has been drinking water that is stored on the loading truck when the crew stops for breaks decided upon by the crew leader. The WBGT is 29°C, but the crew leader is unaware of the environ-

mental heat readings and bases the break schedule on the schedule he has always used, despite the current heat wave. Towards the last hour of work, the worker begins to feel nauseated and lightheaded but knows that the day is almost over and does not want to stop early because he is new and does not want to lose productivity.

When the workday ends, he is feeling so nauseated that he does not want to drink much water and he does not have a sports drink or a low-sugar electrolyte beverage to drink. Because he is new to the crew, he does not have a co-worker who knows him or what he looks like when he is not feeling well. He walks back to the bus that transported all the crews to the fields that morning and will be the sole option for the 30-min ride back to the town center. Pulling himself onto the bus, he steadies himself, placing his hands on the tops of the seats at each row, as he walks down the aisle towards the empty seats in the middle of the bus. He sits down by himself, hoping that the dizziness will subside if he just closes his eyes. One of the other workers on the bus asks him if he is alright, and he replies that he is feeling dizzy and just needs to close his eyes for a few minutes next to the open window. When the bus arrives at the town center, the workers begin to unload off the bus, but he does not get up. One of the other workers notices him and tries to wake him up, but he is unresponsive. Then 911 is called and the other worker stays with him until the ambulance arrives.

These circumstances increased this worker's vulnerability to environmental heat stress. Not being acclimatized to the current work environment increased his sensitivity to heat stress, and the performance pressure he felt as a new crew member increased his workplace exposure to it. He began to decompensate early in the day when he experienced HRI symptoms of muscle cramps and headache; not identifying these as symptoms of HRI marked his progression down the HRI cascade. When the worker's HRI symptoms got worse and he began to feel nauseated, he pushed through, leading to further disequilibrium. His vulnerability to environmental heat stress was further increased because his adaptive capacity was further jeopardized because he was not able to take enough work breaks to attenuate his HRI symptoms, he had inadequate access to appropriate fluid replacement, and the workplace lacked established practices and early action plans for worker symptom surveillance that might have detected his progression down the HRI cascade before severe HRI occurred.

Discussion

This framework is particularly useful for conceptualizing future directions that can prevent HRI, decrease vulnerability to heat, and promote physiologic equilibrium. The framework can aid in the systematic

identification of time points when interventions to promote health and prevent HRI could occur in vulnerable populations. The basic input, heat hazard, is not necessarily modifiable. However, the modifiable components of the framework lie in the combination of factors that constitute vulnerability—exposure, sensitivity, and adaptive capacity—which present valuable opportunities for intervention.

Sensitivity is the component of vulnerability that is the least modifiable since these factors are mainly physiologic or social, but improvements in upstream interventions, like regular and pre-employment medical examinations, might reveal pre-existing conditions or medications that place a person at greater risk. Modifications to workplace exposure are multifaceted and usually beyond the control of the workers without supervisor and employer support. With the support of employers and supervisors, modifications to workplace exposure include work systems that promote self-pacing and alterations of work schedules to avoid high heat periods of the day. Regulations could help, such as those that mandate specific work–rest algorithms based upon environmental conditions and regular and accessible provision of water, shade, and proper work clothing. Interventions to strengthen adaptive capacity could include on-site action plans to quickly identify workers suffering from the early stages of HRI and ensure that actions to halt HRI progression and promote recovery are implemented swiftly by workers, crew leaders, and managers.

The Farmworker Vulnerability of Heat Hazards Framework acknowledges that the three components of vulnerability stand in delicate balance with one another; at any given time, one factor can significantly alter vulnerability and affect the heat stress response. Thus, even if only one aspect is altered, such as duration of exposure time through working earlier hours, this action could have meaningful effects if its impact is large enough to decrease vulnerability and tip the scales towards physiologic equilibrium rather than disequilibrium.

This model provides a useful framework to aid nurses in the design of research to increase our understanding of the complexity of the human response to increasing environmental heat and to inform effective public health policies to diminish HRI risk, particularly among vulnerable working populations. The next step for this model will be to test its value in the study of farmworkers, as well as other climate-vulnerable worker groups, including first responders, military personnel, and aging workers. Further research may expand the model by identifying additional factors, including relationships or interactions between model components that may contribute to increased risks to human health associated with climate change.

Conclusions

The Farmworker Vulnerability to Heat Hazards Framework provides a useful inventory of the factors related to the occurrence of heat injury and HRI in response to heat stress. This model also portrays the concept of vulnerability as a dynamic and changeable mediator of heat stress based upon the presence and magnitude of the factors of vulnerability, including workplace exposure, sensitivity, and adaptive capacity. Finally, the heat stress response of equilibrium or disequilibrium acknowledges the true symptomatic and physiologic responses that can occur in response to heat hazards rather than merely relying on a body temperature reading that does not fully explain what is occurring at the level of the individual. Therefore, the Farmworker Vulnerability to Heat Hazards Framework aids in operationalizing and characterizing heat stress in farmworkers and other climate-vulnerable populations in planning further studies.

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Clinical Resources

- American Academy of Family Physicians. Heat-related illnesses. <http://www.aafp.org/afp/1998/0901/p749.html>
- Migrant Clinicians Network. Clinician guides for farmworker health and safety regulations. <http://www.migrantclinician.org/toolsource/resource/clinician-guides-farmworker-health-and-safety-regulations.html>
- Migrant Clinicians Network. Heat-related illness. <http://www.migrantclinician.org/issues/heat-stress.html>
- Occupational Health and Safety Administration. Heat illness index of educational resources, using the heat index, training, and online toolkit.

<https://www.osha.gov/SLTC/heatillness/index.html>

- Occupational Health and Safety Administration. Occupational heat exposure: Heat-related illnesses and first aid. https://www.osha.gov/SLTC/heatstress/heat_illnesses.html
- Occupational Health and Safety Administration. Occupational heat exposure: Industry-specific resources. https://www.osha.gov/SLTC/heatstress/industry_resources.html
- Occupational Health and Safety Administration. Occupational heat exposure: Prevention. <https://www.osha.gov/SLTC/heatstress/prevention.html>

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SPECIAL ISSUE ARTICLES

Climate Change–Related Water Disasters’ Impact on Population Health

Tener Goodwin Veenema, PhD, MPH, MS, RN, FAAN¹, Clifton P. Thornton, MSN, BS, RN, CNMT, CPNP², Roberta Proffitt Lavin, PhD, FNP-BC, FAAN³, Annah K. Bender, PhD, MSW⁴, Stella Seal, MLS⁵, & Andrew Corley, BSN, RN⁶

1 *Beta Nu*, Associate Professor, School of Nursing, Department Acute and Chronic Care, Johns Hopkins School of Nursing Center for Humanitarian Health, Johns Hopkins Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA

2 *Beta Nu*, Clinical Nurse Practitioner, The Johns Hopkins University School of Medicine, Johns Hopkins Charlotte Bloomberg Children’s Hospital, Baltimore, MD, USA

3 Associate Dean for Academic Programs, University of Missouri-St. Louis, College of Nursing, St. Louis, MO, USA

4 Research Associate, University of Missouri-St. Louis, College of Nursing, St. Louis, MO, USA

5 Associate Director, Hospital, Health System and Community Services, Welch Medical Library, Johns Hopkins University, Baltimore, MD, USA

6 *Beta Nu*, Johns Hopkins School of Nursing, Johns Hopkins School of Public Health, Baltimore, MD, USA

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Correspondence

Dr. Tener Goodwin Veenema, Johns Hopkins University School of Nursing, 525 N. Wolfe Street, Office 532, Baltimore, MD 21205.
E-mail: tveenem1@jhu.edu

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Abstract

Purpose: Rising global temperatures have resulted in an increased frequency and severity of cyclones, hurricanes, and flooding in many parts of the world. These climate change–related water disasters (CCRWDs) have a devastating impact on communities and the health of residents. Clinicians and policy-makers require a substantive body of evidence on which to base planning, prevention, and disaster response to these events. The purpose of this study was to conduct a systematic review of the literature concerning the impact of CCRWDs on public health in order to identify factors in these events that are amenable to preparedness and mitigation. Ultimately, this evidence could be used by nurses to advocate for greater preparedness initiatives and inform national and international disaster policy.

Design and Methods: A systematic literature review of publications identified through a comprehensive search of five relevant databases (PubMed, Cumulative Index to Nursing and Allied Health Literature [CINAHL], Embase, Scopus, and Web of Science) was conducted using a modified Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach in January 2017 to describe major themes and associated factors of the impact of CCRWDs on population health.

Findings: Three major themes emerged: environmental disruption resulting in exposure to toxins, population susceptibility, and health systems infrastructure (failure to plan-prepare-mitigate, inadequate response, and lack of infrastructure). Direct health impact was characterized by four major categories: weather-related morbidity and mortality, waterborne diseases/water-related illness, vector-borne and zoonotic diseases, and psychiatric/mental health effects. Scope and duration of the event are factors that exacerbate the impact of CCRWDs. Discussion of specific factors amenable to mitigation was limited. Flooding as an event was overrepresented in this analysis (60%), and the majority of the research reviewed was conducted in high-income or upper middle-/high-income countries (62%), despite the fact that low-income countries bear a disproportionate share of the burden on morbidity and mortality from CCRWDs.

Conclusions: Empirical evidence related to CCRWDs is predominately descriptive in nature, characterizing the cascade of climatic shifts leading to

major environmental disruption and exposure to toxins, and their resultant morbidity and mortality. There is inadequate representation of research exploring potentially modifiable factors associated with CCRWDs and their impact on population health. This review lays the foundation for a wide array of further areas of analysis to explore the negative health impacts of CCRWDs and for nurses to take a leadership role in identifying and advocating for evidence-based policies to plan, prevent, or mitigate these effects.

Clinical Relevance: Nurses comprise the largest global healthcare workforce and are in a position to advocate for disaster preparedness for CCRWDs, develop more robust environmental health policies, and work towards mitigating exposure to environmental toxins that may threaten human health.

Widespread scientific consensus exists that the world's climate is changing (Crimmins et al., 2016; Portier et al., 2010; Woodward et al., 2014), and as a direct result of climate change, water-related disaster events are increasing in frequency and intensity. Over the past half century, the persistent burning of fossil fuels has released sufficient quantities of carbon dioxide and other greenhouse gases to trap additional heat in the lower atmosphere. Rising greenhouse gas concentrations have resulted in the earth becoming progressively warmer each decade (World Health Organization, 2017). As a result, there have been more variable hydrologic events (glaciers melting, heavy precipitation, general flooding, flash flooding, and coastal floods) and meteorologic events such as cyclones, hurricanes, tropical storms, and sea level rise. Each of these events has the potential to negatively affect the health of populations across the globe. While climate change is a public health issue, the effects of climate change will vary across geographic regions and populations (Crimmins et al., 2016). Some degree of climate change is unavoidable, and we must adapt to its associated health effects; however, aggressive mitigation actions can significantly blunt the worst of the expected exposures (Interagency Working Group on Climate Change and Health, 2016). The scientific evidence to support climate change is strong, yet contentious international political debate persists regarding what actions to take in response. Nurses represent the largest global healthcare resource and, as such, are ideally suited to contribute to disaster preparedness efforts for climate change-related water disasters (CCRWDs), build sustainable communities, advocate for more robust environmental health policy, and work towards mitigating exposure to environmental toxins that may threaten human health.

Public health officials, clinicians, and policymakers require a substantive body of evidence on which to base interventions and disaster response initiatives if they wish to effectively plan, prepare for, and mitigate the impact of cyclones, floods, hurricanes, and sea level rise on global

populations. The purpose of this study was to conduct a systematic review of the literature concerning CCRWDs. Ultimately, this evidence will be useful to inform national and international environmental disaster policy in this area.

Methods

Search Strategy

In order to capture the broad scope of variables impacting public health as a result of CCRWDs, a systematic review of the literature was conducted using a modified Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach (PRISMA, 2015). This framework provides for a guided search and review method with prespecified inclusion and exclusion criteria, definition of terms, and documentation of selection decisions, as recommended by Kastner et al. (2012) and Moher, Liberati, Tetzlaff, Altman, and the PRISMA Group (2009). A systematic review is a review of a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review. Statistical methods (meta-analysis) may or may not be used to analyze and summarize the results of the included studies (Moher et al., 2009).

Our research team collaborated with an experienced medical research librarian to design a rigorous protocol that would identify all peer-reviewed published literature on the public health impact of CCRWDs as outlined in **Table 1**. Databases searched included PubMed, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, Scopus, and Web of Science in order to provide information from a variety of disciplines. Climate change as a topic was searched by using the terms climate change, climatic processes, El Niño-Southern Oscillation, and global warming. Disaster as a topic was searched using the terms disaster, natural

Table 1. Search Strategy

Terms	PubMed	CINAHL	Embase	Scopus	Web of Science
A Climate change OR climatic processes OR El Niño-Southern Oscillation OR global warming	43,144	3,788	31,259	206,935	145,523
B Disasters OR natural disasters, OR cyclones OR hurricanes OR floods	28,334	14,722	42,449	325,012	124,573
C [A + B]	659	422	2,798	16,090	11,577
D Health (population OR public OR community)	846,571	336,933	792,871	553,629	420,604
E [A + B + D]	306	115	254	430	251

Note. CINAHL = Cumulative Index to Nursing and Allied Health Literature.

disasters, cyclone, hurricane, and floods. Public health as a topic was searched using the terms public health, community health, and population health.

The initial search strategy identified 1,356 published works (Figure 1). Duplicates were removed (551), and the titles and abstracts of the remaining 805 published works were reviewed by the research team for relevance to the question at hand. Of these, 758 articles were removed because they did not meet the inclusion criteria (articles were not specific to water-related disaster events, were not human focused, did not address health, or were not peer reviewed). In total, 47 articles met inclusion criteria and were retained for analysis. For an overview on articles by country income, global region, or types of water-related disaster, see Figures S1 and S2 and Table S1. Thematic analysis was conducted to identify the key concepts or major themes, and a second round of analysis was conducted to identify subthemes and factors associated with health impact that may be amenable to mitigation. The two-tiered review of the articles

Table 2. Inclusion and Exclusion Criteria

Search terms	
Climate change, climatic processes, El Niño, global warming Disasters, natural disasters, floods, flash floods, coastal floods, flooding, cyclone, hurricane, heavy rainfall/precipitation, sea-level rise Health (population OR public OR community)	
Inclusion criteria	Exclusion criteria
Published in a peer-reviewed publication	Outside the peer-reviewed publications
Focus on health (population, public, community)	Focus on other disasters (earthquakes, wildfires, heat waves, drought, etc.) Focus not on health
Purpose of the study was to identify impact of climate change related water disasters upon population health	Focus on animals/insects
Focus on human health	Focus on infrastructure, engineering, or agriculture
Dates Limited to 2006–2016	Publication date prior to 2006
English language	Non-English language

supported many previously identified trends in the literature, and no new ideas surfaced, indicating that thematic saturation had been achieved.

Inclusion Criteria

In order to be included in this review, the publication must have focused on the impact on public health resulting from CCRWDs; the criteria and definitions given below were used in this review. To ensure timeliness and relevance, studies were restricted to the past 10 years (2006–2016) and had to be published in the English language. Exclusion criteria included articles that were not published in peer-reviewed publications, focused on other disasters (earthquakes, wildfires, heat waves, drought, etc.), did not focus on health, focused on animals or insects, or focused on infrastructure, engineering, or agriculture. A summary of inclusion criteria, exclusion criteria, and the selection process is depicted in Figure 1 and Table 2.

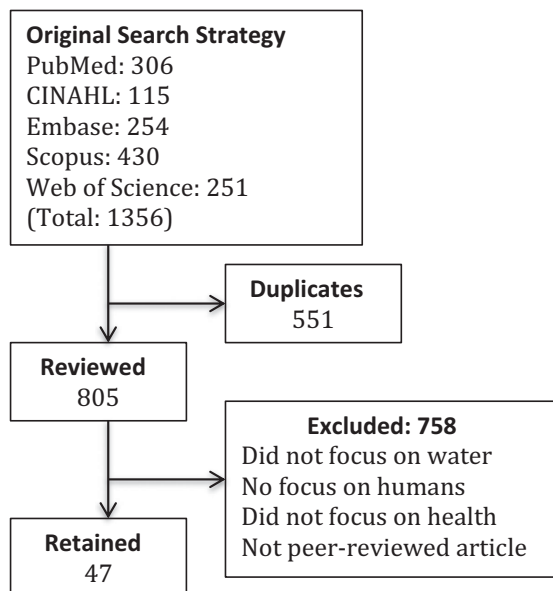


Figure 1. Inclusion scheme.

Definitions

Climate change. Climate change was defined as local or global progressive variations in annual weather patterns and characteristics.

Disaster. Disaster was defined as any event that overwhelms the local or regional capacity to respond or any situation that exceeds the region's response resources.

Susceptibility. Susceptibility was defined as having the potential to be influenced or harmed by an event or threat.

Toxins. Toxins were defined as poisonous substances that are specific products of the metabolic activities of a living organism and are usually very unstable, notably toxic when introduced into the tissues, and typically capable of inducing antibody formation.

Mitigation. Mitigation was defined as those measures that eliminate or reduce the impacts and risks of hazards through proactive measures taken before an emergency or disaster occurs.

Environmental disruption. Environmental disruption was defined as the deterioration of the environment through alterations in natural resources such as air, water, and soil; the destruction of ecosystems; habitat destruction; the extinction of wildlife; and pollution.

Population susceptibility. Population susceptibility was defined as a group of individuals who have an identifiable common characteristic for which the rate and magnitude of response or type of health outcome differs (or could reasonably be expected to differ) from that of a reference population.

Data Evaluation and Study Quality

The authors independently assigned an evidence level and corresponding quality grade as outlined by Dearholt and Dang (2012). Evidence levels were defined as follows:

- Level I: experimental study, randomized controlled trial
- Level II: quasi-experimental study
- Level III: nonexperimental study
- Level IV: opinion of respected authorities or nationally recognized expert committees or consensus panels
- Level V: based on experiential and nonresearch evidence

In order to assess the quality of these studies, the authors used the critical appraisal tool as outlined by Crowe and

Sheppard (2011) and Crowe, Sheppard, and Campbell (2012), which yields a score between 0 and 40. This tool is best utilized for studies with evidence levels I to III and, as such, was not used to review works graded as level IV or V. Each author independently graded each article using this tool. Scores were then combined and averaged if they did not deviate by more than 5 points. If scores differed by more than 5 points, the authors reevaluated the material together in order to determine the score.

Findings

Three major themes emerged: environmental disruption resulting in exposure to toxins, population susceptibility, and health systems infrastructure (failure to plan-prepare-mitigate, inadequate response, and lack of infrastructure). Population health impact was characterized in four major categories: weather-related morbidity and mortality (drowning, electrocution, cerebrovascular accident), waterborne diseases/water-related illness, vector-borne and zoonotic diseases, and psychiatric/mental health. Scope and duration of the event are factors that exacerbate the impact of CCRWDs.

Environmental Exposure to Toxins

Weather-related morbidity and mortality. The health impacts of CCRWDs can be severe, and include direct impacts such as drowning, electrocution, cardiovascular events, and mental health effects. Displacement by flooding leads to sheltering in close quarters, creating unsanitary living conditions, perpetuating infectious disease spread (Abaya, Mandere, & Ewald, 2009).

Waterborne diseases. Increases in water temperature, precipitation frequency and severity, evaporation-transpiration rates, persistent humidity, and changes in coastal ecosystems increase the incidence of water contamination with harmful pathogens and chemicals, resulting in increased human exposure and waterborne disease (Ahmed, Scholz, Al-Faraj, & Niaz, 2016; Alderman, Turner, & Tong, 2012; Davies et al., 2015; De Man et al., 2014; Dura et al., 2010; Gao, Zhang, Ding, Liu, & Jiang, 2016; Kang et al., 2015; Lin, Wade, & Hilborn, 2015; Phung et al., 2015; Wade, Lin, Jagai, & Hilborn, 2014). Flooding events in particular increased the incidence of the following three diseases: hepatitis A virus (Gao, Zhang, Ding, Liu, & Jiang, 2016; Gao, Zhang, Ding, Liu, Wang, & Jiang, 2016), bacillary dysentery (Liu, Liu, Zhang, & Jiang, 2016; Liu, Li, et al., 2016; Lin, Wade, & Hilborn, 2015; Ni, Ding, Li, Li, & Jiang, 2014; Ni, Ding, Li, Li, Liu, & Jiang, 2014; Zhang, Ding, Liu, Zhang, & Jiang, 2016), and *Campylobacter* (Soneja et al., 2016).

Vector-borne and zoonotic diseases. Disease risk increases as a result of climate change due to related expansions in vector numbers and ranges, shortening of pathogen incubation periods, and disruption and relocation of large human populations (Portier et al., 2010). Vector-borne diseases include dengue, dengue hemorrhagic fever, yellow fever, West Nile virus (Ahmed et al., 2016; Alderman et al., 2012; Burton, Rabito, Danielson, & Takaro, 2016; Phung et al., 2014), Japanese encephalitis (Zhang, Liu, Zhang, & Jiang, 2016), Ross River virus (Tall, Gattton, & Tong, 2014), and malaria (Alderman et al., 2012; Boyce et al., 2016; Ding et al., 2014; Gao, Zhang, Ding, Liu, Wang, & Jiang, 2016).

Psychiatric and mental health. Psychological effects such as post-traumatic stress disorder (PTSD) in addition to other mental health sequelae have been noted after water-related disasters (Lane et al., 2013; Su, 2011), and the mental health effects of disasters are related to the intensity of the exposure to that disaster. In the wake of a disaster such as Hurricane Sandy, death, displacement, and psychosocial stress brought on by a loss of life and/or property are risk factors for PTSD, depression, and anxiety. Of these, PTSD has been the most studied with regards to disasters, usually an acute, disruptive event with an unpredictable scope and aftermath. PTSD can be caused by or exacerbated by events related to water-related disasters, including living through the disaster or by consequence of its impact (such as being involved in an evacuation or feeling the strain of the healthcare provisions afterwards; Nitschke et al., 2006). The rates of psychological distress and PTSD remained higher among people in flooded homes compared to those in non-flooded homes up to 6 months after the incident. Depression symptoms, for example, were eight times higher among people in flooded homes (Azuma et al., 2014).

Storms such as Hurricane Sandy also disrupt infrastructure and traditional systems of care, including mental health care that could mitigate the psychological toll of the event for victims. The mental health burden of care post-disaster requires ongoing preparedness and early warning systems to identify individuals at risk. Local and federal organizations may consider establishing evidence-based strategies for trauma and recovery to prevent mental health problems and chronic disability stemming from these problems after a disaster (Neria & Schulz, 2012).

A key recommendation was to monitor the impact of flooding on the health and well-being of those displaced, emphasizing the need for ready access to mental health care among the affected. Establishing local recovery groups and enlisting the aid of community

networks to mitigate the physical and psychological damage from a flood event are paramount among preventive and intervention strategies (Gray, 2008).

Population Susceptibility

Individual susceptibility. Susceptibility of individuals, communities, and countries was described in many of the articles. Risk factors that increase susceptibility to greater impact from CCRWDs include living in poverty, living in unstable dwellings, and lacking access to health care (Alderman et al., 2012; Bloetscher et al., 2016; Burton et al., 2016; Dressler, Allison, Broach, Smith, & Milsten, 2016; Grabich, Horney, Konrad, & Lobdell, 2016; Khan, Gruebner, & Kraemer, 2014; Lane et al., 2013; Rodriguez-Llanes, Ranjan-Dash, Mukhopadhyay, & Guha-Sapir, 2016; Schmeltz et al., 2013; Srikuta, Inmuong, Inmuong, & Bradshaw, 2015). There is a strong correlation between social and health vulnerability as measured by lack of income, percentage of minority residents, lower educational attainment, lack of English fluency, low take up of medical services, age, and disability status (Bloetscher et al., 2016).

Males are more susceptible to drowning (the largest cause of mortality from cyclones), and males are most susceptible to dying from cyclones (Doocy, Dick, Daniels, & Kirsch, 2013). Other factors that were associated with susceptibility include being female, being very young or elderly, living with a disability, being an ethnic minorities, lacking fluency in the country's primary language, having a female head of household, and having lower educational attainment (Abbas & Routray, 2014; Alderman et al., 2012; Bloetscher et al., 2016; Burton et al., 2016; Grabich et al., 2016; Khan et al., 2014; Lane et al., 2013; Rodriguez-Llanes et al., 2016; Schmeltz et al., 2013; Srikuta et al., 2015). Children are more susceptible to injuries, diarrheal diseases, and respiratory infections (Phung et al., 2014). The incidence of severe wasting and stunted growth among children in regularly flooded regions in rural eastern India was significantly higher than among children in areas not regularly flooded (Rodriguez-Llanes et al., 2016). There was a lower incidence of diarrheal diseases associated with those who lived with piped water and toilets in Cambodia (Davies et al., 2015).

Nonfatal injuries and exacerbation of chronic illness are the leading causes of morbidity among residents and relief workers (Alderman et al., 2012). Individuals with ongoing health concerns or pre-existing conditions are susceptible to interruption of health care (Alderman et al., 2012) and may have exacerbations of their conditions during flood disasters (increase in cardiovascular disease during flood seasons in Canada

during flood years; Vanasse et al., 2016). Studies identified susceptibility resulting from proximity to the hazard, such as living in burgeoning coastal communities (Grabich et al., 2016; Lane et al., 2013) or living close to industrial and waste incineration plants (Azuma et al., 2014).

Community susceptibility. Communities with limited resources and those in lower income countries are more susceptible to water-related disasters and have poorer outcomes after disasters (Alderman et al., 2012), and the growth of coastal populations increases the morbidity and mortality of cyclones and the impact they have on global regions (Doocy et al., 2013; Grabich et al., 2016). Warm and humid climates promote microbe growth and exaggerate water-related and waterborne diseases in the area (Ahmed et al., 2016). The health impacts of coastal storms present challenges for cities like New York, a huge metropolis that is heavily dependent on transportation, has energy infrastructure vulnerable to flood damage, and has high-rise residential housing (Lane et al., 2013). Environmental and individual risk factors and symptoms were exacerbated by close proximity to industrial and waste incineration plants (Azuma et al., 2014).

Disruption in food or water sources. Climate change has made agricultural planning difficult due to erratic and unpredictable weather patterns. Crop yields have decreased as a result of climate change (Abaya et al., 2009). Floods have destroyed protected springs and wells, disrupted organic and inorganic material balance, degraded soil, and threatened water quality (Abaya et al., 2009, Ahmed et al., 2016). One of the main health effects of flooding is contamination of drinking water (Burton et al., 2016). Contamination of drinking water was the largest contributor to spreading *Vibrio* and *Leptospira* (Cann, Thomas, Salmon, Wyn-Jones, & Kay, 2013). Extreme rainfall events also contribute to the microbiological contamination of water source and supply, pose a risk to public health (Dura et al., 2010), and result in changes in salinity, chemical contamination, hygienic condition, pathogen contamination, nutrient cycling, and algal blooms (Phung et al., 2015). Flooding causes rapid loss of life from physical damage of the disaster but also interrupts food supply and life support, leading to chronic community malnutrition (Su, 2011). Communities that lack health infrastructure or health facilities have poorer health outcomes due to the interruption in transportation that is associated with flooding or other water-related disasters—people cannot get health care during communication or power disruptions (Abbas & Routray, 2014). Food security is related to increased population growth

rates, deficiency of drinking water, degradation of soil, urbanization, and animal-based diets, all of which are influenced by climate change (Ahmed et al., 2016).

Health Systems Infrastructure

The effects of a water-related disaster spread beyond the time of the disaster and into the recovery period, disrupting health infrastructure and interrupting continuity of healthcare services (Alderman et al., 2012). Failure to plan or prepare and mitigate the effects of CCRWDs and failure to respond in a timely manner result in increased severity in health impact. Response efforts are hampered by a lack of health services and adequate health professionals in the area—poorer areas lack infrastructure to prevent or mitigate floods (no warning systems, boats, swimmers, life jackets; Abaya et al., 2009). Failure to prepare for extreme precipitation and flooding may pose significant challenges to curbing waterborne disease transmission (De Man et al., 2016) and malaria control programs and demands rapid responses to mitigate deleterious impacts on human health (Boyce et al., 2016). Preparation and early warning systems are key to preventing deaths and injuries from cyclones (Doocy et al., 2013).

Lack of infrastructure and damage to existing infrastructure also contribute to increased severity of disaster impact. Tropical storms and cyclones can affect public health infrastructure by damaging equipment, interrupting services, and disrupting access to clean water (Ryan et al., 2015). Infrastructure that is not intended to hold rainwater is inadequate to properly protect individuals from the communicable threats of waste water from flooding and disasters (De Man et al., 2014; Dura et al., 2010). Specifically, disruptions to the healthcare system and infrastructure as a result of hurricanes and tropical storms may have deleterious effects on pregnancy and birth outcomes (Grabich et al., 2016).

Local communities will face the greatest burden of initial response until national or international organizations arrive—local responses to Hurricane Sandy in Brooklyn mobilized volunteers to provide hot meals and deliver medicine and ice to homebound people, and distribute information and resources to community members for 3 weeks before government officials arrived (Schmeltz et al., 2013). Suggestions to improve the resilience of health systems include establishing standard operating procedures (Van Minh et al., 2014), ensuring a functional workforce (Ryan et al., 2016), establishing policy and land use mechanisms, setting mandatory disaster plans for hospitals, assessing current flood and environmental disaster strategies, and being aware of the social inequities

that enhance vulnerability to flood-related health problems (Burton et al., 2016).

Discussion

Increases in the incidence and intensity of extreme weather events such as hurricanes, floods, cyclones, and tropical storms adversely affect people's health immediately during the event or later following the event (Portier et al., 2010). Flooding as an event was over represented (60%) in the total literature reviewed. The majority of the research in this analysis was conducted in high-income or upper middle-to-high-income countries (62%), despite the fact that low-income countries bear a disproportionate share of the burden on morbidity and mortality from CCRWDs. Climate change is instituting new threats to communities who have had little past experience in planning for water-related disasters—lack of planning has led to a lack of mitigation efforts and increased impact from floods and other water events (Abaya et al., 2009).

The results of this analysis describe the cascade that is triggered by climate change, hydrologic and meteorologic disasters, environmental disruption, and release of toxins that ultimately impact public health. CCRWDs endanger our health by affectively destroying or contaminating our food and water sources, the weather we experience, and our interactions with the built and natural environments. Disease risk increases as a result of climate change due to related expansions in vector numbers and ranges, shortening of pathogen incubation periods, and disruption and relocation of large human populations (Portier et al., 2010). As the climate continues to change, the risks to human health continue to grow (Crimmins et al., 2016). It is reasonable if not prudent to expect that CCRWDs will adversely impact the lives and health of a large percentage of the world's population over the next decades, thus the imperative for advancing evidence-based planning. Indeed, climate variability and change affect the most basic health requirements during nonemergency times: clean air, safe water, sufficient food, and adequate shelter. The increasing frequency and intensity of CCRWDs pose new challenges to the control of environmental toxic exposures and emerging infectious diseases, and gradually increase the pressure on the natural, economic, social, and health systems that sustain health.

Health impacts of CCRWDs may differ across populations and are dependent on several factors, such as existing vulnerability and adaptive capacity to changing meteorological conditions of these populations and the associated human and social consequences, as well as a myriad of other determinants that include the

capacities, available resources, and existing behaviors and attitudes of these populations. Our findings suggest that more research is indicated to explore strategies for modifiable factors for reducing public health vulnerability, including exposure reduction, susceptibility reduction, and resilience building in disaster-impacted communities. Building the resilience of health systems to climate change is part of a preventive approach to public health. Existing shortfalls in providing basic health services determine that much of the global population is exposed to climate-sensitive health hazards. Additional investment is needed to strengthen key functions and to ensure that the health sector is ready to react to the challenges posed by climate change, including those posed by acute shocks such as natural disasters and disease epidemics, but also to long-term stresses.

Summary

Empirical evidence related to CCRWDs is predominately descriptive in nature, characterizing the cascade of climatic shifts leading to major environmental disruption and exposure to toxins, and their resultant morbidity and mortality. There is inadequate representation of research exploring potentially modifiable factors associated with CCRWDs and their impact on population health. This review lays the foundation for a wide array of further areas of analysis to explore the negative health impacts of CCRWDs and for nurses to take a leadership role in identifying and advocating for evidence-based policies to plan, prevent, or mitigate these effects.

Clinical Resources

- Centers for Disease Control and Prevention. Climate effects on health. <https://www.cdc.gov/climateandhealth/effects/default.htm>
- U.S. Department of Health & Human Services, Assistant Secretary for Preparedness and Response. Technical Resources, Assistance Center, and Information Exchange. <https://asprtracie.hhs.gov>
- U.S. Department of Health & Human Services, National Library of Medicine. Disaster Information Management Research Center. <https://disaster.nlm.nih.gov/>
- U.S. Environmental Protection Agency. Climate change and health. <https://www.epa.gov/climate-impacts/climate-impacts-human-health%20%>
- World Health Organization. Climate change and health. <http://www.who.int/mediacentre/factsheets/fs266/en/>

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

Figure S1. Articles by Country Income

Table S1. Type of Water Related Disaster Event

Table S2. Research Report Type, Purpose, Methods, and Sample Characteristics

Table S3. Key Findings in Studies of Climate Change Related Water Disasters Upon Public Health



Challenges and Resources for Nurses Participating in a Hurricane Sandy Hospital Evacuation

Nancy VanDevanter, RN, DrPH¹, Victoria H. Raveis, PhD², Christine T. Kovner, RN, PhD³, Meriel McCollum, BSN, RN⁴, & Ronald Keller, PhD, MPA, RN, NE-BC⁵

¹ Professor, New York University, Rory Meyers College of Nursing, New York, NY, USA

² Professor, New York University, College of Dentistry, New York, NY, USA

³ Professor, New York University, Rory Meyers College of Nursing, New York, NY, USA

⁴ PhD Candidate, University of North Carolina Chapel Hill, Chapel Hill, NC, USA

⁵ Senior Director of Nursing NYU Hospitals Center, New York University, Langone Medical Center, New York, NY, USA

Key words

Nurse's disaster experience, nurses' disaster preparedness education, Superstorm Sandy

Correspondence

Dr. Nancy VanDevanter, New York University, College of Nursing, 433 1st Ave., New York, NY 10010. E-mail: nvd2@nyu.edu

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Abstract

Purpose: Weather-related disasters have increased dramatically in recent years. In 2012, severe flooding as a result of Hurricane Sandy necessitated the mid-storm patient evacuation of New York University Langone Medical Center. The purpose of this study was to explore, from the nurses' perspective, what the challenges and resources were to carrying out their responsibilities, and what the implications are for nursing education and preparation for disaster.

Design: This mixed-methods study included qualitative interviews with a purposive sample of nurses and an online survey of nurses who participated in the evacuation.

Methods: The interviews explored prior disaster experience and training, communication, personal experience during the evacuation, and lessons learned. The cross-sectional survey assessed social demographic factors, nursing education and experience, as well as potential challenges and resources in carrying out their disaster roles.

Findings: Qualitative interviews provided important contextual information about the specific challenges nurses experienced and their ability to respond effectively. Survey data identified important resources that helped nurses to carry out their roles, including support from coworkers, providing support to others, personal resourcefulness, and leadership. Nurses experienced considerable challenges in responding to this disaster due to limited prior disaster experience, training, and education, but drew on their personal resourcefulness, support from colleagues, and leadership to adapt to those challenges.

Conclusions: Disaster preparedness education in schools of nursing and practice settings should include more hands-on disaster preparation exercises, more "low-tech" options to address power loss, and specific policies on nurses' disaster roles.

Clinical Relevance: Nurses play a critical role in responding to disasters. Learning from their disaster experience can inform approaches to nursing education and preparation.

Weather-related disasters have increased dramatically in recent years (Guha-Sapir, Hoyois, & Below, 2014) which has resulted in an increased emphasis on institutional

preparation and training, particularly among emergency response and healthcare provider organizations. Hospital evacuations are rare events, usually caused by natural or

manmade disasters such as hurricanes, earthquakes, or chemical spills (Concanour et al., 2002). Forced hospital evacuations without power are even more rare (Chavez & Binder, 1996) and are usually caused by unanticipated loss of power and water damage (Schultz, Koenig, & Lewis, 2003). When hospitals experience a forced evacuation, healthcare providers become both victims and responders. Typically, disaster training in hospitals is directed at dealing with mass casualties rather than forced evacuation (Concanour et al., 2002).

Nurses play a critical role in disaster preparedness (Gebbie & Qureshi, 2006; Institute of Medicine [IOM], 2010), but many nurses are not confident of their abilities to respond effectively to disasters and are unsure of their roles (Baack & Alfred, 2013). Managing disasters presents significant challenges, including disaster-related stress (Collins, 2000). Those with experience and training report feeling more confident to respond (Adams & Canclini, 2008).

Hurricane (Superstorm) Sandy was designated a late-season post-tropical cyclone by the U.S. Weather Service just before it made landfall in Atlantic City, New Jersey, on October 28, 2012. The storm that began in the Caribbean and moved up the east coast of the United States eventually took 149 lives and left billions of dollars in damage to communities.

Preparations for Hurricane Sandy began in New York City Emergency Response agencies and hospitals the week before landfall. New York University Langone Medical Center (NYULMC) is located only one city block from the East River in the New York City borough of Manhattan. This was the second time in a little more than a year that NYULMC had been threatened by a climate event, Hurricane Irene occurring in August 2011. In preparation for Hurricane Irene, city and state officials had mandated NYULMC and two other hospitals to evacuate before the storm made landfall. These hospitals all experienced minimal damage as a result of Hurricane Irene and re-opened within hours of landfall. Prior to Hurricane Sandy, the city and state decided not to mandate evacuation, and hospitals implemented plans to shelter in place (SIP). At NYULMC, preparations included enhancing the physical barriers for flood protection that were used during Hurricane Irene. As many patients as possible were discharged. Within the hospital, some patients who would SIP were moved from units vulnerable to high wind on the east side of the building to less vulnerable units on the lower floors on the west side of the building. Patients heavily dependent on electronic equipment were also moved to areas of the hospital with more robust power capacity. Around 7 p.m. the evening of October 28, the barriers around the medical center that had been put in place in preparation for the storm

were breached, flooding the cellar and ground floors, and causing a power failure throughout the hospital. Though emergency power sources were available for a period of time, it soon became apparent that the level of temporary power was not sustainable, and immediate evacuation of all patients and staff would be required.

The purpose of this study was to explore, from the nurses' perspective, how they functioned in these extraordinary circumstances, what the challenges and resources were to carrying out their responsibilities, what lessons were learned, and what the implications are for nursing education and training for disasters response.

Methods

Study Design

We chose a mixed-methods approach to the study, beginning with in-depth qualitative interviews followed by an anonymous online survey. The qualitative interviews provided important information that informed the content of the quantitative survey. For example, nurses described in detail the challenges they had to face and what resources had helped them to adapt to those challenges. The methodology for the qualitative and quantitative study is detailed separately in the ensuing text. The protocol for the study was reviewed and approved by the New York University School of Medicine Institutional Review Board.

Phase 1: Qualitative Interviews

Sample and recruitment. We recruited a purposive sample of nurses who had experienced the evacuation based on practice area (cardiology, pediatrics, obstetrics, neonatology, oncology, general medicine, orthopedics), nursing experience (a range of less than 1 year to 20 years, with more nurses having 1 to 3 years of experience), and organizational role (staff nurse, nurse manager) in the disaster. We used text, e-mail, and phone to contact nurses and invite them to participate in a 1-hr interview to explore their experiences during and after Hurricane Sandy. Sixteen of the 20 nurses contacted agreed to participate (response rate 80%). Of those, 12 held staff nurse positions and 4 held management positions.

Data collection. Experienced qualitative interviewers (N.V. and V.H.R.) conducted 1-hr interviews with participants in a private setting between April and June 2013. We assured participants that no individual identifiers would be collected, that the interview would be audio-taped to insure the accuracy of the data, and

immediately after the transcription of the interview the audiotape would be destroyed. We gave participants an information sheet describing the study and contact information for the principal investigator (N.V.) and the New York University School of Medicine Institutional Review Board. Participants verbally agreed to participate.

Measures. The interview guide contained questions about professional background and role at NYULMC and potential challenges and resources for nurses during the evacuation, including emergency preparedness training experience prior to the hurricane, familiarly with hospital disaster policies and procedures, role in the disaster, communication and leadership during the disaster, and personal evacuation experience. To develop the interview guide, we drew on the extant disaster literature and information from a small group of NYULMC nurses with disaster experience.

Qualitative data analysis. All interviews were transcribed verbatim. Each member of the research team read all of the transcripts initially. Two members of the research team with extensive qualitative experience developed a detailed codebook using a three-step process, initially conducting open coding followed by focused coding and finally identification of major themes. Transcripts were coded and entered into ATLAS.ti 6.0 (<http://atlasti.com/product/v8-windows/>; ATLAS.ti Scientific Software Development GmbH, Chicago, IL, USA) by a trained qualitative researcher. A subset of 20% of the interviews was independently coded by a research student familiar with the study to establish interrater reliability (84%).

Phase 2. Quantitative Survey

The quantitative cross-sectional study consisted of an anonymous Internet-based survey that was conducted from July to September 2013.

Sample and recruitment. The sampling frame consisted of all registered nurses (RNs; $N = 1,668$) who were employed by NYULMC and worked on inpatient units on October 29, 2013. 528 of the nurses responded to the survey, for a 32% response rate. For the purposes of this analysis, only nurses that were present for the evacuation and responded to the survey were included ($N = 173$).

Nurses were recruited via e-mail using procedures described in the ensuing text. The confidential link to the e-mail addresses of all nurses who worked at NYULMC was obtained from the Senior Vice President and Chief Nursing Officer at the hospital. At no time

did the researchers have a list of the nurses' e-mail addresses.

Measures. We collected information on sociodemographic variables, including type of nursing education and clinical experience, potential challenges during the evacuation such as communication, leadership availability, adequacy of disaster preparedness training prior to the evacuation, and perceived threat to safety for patients and nurses. We also assessed potential resources that could support nurses in their disaster and evacuation roles, such as previous disaster experience and training in disaster preparedness, support from co-workers, family, and friends, personal resourcefulness, faith, spirituality, or religion. Prior to sending out the link to the survey, the survey was pilot tested by professional nurses on the study advisory group.

Data collection. Prior to initiation of the study, we sent an e-mail to the total sample describing the study purpose and alerting potential nurse participants that they would receive an e-mail with a link to the survey within a few days. Three days later, we sent a second e-mail providing a link to the online Qualtrics survey on a secure website at New York University. Qualtrics assigned an identification code to each respondent. Reminder e-mails were sent at the end of the second and third weeks after the initial e-mail. Of the 1,668 nurses contacted, 528 returned completed surveys, for a response rate of 33%.

Quantitative data analysis. Survey data were downloaded into an SPSS data file. Six cases were eliminated because they did not meet the inclusion criteria. Of the 528 nurses who returned surveys who met the criteria of working at NYULMC at the time of the hurricane, all those who did not participate in the evacuation were eliminated, leaving a sample of 173 for this analysis.

Results

Phase 1. Qualitative Interviews

Participants' qualitative interviews revealed the following themes.

Hurricane Irene influenced expectations about Hurricane Sandy. Because this was an unplanned evacuation that ended in hospital closure, nurses had to adapt to rapidly changing unpredictable events and circumstances. Hurricane Irene 1 year earlier had provided practice in evacuation that increased nurses' ability to carry out their responsibilities. However, that experience

also contributed to the erroneous belief that Hurricane Sandy would be a controlled event as Hurricane Irene had been. Hurricane Irene was described by these participants as taking place within a very controlled environment where electricity was available, elevators worked, there was time to make appropriate contacts with other hospitals, and all preparedness was completed a day in advance prior to the storm. Participants variously described that experience as “calm, easy, no stress.” One felt “we were indestructible.” Several participants described Hurricane Irene as “a drill” or “dry run” for Hurricane Sandy; thus, they expected that nothing “bad” would happen. One participant stated:

In the back of my mind I literally just thought it was going to be similar to Irene, yeah the storm is coming, we'll have some flooding in the basement, and you know like they did before, a little water, and they'll dry it up and the hospital will open the next day like it did last time and we'll be back to business as normal. (P6)

As a result of that experience and the institutional decision to SIP, none of the study participants expected that it would be necessary to evacuate patients as a result of Hurricane Sandy until the power outage occurred.

Limited personal external disaster experience prior to Hurricane Sandy. Only three participants described any external formal experience or training in disaster preparedness, one with the Federal Emergency Management Agency (FEMA), one a member of the New York City Medical Response team, and one who came from another country where disasters of this kind were frequent. One who did have previous external experience with disasters reflected on the value she derived from that external experience:

Well, kind of luckily, I'm a member of the local medical response type thing, so I've gone to a couple of their seminars, and their evacuations are much more kind of global, you know with chemical evacuation for those kind of emergencies, but it does give you an idea of how to triage people and um I guess just from experience you know how to triage people, like if we have to evacuate the patients, who should go first, what equipment is needed, and things like that, and you have good support, I won't say I'm an expert, by no means at all. (P16)

Hospital-based policy and nurses' training related to disaster. Most participants (80%) reported limited knowledge of hospital disaster policies and procedures, though many said there were manuals available on the patient care units and online but they had never

accessed the information personally. When asked about hospital-based disaster training, many participants (60%) cited training in the use of Med Sleds (equipment used to move non-ambulatory patients down stairways in an emergency; <http://www.medsled.com/>; ARC Products LLC, Des Peres, MO, USA). However, many (70%) said they had no hands-on experience with the Med Sled and some did not have any orientation to it before the night of the evacuation. One participant described her disaster-related training: “We were trained on how to use the Med Sled but, like I said, we were in unfamiliar territory. All we were trained for was how to evacuate this unit” (P2).

A few nurses identified general disaster training topics they learned about in formal hospital disaster training: “I hadn't much experience to be honest in terms of training. We had basic training, you know, what numbers to call, like fires or spills . . . but not specifically what happens if there is a hurricane” (P5).

In contrast, many participants did feel they had the ability to successfully transport critically ill patients off the unit and to triage which patients could go home and which required further hospitalization.

Perceived ability of nurses to respond effectively to disaster. Many participants stated they did not feel prepared for the actual hospital evacuation (as compared to a unit evacuation). A younger nurse expressed her thinking at the time she first learned about the evacuation: “I felt like I had no idea what I was doing. I don't know what my role is” (P5). Another participant experienced similar feelings when she heard about the coming evacuation: “I couldn't imagine evacuating in the middle of a hurricane” (P10). However, the few participants with external disaster training did feel prepared.

Clarity of expected roles in disaster. Participants characterized their role with regard to the care of the patients more clearly than how they fit into the disaster command structure of the hospital. One experienced nurse explained what she believes about nurses' understanding of their roles in the organizational structure of the hospital disaster response command structure:

I think organizationally that that command structure, I'm not really sure that all of it, that it really gets down to all the staff, quite honestly. I think the staff probably know what happens on their unit and they defer to the nurse manager if there's an issue on their unit, . . . if it's who to shut off oxygen or what to do, they go to the nurse in charge. So I think . . . that they probably just look at the person on their unit as opposed to the whole structure” (P3)

Another participant described her view of the nurses' role in relation to the patient:

I think I was expected to help out to, if there is evacuation, make sure evacuate the patient in a safe way. And also make sure that before you evacuate, each patient must have, you have to have enough stuff to, to take care of the patient. So this is my main concern and main responsibility." (P7)

Nurse managers ($n = 3$) all articulated their disaster-related responsibilities for nursing staff: providing support and leadership, and identifying means and channels of communication with nurses both within the hospital and at home.

Hospital preparations undertaken prior to the storm. All participants described multiple activities undertaken by the nursing department of the hospital to manage the disaster prior to the evacuation. The first activity was action to insure adequate staffing, including identifying accommodations for nurses to sleep in the hospital to insure a round-the-clock staffing pattern for an indeterminate period of time. This included consolidating and reassigning nurses internally and setting an expectation that nurses would report to duty unless they lived too far away or had significant competing demands.

A second major area of hospital disaster preparedness activities for nursing included triage and discharge of patients who could be discharged and making contact with potential transfer hospitals (this only happened with a few units).

Nurses participated in the relocation of patients within the hospital prior to the storm (same day). Patients were moved away from the east side of the hospital because it was the most vulnerable to the storm. Moves were both horizontal (east to west) as well as vertical (down to lower floors), and patients were consolidated where possible to areas with the best (newly remodeled) emergency power capacity. Nurses prepared the patients for this relocation as "a safety precaution" to "decrease potential fear and panic in the patients." The relocation was described this way by one participant:

They had done a horizontal evacuation ... the whole east side of the hospital to the west side ... because the east side had all of those big windows facing the river, high winds ... before anything had even happened ... just in expectation of how things were gonna go. (P1)

Another participant noted the attention to potential power shortages: "Earlier that same day the hospital had

been moving people around so that patients were consolidated in the areas they knew the emergency power was the best" (P7).

Effects of power loss on nurses' ability to function. Nurses reported two major effects of power loss on their ability to function. The first was the ability to care for patients who required equipment run on electricity. Back-up generators provided an initial power source as did battery back-up, but nurses were also at times manually replacing electronic equipment functions (particularly when transporting patients down the stairs during the evacuation) as well as recharging equipment where possible on other units or floors where there were free outlets.

In addition, medical records and medication carts are also electronic; thus, nurses had to improvise access to both. Because patients were to be transported to other hospitals, medical record data needed to accompany them. Nurses printed electronic medical data prior to power loss in some cases and wrote medical summaries to accompany patients when that was not possible. Medication carts were kept open in anticipation of power failure or broken into if necessary. As one participant remembered, "The nurse managers really scrambled and thought quickly about 'let's get the medication, let's print out the MAR [electronic medical record], let's get the face sheet and vital information they needed'" (P3). Another participant noted, "Nurses went around when the lights started to go and they opened all of the med carts because they open by code" (P7).

The second major effect of power loss was on nurses' ability to communicate with each other, with nursing leadership, or with families. Most participants described the significant problem of limited communication options. With loss of power, hospital telephones went out, cell phones, including smart phones, could not be charged, computers were not available, and, without elevators, face-to-face communication became more difficult.

I think the most frustrating part was the communication. We didn't have phone service, our emergency phone, no electricity, no computers, we're so focused on technology now ... my only way to communicate was to use my Blackberry, the telephone and our cell phones and hopefully they didn't die because we couldn't charge them ... so it was communication. (P6)

Nurses' preparation of patients and families for evacuation. One pediatric nurse described the challenge of communicating about the need for

evacuation while trying to insure that family members and patients did not become anxious:

You know you couldn't be outwardly afraid because the parents are freaking out because you had to be a stronghold for this patient's family ... you kind had to put on a brave face and relay the plan to the parents.... (P1)

Nurse participants described making lists of what each patient would need to take with them and began to gather those things together such as a schedule of medications, vital signs, and downloaded electronic medical record data. Nurses sometimes had to go to other floors, recovery rooms, and intensive rooms to find medication if they did not have sufficient doses to send. Patients who were postoperative or in pain were given pain medication prior to evacuation. In some cases, all of this was done in an hour.

Patients were triaged for evacuation based on acuity. In some situations, the plan for order of the evacuation was changed in midcourse when it appeared to not be working (i.e., evacuating sicker patients first meant slowing down the process because they took longer and everyone still had to wait for ambulances at the bottom), showing adaptability to the circumstances. Nurse participants stressed the importance of remaining calm with patients and families, who responded well as a consequence, and thus the nurses remained calm themselves.

Transport of patients to ground floor during evacuation. The physical evacuation of patients down stairwells took place in two buildings of NYULMC over a period of many hours; the Tisch Hospital (from the 17th through the 8th floor) and Swartz Health Care Center tower (13th through 9th floor). Only a few patients who were left in the hospital were able to walk down the staircases themselves. Physical aspects of the evacuation were described in detail by many participants. The majority of patients (80%–90%) had to be evacuated on Med Sleds, which required heavy lifting for staff. "Doing that over and over again is exhausting" (P9).

One participant described how slow the process was:

If you have ever seen an evacuation with a Med Sled, ... it's very slow because you ... have to be careful of the person in the sled. There's a carabiner that goes on the top and like hooks on to the top of each railing so that, heaven forbid one of us slip and let go, it would continue to have that support. So, every time you did a half a flight of stairs, you have to unhook the carabiner ... so it was a long process. (P1)

Mutual support during the stairway evacuation was described by many participants: And I worked with people I'd never seen before ... but we all had the same goal to bring this patient down safely (P12).

Every single person that worked in any kind of a department here ... like the guys in the suits were up here with hard hats and jeans on and everybody in the world seemed like was up here helping us to move. (P7)

Many participants described the assistance provided by the New York Fire Department and the New York City Police Department as very important to the success of the evacuation. Overall, most participants described the stairway evacuation as "organized," "seamless," "extremely professional," "calm," "very, very orderly," "everyone worked together," "everyone listened to the leader," and "there was never an argument."

Availability of support from nursing leadership during evacuation. Both newer and more experienced nurses described the importance of support from nursing leadership and other leaders in enabling them to fulfill their roles during the evacuation:

I got good direction from the people I needed to get direction from, I felt good in terms of my ability to take care of the patient, to take the patient out ... my nurse manager was right there (P1)

And another explained:

The leadership was great. Our senior leadership was there (at the command center). Our nurse manager was there ... our medical director. And whatever they got from the command center, they were good at disseminating the information to us. (P4)

In contrast, one participant did not experience the level of support needed because of the loss of communication once the power was lost:

I have to say unfortunately, during that night, I did not get a lot of support from the administration because we don't even have communication at that time ... the only immediate communication is from my medical director. (P13)

Implications for education and training. Most participants expressed a need for more training in disaster preparedness in professional education and in the workplace.

But from my experience we didn't know what to expect. So, there was a bit of a culture shock associated

with this, even the hospital administration may have been prepared for this but we didn't know who we have to talk to, how to get the ambulances here, they were prepared, we weren't ... so in the future I think that part of nursing education ... there should be a component ... disaster preparedness. What happens in the event of a disaster, if you are working in a hospital, what may you be called on to do. (P2)

A participant suggested nurses across the city should be educated about the possibility that nurses could be deployed to other hospitals in a disaster, and what expectations would be for receiving facilities:

I think nurses all across the city need to be educated about ... disaster, nurses from 99 different hospitals may show up [at yours] to work ... This is our expectation about how you are going to behave towards them ... what you are going to do to make the transition for them easier. (P2)

Quantitative Survey

The majority of the 173 participants were female (89%), White (73%), and never married (47.9%), and about one third (37%) had children. The vast majority of participants (74%) had received a bachelor of science in nursing degree. All of the nurses who participated in the Hurricane Sandy evacuation had participated in the evacuation for Hurricane Irene the previous year. Echoing the findings in the qualitative interviews, only 32% of participants stated that their prior disaster preparedness training had prepared them for the actual evacuation (Table 1). Communication became a major issue due to loss of power for Internet and land phones; thus, the primary mode of communication nurses reported during the disaster was face-to-face communication (72%) followed by personal cell phone (24%). Once power was lost, 73% of nurses perceived a serious or growing threat to safety of patients and nurses. The majority of participants (75%) reported their disaster and evacuation leaders were nurses, which was an important resource for them. Fortunately, 90% of participants described the evacuation route as easy to follow despite crowding and limited lighting.

The most common resources identified (see Table 1) by participants that helped them to carry out their roles in the evacuation were support from co-workers (77%), support from nursing leadership (55%), their own resourcefulness (51%), and the fact that others remained calm (45%). Other, less frequently mentioned, resources included faith or religious beliefs (16%), previous disaster experience (15%), previous disaster training (12%), belief that the hospital was well prepared (12%),

Table 1. Challenges and Resources of Nurses Who Participated in the Hurricane Sandy Hospital Evacuation (N = 173)

	n (%)
Nurses who participated in Hurricane Irene evacuation	173 (100%)
Potential challenges in the evacuation	
Previous disaster preparedness training helped me manage in this disaster (Agree/strongly agree)	55 (32%)
Primary mode of communication during the disaster and the evacuation (Face to face due to lack of internet, phone or cell power)	124 (72%)
Perceived threat to safety of patients and nurses due to power loss (Very serious or growing problem)	117 (73%)
Availability of leadership during the disaster and evacuation	
Nursing leadership	130 (75%)
Physician leadership	11 (7%)
Difficulty of evacuation route	
Easy to follow	155 (90%)
Potential resources to help nurses carry out their role in the evacuation	
Support from co-workers	132 (77%)
Support from leadership	95 (55%)
Personal resourcefulness	88 (51%)
Others remained calm	77 (45%)
Faith/religious beliefs	28 (16%)
Previous disaster experience	25 (15%)
Previous disaster training	21 (12%)
Felt hospital was well prepared	20 (12%)
Support of family and friends	19 (11%)
Other	16 (9%)
Providing support to others	5 (9%)

support of family and friends (11%), and helping others (9%).

Discussion

We explored the experience of nurses in a large urban medical center responding to a major hurricane, hospital evacuation, and subsequent hospital closure for several months. Nurses participating in the evacuation encountered numerous unanticipated challenges in responding to the disaster but overcame many by drawing on personal, interpersonal, system, and community resources, reflecting the dynamic interrelations among various personal and environmental factors described in Broffebrenner's (1977) Social Ecological Model (SEM). This theory-based framework posits that there are five interrelated levels of the SEM that determine behavior: individual, interpersonal, community, organizational, and policy/enabling environment. As the nurses' narrative accounts illustrated, the support they received

spanned these levels. Nurses credited their personal resilience (individual level), support from co-workers (interpersonal level), support from organizational leaders (organizational level), support from family and friends (community level), and external support from emergency response agencies (policy or enabling environment) as resources that emerged and helped them to address the many physical and environmental challenges the disaster presented.

The challenges nurses encountered began with the unanticipated flooding from the storm that resulted in power loss and subsequently necessitated the hospital evacuation. However, despite the lack of disaster training and education, nurses developed creative responses that drew on multiple resources. For example, the power outage impacted two major areas: patient care and staff communication. Without power, patient electronic equipment was a major concern. To address this problem, nurses devised a plan to use back-up generators and batteries, located outlets for charging equipment, and prepared for manual use of equipment. Because medications are now located in electronically operated carts, nurses immediately unlocked medical carts and located alternate sources for medications (intensive care unit, operating room, pharmacy). Patients being transferred to other health facilities needed to arrive with pertinent medical information. Nurses printed out information needed for transfer while generator power was available and later, when adequate power was unavailable, hand-wrote the summary notes of patients' conditions and needs that was needed for transfer of patients. To address the impact of power loss on staff communication, nurses implemented use of Blackberries where possible and physically went from one unit to another (nurse leaders) for face-to-face communication.

The study confirms the findings in the limited literature on nurses and disaster preparedness. It demonstrated that nurses do play a critical role in responding to disaster (Gebbie & Qureshi, 2006; IOM, 2010) and that those with experience and training report feeling more confident in their ability to respond (Adams & Canclini, 2008).

Conclusions

The narrative accounts and quantitative survey data in this study revealed important lessons learned from this weather-related disaster. It is essential to enhance the resources that can support nurses facing such challenges. FEMA recommends the use of exercises such as an "all hazards approach" where professionals work together to plan necessary steps to prepare for, respond to, and recover from hazards of all types, including climate-related (hurricane) and manmade disasters. They also

recommend the use of "table top" exercises where team members engage and work together to manage the response to a hypothetical incident. These exercises can greatly enhance the ability of participants to function in future events. In particular, disaster preparedness training and policies and procedures for nurses practicing in institutional settings should include preparation for short- and long-term power outages. There is a need to develop and make available more "low-tech" options in the event of power loss (Med Sleds are a good example of replacing elevators) and alternatives for situations when high-tech equipment is not usable. Finally, the dramatic increase in climate-related events worldwide over the past two decades demonstrates the compelling need to learn from these events and to routinely include disaster preparedness in nursing education and training.

Limitations

There are limitations to this study. Qualitative data are not generalizable to other settings; however, they can contribute to an understanding of the experience of participants in disaster events. Also, the study was conducted 6 to 10 months after Hurricane Sandy and the hospital evacuation; thus, study participants' recall could be affected. Despite these limitations, there is remarkable uniformity to the qualitative reports, and these accounts are consistent with the quantitative findings.

Clinical Resource

American Nurses Association. Disaster preparedness & response. <http://www.nursingworld.org/disasterpreparedness>

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SPECIAL ISSUE ARTICLES

Climate Change Effects on Respiratory Health: Implications for Nursing

Maureen George, PhD, RN, AE-C, FAAN¹, Jean-Marie Bruzzese, PhD², & Lea Ann Matura, PhD, RN, CRNP FAAN³

¹ Xi, Associate Professor, Columbia University School of Nursing, New York, NY, USA

² Associate Professor of Applied Developmental Psychology (in Nursing), Columbia University School of Nursing, New York, NY, USA

³ Beta Beta, Associate Professor, University of Pennsylvania School of Nursing, Philadelphia, PA, USA

Key words

climate change, adult, children, COPD, asthma, infectious respiratory disease

Correspondence

Dr. Maureen George, Columbia University School of Nursing, 630 West 168th Street, Mail Code 6, New York, NY 10032.
E-mail: mg3656@cumc.columbia.edu

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Abstract

Purpose: Greenhouse gases are driving climate change. This article explores the adverse health effects of climate change on a particularly vulnerable population: children and adults with respiratory conditions.

Approach: This review provides a general overview of the effects of increasing temperatures, extreme weather, desertification, and flooding on asthma, chronic obstructive lung disease, and respiratory infections. We offer suggestions for future research to better understand climate change hazards, policies to support prevention and mitigation efforts targeting climate change, and clinical actions to reduce individual risk.

Findings and Conclusions: Climate change produces a number of changes to the natural and built environments that may potentially increase respiratory disease prevalence, morbidity, and mortality. Nurses might consider focusing their research efforts on reducing the effects of greenhouse gases and in directing policy to mitigate the harmful effects of climate change. Nurses can also continue to direct educational and clinical actions to reduce risks for all populations, but most importantly, for our most vulnerable groups.

Clinical Relevance: While advancements have been made in understanding the impact of climate change on respiratory health, nurses can play an important role in reducing the deleterious effects of climate change. This will require a multipronged approach of research, policy, and clinical action.

Nurses, the largest global health workforce group (World Health Organization, 2016b), are critically important to efforts aimed at increasing patient and public awareness of the effects of climate change on human health, anticipating threats to individual health, assessing communities' environmental health vulnerabilities, and lessening the health effects of climate change (Canadian Nursing Association, 2008). Nurses can accomplish these aims through research, practice, and policy that strengthens community resilience, narrows health inequities, and facilitates positive adaptation in the face of climate stressors (Anderko, Davies-Cole, & Strunk, 2014; Goodman, 2015).

Unfortunately, the health threats inherent in climate risk exposures are poorly understood by many

nurses (Adlong & Dietsch, 2015), who often see climate change actions as incongruent with their daily work (Anåker, Nilsson, Holmner, & Elf, 2015). Further, education curricula focused on climate change are scant (Barna, Goodman, & Mortimer, 2012; Goodman, 2015; Richardson, Grose, Doman, & Kelsey, 2014; Richardson et al., 2016). To address these gaps, deans from schools of nursing, medicine, and public health have created a global partnership committed to training their students to effectively address the health impacts of climate change (The White House, 2015), supporting the integration of content across science and clinical course work (pediatrics, maternal health, geriatrics, chronic diseases). The purpose of this review of the literature, therefore, is to provide an overview of climate change effects on

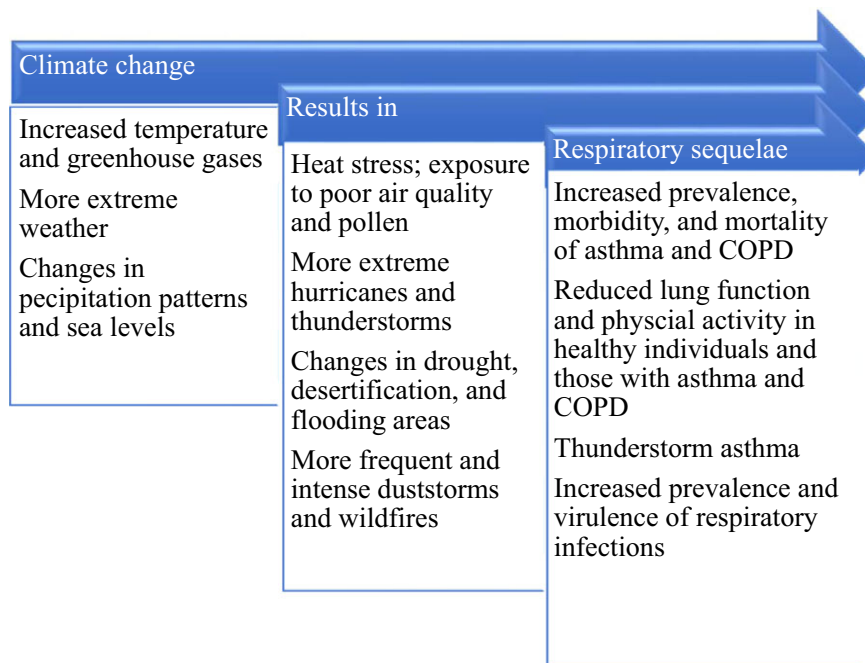


Figure 1. Effects of climate change and its respiratory consequences. COPD = chronic obstructive pulmonary disease.

human respiratory health, highlighting the role of nurses in shaping research priorities, practice standards, and policies to minimize these risks.

We first review the climate change events that will impact respiratory health. Next, we examine the dangers of climate impact on specific respiratory disease populations (e.g., chronic obstructive pulmonary disease [COPD], adult and pediatric asthma), identify reasons why respiratory infectious diseases will increase with climate change, and explore the threats to human health if these risks are not lessened (**Figure 1**). We conclude with the policy, research, and practice changes that will be needed for nurses to meet the challenges to population health posed by climate change.

The Impact of Climate Change on Factors Associated With Respiratory Health

Carbon dioxide (CO₂) and black carbon (BC) are the leading greenhouse gases implicated in global warming. These gases are the end-products of fossil fuels burned in order to power industrial processes, and air, marine, rail, and road transportation. Together with greenhouse gases formed from agricultural burning (deforestation), wildfires, and volcanic eruptions, CO₂ and BC cause increases in average temperature, more extreme weather, changes in precipitation patterns, and rising sea levels (Engelthaler et al., 1999; National Academies of Sciences Engineering and Medicine, 2016). Changing weather

patterns mean that days are hotter than average seasonal temperatures in the summer, which increases ground-level ozone (O₃) and the levels of outdoor air pollutants such as fine particulate matter (PM) and CO₂. In turn, higher CO₂ levels increase the volume of allergenic plant growth, the speed of growth, and the amount of pollen produced and released while also extending the plants' range and the length of the pollen-producing season (D'Amato et al., 2007; D'Amato, Cecchi, D'Amato, & Annesi-Maesano, 2014; Engelthaler et al., 1999). Additionally, PM and O₃ have been shown to have an inflammatory effect on the airways, allowing easier airway penetration of aeroallergens that produce respiratory effects (D'Amato et al., 2014).

Climate change is expected to drive more extreme weather events, which have the potential to increase respiratory-related morbidity and mortality. For example, severe weather, such as thunderstorms and hurricanes, is expected to increase in frequency and intensity (Crimmins et al., 2016). The rainwater from these storms is thought to hydrate and rupture pollen grains, releasing inhalable aeroallergens that, under typical conditions, would be too large to be respirable. When this occurs in high pollen seasons such as in late spring and summer, asthma epidemics can occur (D'Amato et al., 2007; D'Amato et al., 2014), as was recently the case in Australia when eight persons with asthma died and 10,000 required hospital treatment after a severe thunderstorm was implicated in the release of dangerous

levels of ryegrass pollen (Innis, 2016). Acute respiratory infections also increase following hurricanes (Centers for Disease Control and Prevention, 1999).

Further, more severe and more frequent wildfires and dust storms can be anticipated due to increased drought and desertification resulting from climate change. These wildfires and dust storms have the potential to transport high concentrations of PM thousands of miles from their source (De Sario, Katsouyanni, & Michelozzi, 2013). Dust storms also have the potential to carry bacteria, fungi, and influenza across vast distances, posing a serious health risk to those with a compromised respiratory status (Wu, Lu, Zhou, Chen, & Xu, 2016; Xu et al., 2012). Changing precipitation patterns and rising sea levels will cause more flooding, which has been linked to spikes in both indoor and outdoor levels of microbes and mold (D'Amato et al., 2014; Institute of Medicine, 2011; Takaro, Knowlton, & Balmes, 2013).

Climate changes may also influence the survival, reproduction, or distribution of allergens/pathogens (bacterial, viral, and fungal), vectors, hosts, and disease transmission (Institute of Medicine, 2011; Wu et al., 2016). For example, warmer and longer seasons will extend the range and activity of stinging insects, and as a result, more cases of anaphylaxis can be projected (D'Amato, 2002; Institute of Medicine, 2011). El Niños, recurring patterns of warm water that influence global climate patterns, will be more common and more powerful in coming years; hantavirus pulmonary syndrome is more prevalent when El Niños occur (Hjelle & Glass, 2000). These types of climate pattern changes, along with more extreme weather events, will likely affect vectors and host immune responses too, leading to higher incidence and virulence of respiratory infections, including zoonotic and waterborne bacterial respiratory infections.

Taken together, the effects of climate change on the built and natural environments will contribute significantly to increases in the prevalence of pulmonary, allergic, and infectious respiratory diseases and their associated morbidity and mortality.

Climate Change and Respiratory-Related Diseases and Infections

Chronic Obstructive Pulmonary Disease

Although respiratory disorders are prevalent worldwide and contribute significantly to global morbidity and mortality, climate change is creating a rise of health-related respiratory diseases. According to the World Health Organization, over 235 million people suffer from asthma (World Health Organization, 2013), and 65 million people are living with COPD (World Health

Organization, 2016a). Three million people die from COPD each year, and the World Health Organization predicts COPD will be the third leading cause of death by 2030 (World Health Organization, 2016a), with climate change–driven heat stress, outdoor and indoor air pollution, and respiratory infections identified as major contributing factors. Increasing levels of ground-level O₃ (Cheuvront & Haymes, 2001), hotter than average seasonal temperatures in the summer and temperature extremes have all been implicated as contributing to premature death in those with respiratory conditions (Crimmins et al., 2016). In fact, many of the 70,000 who died in a 2003 European heat wave had co-existing respiratory conditions (Robine et al., 2008).

Asthma

In particular, asthma is strongly influenced by changing environmental factors. Increasing temperatures and altered rainfall patterns, along with the changing frequency and severity of extreme weather patterns, which include extreme heat, floods, and storms, can increase the number of people affected with asthma (McIver et al., 2015). Moreover, there has been an increased prevalence in allergic respiratory disease and asthma over the past decades (D'Amato, Vitale, Lanza, Molino, & D'Amato, 2016) as a direct result of changes in the production and dispersion of pollen (D'Amato et al., 2015; D'Amato et al., 2016). In addition, long-term continuous exposure to high levels of O₃ may reduce lung function in adults (and children) and contribute to the increasing prevalence of both asthma and COPD (McConnell et al., 2002).

Asthma in older adults. Older adults have anatomical and physiological changes that put them at increased risk for experiencing adverse sequelae due to climate change (Sharma & Goodwin, 2006). Structurally, chest wall changes impair respiratory compliance, increasing the workload of breathing. Additionally, there is a decrease in respiratory muscle strength, impairing and weakening their cough reflex making them less able to clear irritants due to climate change. Overall, older adults have decreased lung function with aging.

Asthma in children. Asthma is a significant pediatric health concern. Its prevalence, highest during childhood (Sears et al., 2003), has been increasing over the past six decades, with the estimated overall worldwide prevalence of current asthma being 11.7% among children 6 to 7 years old and 14.1% among those 13 to 14 years old (Mallol et al., 2013). Children are especially vulnerable to the negative effects of climate change due to the fact that children are physiologically different from

adults, and that children are exposed to a greater amount of pollutants and allergens than adults.

The respiratory and immune systems of children are still developing and, as such, differ significantly from those of adults, with the consequences of exposure to toxins having more harmful results. Lung development is an ongoing process, with most of the development occurring postnatally, and not being complete until 18 to 20 years of age (Dietert et al., 2000); the developing lung is very susceptible to damage when exposed to environmental pollutants (Miller & Marty, 2010). In addition, children have smaller lungs and airway passages, and when inflammation occurs because of exposure to inhaled agents, inflammation can significantly block air flow. This is in contrast to adults, in whom the larger airways may allow for air to be distributed throughout the lung, bypassing inflamed areas. Additionally, children's immature immune systems (Dietert et al., 2000) make them more vulnerable to respiratory infections because children cannot fight the negative effects when exposed to toxins.

Another factor contributing to the increased vulnerability of children to climate change is their greater exposure to pollutants and allergens. One reason for this is that children breathe more rapidly than adults (Bunyavanich, Landrigan, McMichael, & Epstein, 2003), inhaling a higher volume of air per kilogram of body weight (Tzivian, 2011). Additionally, their relatively more narrow airways leads to more tissue exposure per volume inhaled, which in turn results in more inflammation (Bunyavanich et al., 2003). Children are also exposed to more pollutants and allergens because children play outdoors more and have higher rates of mouth breathing with exercise. As such, children are exposed to a greater amount of polluted air and allergens, which enters directly into their lungs with mouth breathing, bypassing potential filtration that takes place in the nasal passages, increasing parenchymal damage (Bunyavanich et al., 2003). Moreover, relative to adults, children play closer to the ground, where particulate matters are found in higher concentrations (Kenagy, Lin, Wu, & Heal, 2016).

Infectious Respiratory Diseases

It is expected that climate change will increase infectious respiratory diseases. For example, hantavirus pulmonary syndrome caused by exposure to deer mice urine and feces (Khasnis & Nettleman, 2005) is more prevalent when El Niños occur (Hjelle & Glass, 2000). As of January 2016, there have been 690 cases of hantavirus pulmonary syndrome in the United States, with a mortality rate of 36% (Centers for Disease Control and

Prevention, 1999). There are no effective treatments to date. Variable rainfall associated with El Niños has been hypothesized to affect the production of the pine nuts on which deer mice feed (Douglass, Calisher, & Bradley, 2005) or to increase the likelihood that deer mice seek shelter in homes (Engelthaler et al., 1999), increasing deer mice populations and human contact, which in turn increases the risk for disease transmission. Increases in humidity and temperatures will also support the transmission and survival of influenza virus (Wu et al., 2016).

Respiratory-related mortality is also higher in sand dust storms (Stanley & Farrant, 2015) and in heat waves due to more occurrences of infectious respiratory diseases (Kan, 2011). Climate change and extreme weather events will likely lead to higher incidence and virulence of waterborne bacterial respiratory infections, like Legionella (Yoder et al., 2008), and respiratory fungal infections like aspergillosis; an outbreak of aspergillosis struck survivors of the 2011 tsunami in Japan (Mirsaeidi et al., 2016).

Morbidity Associated With Respiratory Disease and Respiratory Infection

Seventy-five percent of CO₂ emissions are directly related to fossil fuel burning and agricultural burning (deforestation; D'Amato et al., 2016). Air pollution and high pollen counts affect health, especially for those with chronic respiratory diseases like COPD and allergic asthma. Inhaling O₃ causes epithelial damage, with a subsequent inflammatory response that affects the upper and lower airways (D'Amato et al., 2016). When air pollution exceeds safe levels, emergency department visits increase and patients with asthma experience more symptoms (D'Amato et al., 2011). As O₃ levels increase, lung function is reduced, airways become more hyperreactive, and the risk for asthma and COPD exacerbations increases (D'Amato, 2002). Long-term continuous exposure to high levels of O₃ impairs respiratory function and exacerbates airway inflammation not only in patients with asthma, but also in healthy individuals. Increased temperatures are associated with more emergency room visits and hospitalizations for pneumonias, asthma, and COPD (Ostro, Rauch, Green, Malig, & Basu, 2010), and heat waves contribute to increased morbidity from infectious respiratory diseases (Kan, 2011).

Physical activity is important in both healthy individuals and individuals with chronic illnesses; over 3 million deaths are attributed to insufficient physical activity annually (World Health Organization, 2016c). In healthy individuals, increased temperatures and changes in air quality can significantly limit physical activity performance (Cheuvront & Haymes, 2001). Increased heat

stress associated with climate change can also negatively affect lung function and exercise capacity in patients with COPD (Jehn et al., 2013). In a cross-sectional analysis of 10,898 adults in the National Health and Nutrition Examination Survey, individuals with respiratory conditions reported changing their activities due to poor air quality (Wells, Dearborn, & Jackson, 2012). Increases in air pollution are associated with greater symptom burden (e.g., cough) and a limitation in walking for those with asthma and COPD (Alahmari et al., 2015). As mentioned previously, indoor air quality is also negatively affected by climate change; indoor aerobic exercise may increase the inhalation of indoor air pollutants (Ramos et al., 2015).

Anticipating, Responding to, and Lessening the Impact of Climate Change: The Role of Nurses

The potential exists for respiratory disease epidemics and respiratory infection pandemics to overwhelm healthcare systems and bankrupt global and human resources. In these scenarios, vulnerable patient groups will suffer the most. Combating the deleterious effects of climate change on respiratory health will require a multipronged approach. While it will take generations to reduce the health effects of greenhouse gases, there are immediate opportunities for nurses to lead research, practice, and policy initiatives aimed at lessening these effects. In fact, national nursing organizations (American Association of Colleges of Nursing, 2011) and international nursing organizations (International Council of Nurses, 2012) mandate such actions. The only risk is if nurses choose not to act. **Table 1** identifies research, practice, and policy strategies that nurses can undertake to reduce the harmful health effects of climate change, detailed in the following three sections.

Setting a Climate Change Research Agenda

Nurse scientists must contribute to the growing body of bench-to-bedside scientific evidence that documents the health impacts of climate change and evaluates the efficacy and effectiveness of interventions focused on reducing exposure or on reducing the health effects of unavoidable exposure. While more research is needed on understanding the driving forces behind climate change, efforts must also be focused on understanding vulnerability. To that end, data are needed on factors that may modify the effects of climate change (e.g., sex, age, socioeconomic status; Xu et al., 2012) so that we may better understand the potentially differential impact on subpopulations (Bunyanich et al., 2003). Similarly, examining

Table 1. Nursing Strategies to Reduce the Harmful Effects of Climate Change

Priority areas for	
Nursing research	<p>Develop programs of research focused on enhancing understanding of</p> <ul style="list-style-type: none"> the health impacts of climate change the efficacy and effectiveness of risk reduction interventions vulnerable populations (those with respiratory or mental health conditions, reduced mobility or cognitive function, the poor, children, those who reside or work in prone-risk areas) social factors that foster adaptation or alter risk decision support and integrated assessment tools
Nursing practice	<p>Provide evidence-based information to help patients develop adaptive strategies focused on modifying exposure to excessive temperatures, extreme events or poor air quality</p> <ul style="list-style-type: none"> Daily monitoring of heat, air quality and pollen counts Identification of alternative locations and types of physical activity during periods of excessive heat, pollution, or pollen counts Identification of best times and locations (inside/outside) for exercise Securing appropriate shelter during extreme weather events Use of personal cooling garments and devices <p>Support disaster preparedness and response efforts</p> <p>Integrate effects of climate change in clinical coursework (pediatrics, maternal health, geriatrics, chronic diseases, etc.)</p>
Nursing policy	<p>Promote public health initiatives (e.g., public transportation, improved air quality standards, mitigation programs focused on water-borne, airborne, or vector-borne illnesses)</p> <p>Participate in urban planning efforts to increase safe, accessible, walkable green spaces</p> <p>Develop relationships with local governments or planning commissions to improve the built environment</p> <p>Promote efforts to reduce healthcare systems' carbon footprint (e.g., waste management, green buildings, energy and purchasing, safer chemical use)</p> <p>Support national and international efforts to capture and store (underground sequestration) CO₂ and energy</p>

existing social factors that may foster adaptation, or alter risk, to climate change (e.g., participation in sports) is needed (Xu et al., 2012). Decision support and integrated assessments will be needed if tailored adaptation and prevention strategies are to be designed and tested (Corell et al., 2014).

Nursing Practice in the Era of Climate Change

There is a need for nurses to help their patients develop adaptive strategies, which focus on modifying the

built environment to respond to the negative impact of climate change that has already occurred (Sheffield & Landrigan, 2011). For example, nurses may want to be involved in actions to minimize exposure to smoke from fuels (Institute of Medicine, 2011). Nurses can assess patients' risk by evaluating their overall health, including respiratory function. Nurses may want to consider assessing the environment where patients live and work (or go to school, for pediatric patients), including air quality by noting the proximity to emissions from cars (living close to highways) or factories and their mass transit accessibility. Teaching families how to assess allergen exposure and palliative measures are also important steps nurses can take.

Patient education may focus on changing physical activity patterns of asthma and COPD patients in response to temperature extremes (Jehn et al., 2013) or poor air quality indices (Wells et al., 2012). Nurses could assess a patient's usual physical activity patterns and develop personalized interventions. Educating patients on where to exercise (indoors versus outdoors; Wen, Balluz, & Mokdad, 2009) and when to exercise (e.g., early morning when temperatures, pollutants, and pollen levels are lower) requires that patients understand what exposures pose a risk and where important data on temperature, air quality, and pollen counts can be found. In Australia, patients responded to extreme heat by employing personal cooling techniques in addition to engaging in physical activity during the morning hours (Banwell, Dixon, Bambrick, Edwards, & Kjellström, 2012). This strategy can also be used during periods of extreme cold; for example, performing activities when temperatures are warmer in the afternoon hours or exercising indoors (Carey, Aase, & Pliego, 2010).

Climate Change Policy

From a policy perspective, nurses might become involved in efforts to promote public transportation or increase urban tree canopy or may want to be involved in urban planning efforts to increase economic development and reduce economic disparities (Xu et al., 2012). Other policies around providing green, open spaces that are accessible to residents in conjunction with efforts to improve air quality may foster recreational walking that can promote physical activity and well-being in individuals with respiratory illnesses (Chaix et al., 2014). Community-level interventions might also target the features of the built environment that conspire against control of respiratory disease (Keddem et al., 2015), such as ventilation and weatherization of homes in which vulnerable populations reside (Institute of Medicine, 2011). Lastly, nurses may want to consider becoming involved

in efforts within their healthcare system to reduce the agencies' carbon footprint (Muñoz, 2012; Stanley & Farrant, 2015; Wormer et al., 2013). For example, nurses could encourage their healthcare system to make operating rooms green by using reusable gel pads, powering down operating room lights and equipment when not in use, and using alcohol-based waterless scrub; decrease hospital waste by segregating nonhazardous waste (e.g., paper, metal, glass) from infectious waste; use recyclable products and reusable cups and dishware in break rooms; and have monitors and computers go into sleep mode automatically when not in use.

Conclusions

Climate change produces a number of changes to the natural and built environments that lead to potential increases in the severity and prevalence of respiratory diseases, and children appear to be most vulnerable. While advancements have been made in understanding the impact of climate change on respiratory health, additional work is needed to help prevent and reduce the deleterious effects of climate change. Nurses can play an important role in reducing this negative effect of climate change with a range of actions, including developing, implementing, and evaluating strategies to directly reduce greenhouse gases, being involved in policy work, and considering the impact of climate change in their clinical assessment of patients and tailoring treatment and education based on these assessments.

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Clinical Resources

- American Academy of Nursing's Expert Panel on Environmental & Public Health <http://www.aannet.org/expert-panels/ep-environmental-and-public-health>
- Natural Resources Defense Council, <https://www.nrdc.org/>
- Health Care Without Harm's Nurses Climate Change Toolkit, <https://noharm-uscanada.org/content/us-canada/nurses-climate-change-toolkit>

- Canadian Nurses Association, https://www.cna-aiic.ca/~media/cna/page-content/pdf-en/climate_change_2008_e.pdf?la=en
- Campaign for Action, <http://campaignforaction.org/climate-change-health-nursing/>
- Alliance of Nurses for Healthy Environments, <http://envirn.org/>
- American Nurses Association's Principles of Environmental Health for Nursing Practice with Implementation Strategies, <http://www.nursing-world.org/MainMenuCategories/WorkplaceSafety/Healthy-Nurse/ANAsPrinciplesofEnvironmentalHealthforNursingPractice.pdf>

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SPECIAL ISSUE ARTICLES

Enabling a Disaster-Resilient Workforce: Attending to Individual Stress and Collective Trauma

Victoria H. Raveis, PhD¹, Nancy VanDevanter, DrPH², Christine T. Kovner, PhD³, & Robyn Gershon, DrPH⁴

1 Research Professor and Director, Psychosocial Research Unit on Health, Aging & the Community, New York University College of Dentistry, New York, NY, USA

2 Professor, New York University, College of Nursing, New York, NY, USA

3 Professor, New York University, College of Nursing, New York, NY, USA

4 Clinical Professor, College of Global Public Health, New York, NY, USA

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Correspondence

Dr. Victoria H. Raveis, Psychosocial Research Unit on Health, Aging & the Community, New York University, College of Dentistry, 137 E. 25th Street, Rm 503, New York, NY 10010.
E-mail: vr31@nyu.edu

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Abstract

Purpose: Superstorm Sandy forced the evacuation and extended shutdown of New York University Langone Medical Center. This investigation explored how nurses were impacted by the disasters and how they can best be supported in their nursing responsibilities.

Design: Sequential mixed methods were used to explore the psychosocial issues nurses experienced throughout the course of this natural disaster and its lingering aftermath.

Methods: In-depth interviews were conducted from April to June 2013 with a subsample of nurses who participated in the evacuation deployment ($n = 16$). An anonymous, Internet-based cross-sectional survey sent to all registered nurses employed at the hospital at the time of the storm explored storm impact and recovery. Between July and September 2013, 528 surveys were completed.

Findings: The qualitative data revealed challenges in balancing professional obligations and personal concerns. Accounts described dealing in the immediate recovery period with unexpected job changes and resultant work uncertainty. The storm's lingering aftermath did not signify restoration of their predisaster lifestyle for some, but necessitated coping with this massive storm's long-lasting impact on their personal lives and communal loss.

Conclusions: Nurses working under the rapidly changing, uncontrolled, and potentially dangerous circumstances of a weather-related disaster are also experiencing concerns about their families' welfare and worries about personal loss. These multiple issues increase the psychosocial toll on nurses during a disaster response and impending recovery.

Clinical Relevance: Awareness of concerns and competing demands nurses experience in a disaster and aftermath can inform education and services to enable nurses to perform their critical functions while minimizing risk to patients and themselves.

Globally, the scope and frequency of natural disasters—particularly climate-related disasters—are increasing, and the human impact of these events is widening. Since 2000, climate-related disasters have increased 44% from the 1994–2000 average (Centre for Research on the

Epidemiology of Disasters, 2015). Large-scale natural disasters are by their very nature extremely disruptive, overwhelming a community's infrastructure and severely impacting access to essential public health and medical services. The emergency response goals in a natural

disaster are twofold: to continue to maintain provision of the public health services, and to provide acute response to the public health needs created by the disaster. Natural, weather-related disasters such as hurricanes provide considerable forewarning of the event and enable preparedness planning.

During these catastrophic events, significant burdens are imposed on those individuals engaged in the delivery of essential public health and medical services, such as nurses, who must balance professional obligations along with the demands of their personal life, such as family needs (Adams & Berry, 2012; Qureshi et al, 2005). Experiencing a disaster can have both short- and long-term effects. A growing body of research is documenting that emergency response and healthcare workers are at increased risk for developing mental health conditions, such as post-traumatic stress disorder, depression, and anxiety (Benedek, Fullerton, & Ursan, 2007). Given the nature of their work, nurses are at particular risk for compassion fatigue, burnout, and psychological trauma (Johal, 2015; Qureshi et al., 2005).

When Superstorm Sandy hit the New York–New Jersey coastline in October 2012, the vulnerability and interdependence of area hospitals and healthcare workers were revealed. Severe flooding from the storm surges forced an evacuation of New York University Langone Medical Center (NYULMC), a 725-bed tertiary care facility in New York City, during the height of the storm, and subsequently an extended shutdown, along with other area hospitals in the flood zone, of essential healthcare facilities. Superstorm Sandy was the second storm to result in the evacuation of NYULMC within a 14-month period. Even though weather-related disasters can provide for considerable forewarning and an opportunity for predisaster planning, the psychosocial toll on nurses working in such rapidly changing circumstances can be considerable.

The primary aim of this study was to assess nurses' experiences and the challenges they faced during Superstorm Sandy in order to identify how nurses can be supported to function effectively before, during, and after a weather-related disaster. The study was approved by the NYULMC School of Medicine Institutional Review Board.

Methods

Study Design

In order to develop a more complete understanding of the NYULMC nurses' experiences during this event and to contextualize the data (Miles & Huberman, 1994), we implemented a sequential mixed-methods study consisting of in-depth qualitative interviews with a purposive

sample of the hospital nurses followed by a quantitative Internet survey of the hospital nursing staff employed at the time of the evacuation and deployment.

Qualitative Interviews

Sample and recruitment. We recruited a purposive sample of 20 nurses reflecting the diversity of practice areas, nursing experience, and organizational role in the disaster. Nurses were contacted by the research team via text, e-mail, or phone and invited to participate in a 60-min semistructured interview to explore their Superstorm Sandy experiences. Sixteen of the 20 nurses sampled agreed to participate and completed an interview (response rate 80%); 12 of the participants held staff nurse positions, and 4 had management positions. The interviews were conducted by experienced qualitative interviewers in a private setting from April to June 2013. Participants were assured that no individual identifiers would be collected. They consented to the digital audio recording of the interview to insure the accuracy of the data, and were informed that the recording would be deleted immediately after the interview was transcribed. Participants were also given an information sheet describing the study and contact information for the principal investigator and the NYULMC School of Medicine Institutional Review Board.

Measures. We drew on the extant disaster literature and held informed discussions with a small group of nurses with disaster experience to develop the qualitative interview guide. Topics covered prior disaster experience and training, communication and experience during the disaster, the evacuation and deployment, and challenges and experiences during recovery.

Qualitative data analysis. The interviews were transcribed verbatim and read by the research team. Data reduction was a three-level coding process: open coding, focused coding, and then, identification of major themes. A detailed code book was developed. Interviews were coded and entered into ATLAS.ti 6.0 (<http://atlasti.com/>) by a trained qualitative researcher. To establish inter-rater reliability, a subset of 20% was independently coded by a research student familiar with the study. Consistencies were 84%, appropriate for inter-rater reliability (Plano Clark, 2010).

Quantitative Survey

Data for the cross-sectional study were collected from July to September 2013 using an Internet-based survey. The survey instrument was constructed after the

qualitative interviews had been conducted and analyzed to inform the survey content.

Sample and recruitment. The population of interest was all registered nurses (RNs; $n = 1,668$) who were employed by NYULMC and worked on inpatient units on October 29, 2013. We included all nurses even if they were not on site during the evacuation. Nurses were recruited via e-mail using procedures described below.

Measures. We collected information on sociodemographic factors, disaster preparedness prior to the evacuation, perceptions of their disaster experience and recovery, the impact of the storm on their home life, and their experience with deployment to other area hospitals. The survey was placed on a secure web site at NYULMC using Qualtrics survey software (Qualtrics, Provo, UT, USA). Prior to sending out the link to the survey, the survey was tested by several research staff members.

Data collection. The confidential link to the e-mail addresses of all nurses who worked at NYULMC was obtained from the hospital's Senior Vice President and Chief Nursing Officer at the hospital. At no time did the researchers have a list of the nurses' e-mails. We sent a total of four e-mails. To preserve confidentiality, we did not keep a record of who responded and who did not. Therefore, all nurses received all four e-mails. The first e-mail described the study purpose and alerted the nurses that they would shortly get an e-mail with a link to the survey. No e-mails bounced back, but one respondent said that she no longer worked at NYULMC. We sent the second e-mail 3 days later, providing the link to the online Qualtrics survey on a secure web site at New York University. Qualtrics gave each respondent a unique identification code. Reminder e-mails were sent 2 and 3 weeks after the initial e-mail. Of the 1,668 nurses contacted, 528 returned responses, for a response rate of 32%.

Quantitative data analysis. The online survey data were downloaded into an SPSS data file (IBM Corp., Armonk, NY, USA). Six cases were eliminated because they did not meet the inclusion criteria; they were not RNs working at the time of the storm.

Results

Qualitative Interviews

There are three phases to a weather-related disaster, such as the Superstorm Sandy event: peri-event phase,

during which awareness of the risk of a major weather-related disaster is predicted and advance planning and preparations are implemented; the event phase; and the recovery period. Our content analysis of the participants' narrative interviews yielded a rich description of the psychosocial issues and related events at each phase of Superstorm Sandy.

Peri-Event Phase: Hurricane Sandy Is Predicted to Hit New York City

Disaster concerns and expectations. For some nurses, their assessments and expectations of the impact of the anticipated hurricane were informed by a prior experience with a weather-related disaster. Several nurses specifically mentioned Hurricane Irene from the prior year. Prior to Superstorm Sandy, Irene was the largest hurricane to hit the New York metropolitan area in more than 25 years, and preparations for its predicted impact prompted widespread closure and evaluations. Irene was downgraded to a tropical storm just before it reached New York City, and its impact was significantly less severe than predicted. As one nurse commented, "Working during Hurricane Irene ... I just kinda compared it, so I wasn't concerned. I figured by the time it hit New York, it would be, you know, it would've died down."

Others recalled the uncertainty and associated anxiety they felt as Sandy drew closer to the New York City region:

I was worried ... I was a mess ... I really wasn't sure what was going to happen ... I was nervous that I probably wasn't going to get home for a few days and what was going to happen. It's always that fear of the unknown.

Nurses also shared that their concerns and worries about their family's safety. As one nurse recounted,

I wasn't so much worried about myself because I knew that I would be here ... in this big structurally sound building with people I knew and knew me ... I was more worried about him [husband] being by himself.

Disaster preparedness planning. The nurses' accounts contained descriptions of the various preparations some of them carried out to ensure that the impending storm would not impede their fulfilling their professional responsibilities. Because the hospital staff lived across a wide geographic area, many had lengthy commutes and relied on public transportation to get to NYULMC. Several related that as Sandy approached New York City, they brought along extra clothing and supplies, as they expected that they would need to stay on duty longer

and feared that they would experience difficulties traveling back home. As one nurse stated, "I packed a bag . . . I packed a few pairs of scrubs. I put toiletries in 'cause I knew I wasn't gonna be coming home and, you know, I said: 'Let me gear up for it.'"

Nurses also recounted coming into New York City hours early, well in advance of the storm, to be certain that they would be at the hospital for their shift the following day. One nurse, who stayed with a friend the night before Sandy was expected to hit New York City, recalled, "It was very eerie that night going to my friend's apartment 'cause I was on the last train to Penn Station." Others changed their mode of travel to try to alleviate lengthy delays traveling back home once their shift ended:

I drove to work that night because I thought, "Well, if there is a flood, if something happens, I don't want to be stuck in Manhattan on the trains" . . . I picked up a colleague on the way.

Balancing personal and professional demands.

Many nurses reported being challenged with competing role demands as they tried to make arrangements that would enable them to fulfill their professional duties and also attend to their personal responsibilities as a parent, spouse, and adult child in anticipation of the scope of destruction that the storm could potentially create. In these instances, torn between personal and familial responsibilities and professional obligations, a number of nurses reported experiencing anxiety and stress as they carefully reviewed their options and tried to make the appropriate decision that fit their circumstances.

One nurse decided, after discussing her situation with her nursing supervisor, to travel back home when her shift ended on Sunday evening. Because mass transit service was being suspended in anticipation of the storm, she knew that once she left the city she would be unable to travel back in for work the next day. She recalled how difficult this decision was to make and stated that she was distressed and had ambivalent feelings. As she recounted, "I looked at my mom. She was really grateful [that I was there], so it was comforting, but not really comforting enough because my heart is really, I mean that's my profession." She then explained:

I like giving my life to my profession, my career and here I literally left. And although I told my boss and he was like, "No, go home," but I knew that other people had stayed overnight. It was offered to me several times, but it was a choice I made [to go home]. I just have to live with it.

Even those nurses who reported for their shift described an emotionally charged dilemma and a decision fraught with feelings of unease as the following account illustrates:

I was scheduled to come to work that Monday morning. It was really windy and my husband was like, "There's no way you can go. There's going to be a storm." And I was like, "Well, I really need to be there. It's, you know, I'm scheduled to be there." And then at that point it became a decision of whether to leave my family to come to work . . . and I thought, "OMG, if something happened to them, how guilty would I feel because I left?" You know? But at the same time, I was torn.

She then related further that she did prepare the household for the storm: "I said, 'I really feel like I need to be at work and I went to the grocery store yesterday. I stocked the house, you should be fine.' Like that was my way of making it ok."

The nurses' reports also documented that some family members were supportive of their relative's public service duty, understanding that this responsibility would take precedence over their personal life: "My husband sort of said to me: 'You're wrong. You are a nurse and a nurse first.' And when he said that to me, much like now, I started to kind of tear up." Other narrative accounts documented the burden family members experienced as the following illustrates:

We both worked through 911, so this wasn't the first experience with having to deal with a crisis. But this time around I had a daughter . . . He [husband] had to go in early. I knew I had to get into the city, and it was funny, cause then my daughter comes to me and goes, "What's gonna happen to me? Where am I gonna go? . . . I hate having parents that are first responders."

Event Phase: Superstorm Sandy Hits New York Metropolitan Area

Maintaining contact with family and other network members. The nurses' narratives documented that it was critically important to maintain contact throughout a disaster event when physically separated from family and other network members. Knowing that loved ones were safe and the status of their home and other possessions enabled the nurses to focus on their patients and their safety. As one nurse, who was working on one of the inpatient units the evening Superstorm Sandy struck, observed,

I was more just focusing on here and what was going on here [NYU Langone]. I had been getting some text messages to my phone earlier in the night from some of my friends and family, so at least I knew that they were ok. I knew they were safe.

Another similarly related:

I had spoken to my mother when I got to the hotel. She was fine, and my husband was fine. We didn't lose power where I live. My daughters were fine. I had called all of them I was less concerned about them because I knew they were safe and okay. I think I was more concerned about staff and patients and making sure everybody was outta here.

As disasters are dynamic events and the situation can change over time, being able to maintain communication with family and other network members over the course of the disaster event provides continued reassurance that they are still safe, reducing any worry that could develop as the storm intensified. As one nurse related:

I was able to call her [wife] before I start work, and around like, the last call I made was at 11:30 [p.m.] At that time she says she's fine, and the kids are sleeping . . . so I did not really feel concern too much at that time.

Communication breakdown during hospital evacuation. The nurses' accounts document the intense concerns that were precipitated by the breakdown in communication with the outside world that occurred during the hospital evacuation, as the following succinctly illustrates:

Once we got out to First Avenue, there was like a half a bar of service. And once I got that half a bar, I got nine text messages, six e-mails, three voice-mails, and, it was all my family and friends, and boyfriend, who lives far away. All checking in on me, because, after midnight, no one had heard anything from me. Because we were evacuating and that was the last thing I heard. I couldn't get in contact with anyone.

Recovery Phase: Taking Stock, Rebuilding, Resilience

Commitment to professional responsibilities impacted feelings and behavior. An initial focus of concern for the nurses as soon as the storm abated was what was their responsibility now that the evacuation was completed. Communication was still not restored

and the hospital was closed. The breakdown in infrastructure generated anxiety, feelings of uncertainty, and confusion. The lack of guidance on what their professional responsibility was currently is captured in the following statement:

What's our like professional responsibility, now that we're all, you [know], like safe and alive and we're fine? But what's our professional responsibility? We sent all these patients out. Like I don't have any way to, no cell service, I can't go on the Internet. How can I get in contact with the hospital to see if I need to go to work?

Despite the emotional stress and strain the nurses experienced during the storm and the immediate recovery period, professionalism also motivated their actions postevent. As one nurse succinctly summarized, "We were sad, we were scared, we were traumatized. . . . But sure enough, we got up, we made the call: 'What can we do? Do you need us? How can we help?'"

Strategies needed to be devised to communicate with the nursing workforce. In the immediate period following the storm, communication systems were not fully restored and the limited contact with the nursing staff generated additional stress, anxiety, and burdens. The deployment to other area hospitals that received the evacuated patients and reduced the resource infrastructure strain from this surge in the patient census (Adalja et al., 2014) required that strategies be devised to contact the NYULMC nursing workforce (see VanDevanter, Kovner, Raveis, McCollum, & Keller [2014] for a description of the deployment experience). As one nursing manager recalled, "It was just a little hairy. Even the people who live nearby, they didn't have power, so it was hard to get in contact with them."

This difficulty in reaching all the nurses created more workload for a subgroup of nurses:

We called everybody on the roster, but they had no phones, no electricity. You couldn't get them. So now you're rotating the same folks until people resurface and now they are reaching out to you. Can't [send] them an e-mail. There's no e-mail blast to send out. So, it was word of mouth, you know. Someone's looking for help, or someone's looking for help if you can help out, and people flexed their hours if they could help.

Social support facilitated recovery. Social support was an important resource in helping the nurses through the stressfulness of the disaster event, the hospital closure, and period of restoration and recovery. Just

as there were instances of family members expressing their upset at their loved one being at work during the storm, the narratives also document that family, friends, and other network members, particularly co-workers and management staff, performed a critical function in acknowledging the importance of the nurses' behavior. As one nurse recalled, "We were all helped by the team spirit that we had before . . . we met a few times, we saw each other." Another explained, "We had talked on the phone a lot. I talked to my coworkers on the phone more in those 3 months than I talked to them on the phone the 5 years that I've worked here."

Collective trauma and personal loss. The scope of destruction was difficult for some nurses to accept. As one nurse explained:

We don't get extreme weather in Jersey. Like we don't get hurricanes, we don't get tornadoes, we don't get that kind of stuff . . . you watched Hurricane Katrina and you saw all that devastation, but it didn't impact you until you see like the restaurant that you go to all the time and the beaches that you go to all the time, like, completely destroyed.

Uncertainty was another element that created stress and worry. Even after the storm left the area, people were unable to return to their homes, a condition that prolonged efforts to recovery:

We couldn't get down to see, to the barrier island to see our shore house for months because the whole island was completely devastated . . . our house was ocean-front, front yard was sand . . . we stumbled onto a Coast Guard picture on the Internet . . . that was a picture of our house and it was intact and looked fine . . . we don't know what the inside looks like, but it's standing. So, then we felt a little better.

Quantitative Findings

Survey

A sizable number of survey respondents experienced stressful events and losses in Superstorm Sandy. One third (33.4%) of the nurses participated in the evacuation of patients from NYULMC the night of October 29. Over two thirds (70%) of the nurses were assigned to work at other hospitals during the period NYULMC was closed. One fourth (25.3%) reported experiencing personal property damage or loss in Superstorm Sandy, and about one tenth (11.1%) reported a loss or damage to their possessions. Twenty-two percent of the nurses needed to relocate or move in with rela-

tives or friends following the storm, and another 13% reported that they had family or friends move in with them.

The survey was completed between July and September 2013, almost a year after Sandy. For the majority of the nurses, life was back to normal. However, for 6% of the survey participants, although things were getting better, they were still not back to normal, and for 5% of the nurses, they were still dealing with ongoing issues that would require more time to fully resolve.

In terms of how they were feeling, since Superstorm Sandy, only a small proportion of the survey participants reported any extreme problems. Specifically, 5% of the survey participants said that they were bothered quite a bit or extremely by repeated, disturbing memories, thoughts, and dreams of the event. Nine percent were bothered quite a bit or extremely when something that reminds them of Superstorm Sandy occurs. Four percent added to being bothered by trouble falling asleep or staying awake since Superstorm Sandy.

Discussion

Role theory (Pearlin, 1983, 1989) provides a theoretical framework for understanding some of the factors contributing to mental health outcomes following a disaster, both the factors that increase stress experienced as well as the mechanisms for reducing stress and increasing resilience, thereby facilitating postdisaster recovery. Role theory posits that the strains and stresses experienced in one role domain can be moderated by beneficial experiences and supports available in different domains. However, multiple roles carry with them the possibility of adverse consequences: role overload, burdens, and stress in one role can impact role performance in other roles. When both personal life and professional life are impacted by an adverse event, as occurred in Superstorm Sandy, stress and strain exponentially increased for some individuals.

The responsibilities associated with the profession of nursing adds additional demands that increase the risk for role overload and role conflict across the other social roles (e.g., spouse, parent, adult child caregiver, student) in situations when a disaster occurs. When the disaster-related consequences are severe or long-lasting, the potential for conflict with other roles increases. Unmet demands create strain; role conflict contributes to stress. When a role's demands are met, the benefits of that role may offset the strain experienced in other roles, reducing cumulative deleterious impact on mental health.

Lessons for Education

With climate change, there is likely to be more frequent Superstorm Sandy events in the future. An increase in these types of disaster events will make unprecedented demands on the healthcare workforce. Preparing the next generation of nurses in the basic tenets of emergency preparedness and a surge environment also means advising them on the importance of preparedness planning for multiple domains of their life. A critical component of professional education related to disaster preparedness is addressing the psychosocial and practical considerations that need to be included as part of emergency response and the preparedness planning.

Conclusions

The healthcare workforce and first responders are at high risk for burnout, psychosocial distress, and mental health issues. The widespread nature of these occurrences increases the likelihood that a growing number of individuals will be exposed to these risks. Educational efforts that ensure appropriate disaster training should address the challenges of integrating family responsibilities with professional responsibility, balancing demands and conflicts, and presenting strategies for managing professional and personal demands. In particular, professional identity and the conflicts with personal and family responsibilities and concerns emerged as important issues meriting attention.

All disasters are local. The NYULMC nurses lived and worked in the communities directly impacted by the storm. When a person is also experiencing personal loss, such as loss of personal property, relocation of family and friends, and widespread destruction in the community, both individual and collective trauma are present. As the nurses' narrative accounts and survey responses indicate, reliance on sources of social support was an important contributor to psychological well-being. Opportunities to re-engage at home and work with family, friends, and co-workers were essential factors in the nurses' resilience.

Limitations

There are limitations with this study that merit consideration. The participants in the qualitative interviews and the quantitative survey self-selected to participate. It is possible that those individuals who experienced severe psychological consequences as a result of their experiences during Superstorm Sandy and during the extended recovery period did not choose to participate. The study was conducted 4 to 10 months following the event, and

participants' accounts are subject to recall bias. The time period, however, does provide an opportunity to examine the longer-term response to the impact of this massive storm and assess functioning during a lengthy rebuilding period.

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Clinical Resources

- Centers for Disease Control and Prevention. Emergency preparedness and response resources for business, healthcare facilities, personal and legal: Available at <https://emergency.cdc.gov/planning/index.asp>
- Federal Emergency Management Agency and the American Red Cross. Preparing for disaster for people with disabilities and other special needs: Available at <https://www.fema.gov/media-library/assets/documents/897>
- Psychological First Aid: Field Operations Guide: Available at <https://www.ptsd.va.gov/professional/manuals/psych-first-aid.asp>

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SPECIAL ISSUE ARTICLES

Development of a Course on Complex Humanitarian Emergencies: Preparation for the Impact of Climate Change

Holly Williams, PhD, MN, RN, FAAN¹, & Elizabeth Downes, DNP, MPH, NP-C, CNE, FAANP, ANEF²

¹ Team Lead, Intimate Partner Violence and Teen Dating Violence, Division of Violence Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA

² Professor of Nursing, Emory University, Atlanta, GA, USA

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Correspondence

Dr. Holly Ann Williams, Centers for Disease Control and Prevention, Mail Stop F-63, 4770 Buford Highway NE, Atlanta, GA 30341.
E-mail: hbw2@cdc.gov

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Abstract

Purpose: The effects of climate change are far-reaching and multifactorial, with potential impacts on food security and conflict. Large population movements, whether from the aftermath of natural disasters or resulting from conflict, can precipitate the need for humanitarian response in what can become complex humanitarian emergencies (CHEs). Nurses need to be prepared to respond to affected communities in need, whether the emergency is domestic or global. The purpose of the article is to describe a novel course for nursing students interested in practice within the confines of CHEs and natural disasters.

Methods and Framework: The authors used the Sphere Humanitarian Charter and Minimum Standards as a practical framework to inform the course development. They completed a review of the literature on the interaction on climate change, conflict and health, and competencies related to working CHEs. Resettled refugees, as well as experts in the area of humanitarian response, recovery, and mitigation from the Centers for Disease Control and Prevention and nongovernmental organizations further informed the development of the course.

Clinical Relevance: This course prepares the nursing workforce to respond appropriately to large population movements that may arise from the aftermath of natural disasters or conflict, both of which can comprise a complex humanitarian disaster. Using The Sphere Project e-learning course, students learn about the Sphere Project, which works to ensure accountability and quality in humanitarian response and offers core minimal standards for technical assistance. These guidelines are seen globally as the gold standard for humanitarian response and address many of the competencies for disaster nursing (<http://www.sphereproject.org/learning/e-learning-course/>).

Graduates of accredited baccalaureate nursing programs in the United States are expected to show competency in emergency preparedness to “minimize the health consequences of emergencies including mass casualty disasters” (American Association of Colleges of Nursing, 2008, p. 23). Emergencies and disasters can lead to large population movements and, whether from the aftermath of natural disasters or resulting from conflict, can precipitate the need for humanitarian responses. A humanitarian emergency is defined as an event or series of events,

usually over a wide area, that threaten the well-being, security, health or safety of communities, which can result from natural disasters or man-made emergencies, such as armed conflict (Humanitarian Coalition, n.d.). Internal or external conflicts can cause a breakdown of authority and overwhelm the abilities of a government, an ongoing United Nations (UN) country program, or any single agency, which then results in a complex humanitarian emergency (CHE; Center for Disaster Philanthropy, n.d.).

While the generalist nurse is expected to be prepared to participate “in emergency preparedness and disaster response with an awareness of environmental factors” (American Association of Colleges of Nursing, 2008, p. 32), in order to appropriately plan for and address the subsequent impacts on current and future population health, nurses need to understand the increasingly complex interplay among climate change, migration, and conflict. Additionally, it is incumbent upon nursing to understand the context in which the effects of environmental factors, such as climate change, and potential conflict could occur and the resultant public health and clinical implications. Nurses need to be prepared to respond to affected communities in need, whether the emergency is domestic or global. This article reviews literature on climate change as it relates to conflict and health and describes a novel course for nursing students that can serve as an exemplar for preparing our future workforce to understand nursing practice within the confines of CHEs and natural disasters.

The effects of climate change are far reaching and multifactorial. Substantial social and economic burdens result from climate change, and these burdens are expected to rise in the future. Some societies adapt well to these burdens, while others adapt less well (Carleton & Hsiang, 2016), and the differential impact from climate change will most burden the countries that are least able to respond (Watts et al., 2017). In a recent publication, *The Lancet Countdown* (a multidisciplinary, global research collaboration between academic institutions and practitioners), using a comprehensive figure (Figure 1 in Watts et al., 2017, p. 1153), demonstrates the complex interplay of climate change and health, with potential effects on determinants of health such as displacement, socioeconomic status, and conflict (Watts et al., 2017).

Climate change can also affect population health through a variety of mechanisms (Cook, 2011; Luber et al., 2014), including impacts to environmental and social determinants of health, such as potable water and adequate food, shelter, and safe air (World Health Organization, 2016). Health effects from climate change can include such things as increased risk from infectious diseases and injuries, mental health disorders, respiratory and cardiovascular diseases, and allergic reactions (Levy, Sidel, & Patz, 2017). For example, heatstroke can result from increased temperatures, while malnutrition can be a concomitant result from economic disruption or resource depletion secondary to severe famine caused by drought (Applebaum et al., 2016; Butler & Harley, 2010). Indirect health consequences and potential social unrest can arise from resource competition, forced population migrations, loss of livelihoods, and enhanced grievances secondary to

perceived scarcity and deprivation—these dynamics can directly impact political and societal stability, enhanced in nations with fragile or poor governance (Levy et al., 2017; Morisetti & Blackstock, 2017; U.S. Agency for International Development, 2015).

One area of impact from climate change that has been widely debated in the literature is that of the association between climate change and conflict (Bernauer, Böhmelt, & Koubi, 2012; Scheffran, Brzoska, Kominek, Link, & Schilling, 2012). While the association between climate change and conflict is not entirely clear, conflict may arise indirectly from factors associated with climate change, such as migration. For example, climate change is cited as a catalyst for the Syrian conflict (de Chatel, 2014). A severe drought from 2006 to 2010 led to “widespread crop failure and a mass migration of farming families to urban centers” (Kelley, Mohtadi, Cane, Seager, & Kushnir, 2015, p. 3241). The mass migration of over 1 million people into cities led to unsustainable urbanization whereby “the rapidly growing urban peripheries of Syria, marked by illegal settlements, overcrowding, poor infrastructure, unemployment, and crime, were neglected by the Assad government and became the heart of the developing unrest” (Kelley et al., 2015, p. 3242). However, the interplay of climate change and conflict varies by geographic location, the scale and type of conflict, vulnerability and resiliency of both the affected and host population when climate changes cause migration, underlying political and economic strengths, and whether or not preparedness and mitigation strategies are in place (Busby, 2010; Levy et al., 2017; Scheffran et al., 2012). The risk for conflict as a result of climate change is greatest in situations where the risk for conflict is already high—in developing nations that have the greatest degree of economic and social vulnerability (Levy et al., 2017). Conversely, the negative impact of armed conflict on things such as health infrastructure, shelter, and food production heightens environmental vulnerability and the ability to withstand climatic stressors (Adger et al., 2014; Buhaug, 2015).

Background

How climate change affects the environment and subsequent risk for violent conflict has been a matter of debate, but there is no clear consensus as to the nature of this potential linkage (Bernauer et al., 2012; Burrows & Kinney, 2016). Risks from climate change differentially affect marginalized populations, but the vulnerabilities experienced are rarely caused by a single factor. Rather, it is the complex interplay of economic, political, demographic, and social factors with climate variability and

change that affects vulnerability and exposure (Burrows & Kinney, 2016; Busby, 2010; Evans, 2010; Hsiang, Burke, & Miguel, 2013; Intergovernmental Panel on Climate Change [IPCC], 2014b; Scheffran et al., 2012). Climate-related hazards can exacerbate stress for those living in poverty through direct mechanisms such as loss of or impact to livelihoods, destruction of homes and businesses, or diminished crop production, or indirectly through food insecurity (IPCC, 2014b).

The World Bank estimates that 2 billion people live in areas of conflict, fragility, or large scale, organized criminal violence, with 46% of those living in poverty expected to live in fragile and conflict-affected areas by 2030. Currently, developing countries host 95% of refugees and those internally displaced (The World Bank, 2017). Negative impacts (direct and indirect) from climate-related changes will presumably only add additional stress on these highly vulnerable populations, including those suffering through a CHE.

Various scholars have studied the relationship of climate change and potential conflict through an array of approaches. Examining 60 rigorous quantitative studies from a variety of disciplines, Hsiang et al. (2013) concluded that there was strong causal evidence linking climatic events to conflict and that this relationship held across factors such as regions of the world, temporal scales, types of conflict, income levels, spatial scales, and various durations of climate changes. However, Hsiang et al. stressed that climatic influence was just one of many factors contributing to conflict. Bollfrass and Shaver (2015), using a subnational data set, concluded that a relationship between higher ambient temperatures and an increase in substate violence exists partially from a disruption of agricultural production. Their findings indicate that this mechanism holds at both the global and the substate level, and, even in areas without significant agricultural production, higher temperatures have been associated with increased conflict.

Consensus among scientists from the IPCC indicates a high agreement between varying studies and sources of evidence that climate change is projected to increase displacement in the future (IPCC, 2014a). Other scholars have examined possible linkages among climate change, migration, and conflict. Findings from these publications indicate that the linkages among these three factors are far from simplistic (Brzoska & Fröhlich, 2016). While climate change has the potential to cause increased migration and risk for conflict, this potential is highly location dependent (Burrows & Kinney, 2016). However, compared to other factors, the weight of the association between climate change and migration as a driving force for conflict is not known and requires additional research. The IPCC 2014 Synthesis Report notes, however, that

violent conflict increases vulnerability to climate change by harming resources (such as infrastructure, social capital, or economic opportunities) that facilitate adaptation to the changing climatic conditions (IPCC, 2014a).

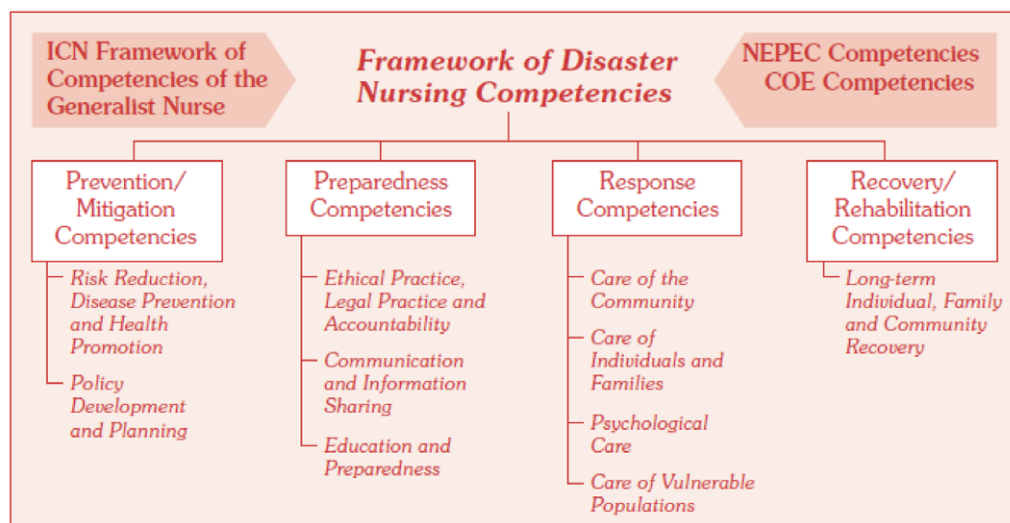
Preparing Future Nurses to Deal With the Impact of Climate Change

It has been argued that the nature of disasters may shift humanitarian response addressing consequences of war to that of more extreme climatic events dominating the need for humanitarian action. Demographically, populations are moving toward greater urbanization and will be vulnerable to new hazards (O'Keefe, O'Brien, & Jayawickrama, 2015). This has also been seen with refugees and internally displaced populations (IDPs) moving from traditional rural settings to more urban settings, as with the Syrian example mentioned earlier. In fact, the United Nation's High Commissioner for Refugees (n.d.) estimates that as much as 60% of the world's refugees and 80% of IDPs now live in urban areas.

Nurses will be engaged in the humanitarian situations that may result from extreme climatic changes. In order to best do so, educational preparation should include content about all phases of humanitarian emergencies and their consequences, from predisaster planning through mitigation, response, and recovery. It is also necessary to understand the differences between humanitarian relief provided domestically versus globally.

International Council of Nurses Framework for Disaster Nursing Competencies

Numerous public health and specialty organizations have published core competencies for healthcare workers in disasters and emergencies (Gebbie & Qureshi, 2002; Walsh, Altman, King, & Strauss-Riggs, 2014; Wong et al., 2015; World Health Organization & International Council of Nurses, 2009), but few, if any, are specific for the types of CHEs as discussed above. The World Health Organization and the International Council of Nursing (2009) published the ICN Framework for Disaster Nursing Competencies to clarify the role of the generalist nurse in disasters. These competencies are based on the disaster management continuum and organized under the four areas of mitigation and prevention, preparedness, response, and recovery and rehabilitation. **Figure 1** lists the 10 domains of the competencies. Drawing on these and other competencies, the authors developed a course specific to the nursing role. In addition to the listed competencies, the course includes content on self-care



* COE: Center of Excellence; ICN, International Council of Nurses; NEPEC, Nursing Emergency Preparedness Education Coalition.

Figure 1. International Council of Nurses framework of disaster nursing competencies. Reprinted from World Health Organization and International Council of Nurses (2009), p. 49. http://www.wpro.who.int/hrh/documents/icn_framework.pdf?ua=1

and security, which have been recommended based on a recent review of the ICN Framework for Disaster Nursing Competencies (Hutton, Veenema, & Gebbie, 2016).

Humanitarian response is a fairly narrow field of work and, as such, has not traditionally been included in nursing curriculum. While existing courses may prepare nurses for all hazard or disaster responses, we did not know of any school offering a course geared specifically to the nursing role within CHEs. Identifying this gap and realizing the strength of collaboration between nurses at the Centers for Disease Control and Prevention (CDC) and the Emory University Nell Hodgson School of Nursing (hereafter referred to as Emory), we, the authors of this article (a nurse anthropologist from the CDC and a family nurse practitioner from the faculty at Emory), developed a novel, 3-day (total 24 hr) intensive, graduate-level course focused on introducing nursing students to complex humanitarian emergencies, including natural disasters. Both of us have decades of experience working in humanitarian settings, both domestically and globally.

Course Description

"Introduction to Complex Humanitarian Emergencies" is intended for students to not only understand clinical care in a humanitarian emergency, but, perhaps more importantly, to understand the context of the entire trajectory of the disaster continuum (from the events leading up to the emergency through to the aftermath), including

the environmental, political, and sociocultural aspects of migration and conflict. The objectives of the course are as follows: (a) differentiate between natural disasters and CHEs; (b) describe the causes and context surrounding CHEs and the political complexities of the global arena; (c) discuss the global humanitarian response, including actors and global standards that guide humanitarian practice; (d) differentiate and describe the roles of non-governmental organizations (NGOs), UN agencies, host governments, and other global partners; (e) identify and discuss the provision of clinical care within the limited resources and political environments of a CHE and the expanded roles that nurses play in a CHE; (f) describe the public health perspective of CHEs, including essential data collection; (g) describe nursing roles in CHEs in the provision of health care in the areas, including nutrition, community disease, epidemic preparedness and response, and reproductive and mental health; and (h) analyze the nursing leadership challenges in the context of a CHE. The two-credit course is one of many organized courses and experiences at the Emory School of Nursing that leads to "Global Health Recognition" upon graduation.

The course is taught from a participatory perspective and encourages students to reflect upon their own personal experiences that they may have had while involved in CHEs or disasters and share those experiences with their classmates. Many of the students have had experiences with a natural disaster, either as a survivor of the disaster or as a volunteer assisting affected communities,

while others have had prior global experience working with NGOs, serving as Peace Corps volunteers, or participating in faith-based mission work. In addition to the authors who facilitate much of the course, guest speakers from the local refugee community, CDC, and NGOs, such as CARE, Doctors Without Borders, and The Carter Center, provide varied perspectives from the field—be it as a field researcher developing evidence-based interventions for humanitarian situations, an implementing partner, or the lived experience of a resettled refugee adapting to the United States.

Teaching Strategies

The course, now in its fourth year, is held over a 3-day holiday weekend, allowing students to be immersed in the material. Varied teaching methods are used, including traditional lecture, case studies, table-top exercises, online modules, video conferences, a panel presentation, and group work. As is common with a “flipped classroom” (i.e., a teaching model that reverses traditionally held practices of what is taught in the classroom versus out-of-class work), students are expected to prepare prior to class, in this case by completing a series of online modules developed by leading experts. These modules serve as a foundation to the course and are therefore completed prior to the 3-day intensive course. The face-to-face course activities alternate between didactic presentations and interactive exercises. Didactic content presents additional background information and core knowledge in topical areas pertinent to CHEs and disasters, particularly as related to nursing. The active, group learning scenarios allow students to apply this information to real-life scenarios.

Online Modules

The use of online modules served two purposes. First is the benefit of the actual module content. A secondary benefit is to introduce the students to the humanitarian community. Becoming aware of these resources allows the student to return and facilitates engagement in continuous and purposeful, or life-long, learning.

The first of the online modules, the Sphere e-learning course (The Sphere Project, 2017) is foundational to the course. Through this course, students learn about the Sphere Project, which works to ensure accountability and quality in humanitarian response. This module includes content on the humanitarian charter, protection principles, and the core minimal standards for technical assistance. These guidelines are seen globally as the gold standard for humanitarian response and address many of the competencies for disaster nursing. Sphere’s

humanitarian charter sets out the legal and moral ground for the technical minimum standards (The Sphere Project, 2011). The technical standards include the universal minimum standards based on sectoral best practice for emergency response. For example, key indicators for human resources for health (at least one qualified nurse per 10,000 population) and the number of latrines in a refugee camp (one per 20 people). Students examine these principles later in class as they work through case studies to plan a response and discuss ethical dilemmas that can arise.

Additional modules are from DisasterReady.org (n.d.). This organization offers a library of hundreds of professional development modules for relief and development workers. For the purposes of this class, students complete modules on travel safety and personal security, basic principles of disability inclusion in humanitarian response, and understanding the elderly and their needs within a humanitarian context. These modules address various competencies within each of the domains, such as risk reduction, ethical practice, and care of vulnerable populations.

Didactic Component

The didactic portions of the course cover the following: (a) an overview of CHEs and disasters (including all aspects of the humanitarian system), (b) establishing an Ebola or cholera treatment unit, (c) nutrition in a CHE and the role of nursing in therapeutic feeding, (d) mental health issues in CHEs, (e) an introduction to logistics and an emergency operations center (EOC), using the CDC EOC as an example, (f) global polio eradication as an example of managing communicable diseases in a CHE, (g) reproductive health and gender-based sexual violence, and (h) nursing leadership in crisis situations.

Participatory Group Exercises

The participatory group exercises build on these topical areas and they are interspersed throughout the 3 days of class, with the exception of one exercise that is done out of class and presented in class (item 4 described below). Most of these exercises use information that has been modified from real-life situations. In some of the exercises, the students work through an evolving situation in which the ground situation changes over the course of a few days. While most of the group exercises address competencies within the response domain, other domains are also explored as students focus on the following areas:

1. Key actors in the humanitarian setting. Students are divided into three groups (UN agencies, NGOs, or

You are the director of a nongovernmental organization working in a country that has just experienced a large influx of refugees due to a conflict with insurgencies in a neighboring country near to the border where you are situated. As with any new emergency, you are swamped. You get a call from a large university in the United States asking for your support to allow a team of researchers to come in as soon as possible to do two types of research: (a) mortality surveys and (b) use of a rapid diagnostic test for respiratory diseases that could potentially improve diagnostics. You must make the decision as to whether or not this research can proceed.

1. Should research be done in this setting? (pros and cons)
2. When is the ideal time to do research?
3. Are these research topics appropriate for this emergency?
4. What key issues must you address when thinking about conducting research?
5. What must you think about in terms of support (i.e., all the issues to consider) if you agree to work with this university?

Figure 2. Sample scenario from leadership exercise.

- donors). This exercise touches upon the competencies within policy development and planning as students describe the type of agency and its role in CHEs, locate a current CHE or disaster in which they are involved, and describe the job opportunities for nurses within that type of agency.
2. Establishment of command during a CHE or natural disaster. Students differentiate between global and domestic events and select response leadership across a variety of types of disasters (i.e., conflicts, floods, earthquakes, etc.). For each unique disaster, they describe the impact on population health, identify vulnerable groups, and discuss policy, security, and logistical concerns, thus addressing competencies within the domains of prevention/mitigation and preparedness.
 3. Design of infectious disease treatment units for use during epidemics. Students draw a treatment unit and must correctly identify safe and appropriate patient, staff, and family flows through the unit.
 4. Healthcare planning during a humanitarian crisis. Students select a current CHE or natural disaster and are given the role of a health planner from an international NGO. They are charged with planning care for an additional 50,000 people in the areas of primary care for adults, primary care for children, and immunization services. They must describe the type of services needed, what information is needed for planning, and how they would incorporate Sphere standards or other indicators.
 5. Nursing roles in a refugee camp. Students identify clinical and public health concerns, priorities, needed resources, and information that is lacking in three areas: camp intake, mobile clinic, and hospital. At the end of the exercise they are presented with an ethical dilemma focused on limited resources. Students are given information about three patients and they must select which patient would be prioritized

to receive care and provide a justification for their selection.

6. Services for a mobile population in a crisis. Students must address issues such as site planning, principles of water and sanitation, cultural concerns across the displaced and host communities, food distribution, and how to deal with “disaster tourism” when it involves nursing student volunteers. In addition, given very limited cargo air weight, they must use logistical principles to select and justify which supplies are necessary to meet critical needs for the displaced population over a 3-month period.
7. Crisis leadership principles. Students choose one of three scenarios: communication in high-risk settings, education and nursing capacity development, and ethics of conducting research in a CHE/disaster setting (**Figure 2**). They develop a response to the scenario, incorporating core principles learned from the course, and present it to the class as a final exercise. Emory nursing faculty and graduate students, as well as members of the CDC Nursing Workgroup, are invited for the final presentations and engage in questions and answers with the students.

Video Conferencing and Refugee Panel

Complementing the didactic and group modalities, the students video conference with a nurse in Liberia who directs a mental health program in a postconflict country that also experienced the Ebola epidemic. The students have an opportunity to actively engage the speaker in the video conference by posing questions about the program itself, the role of nurses in the mental health program, and the outcomes. The last type of presentation offered is a panel in which resettled refugees from Atlanta discuss their previous lives in refugee camps, their memories of resettlement, and their first introduction to the healthcare system in the United States. The panel

offers a realistic view into the struggles of resettlement and adaptation to a new culture, including to a different healthcare system. These participatory exercises provide the students with an opportunity to apply the concepts gleaned from the course and the required readings, as well as learn from each other.

Conclusions

Student evaluation of this course has been consistently positive. On a 5-point scale, with 5 being the highest, the course received overall ratings of 4.8, 5, and 4.9, respectively. Students comment that they develop unique skills and competencies that better prepare them for disaster and emergency work. One student evaluation stated, "I learned a lot and have a lot better sense of the role of nurses, NPs, CNMs in complex humanitarian emergencies ... liked the Sphere modules and the other online modules." Another wrote, "Its timing over the course over fall break enables students to be fully engaged in the intense nature of the course (meets for 7–8 hours for 3 days)." These sentiments were consistently echoed in other evaluations from year to year. The certificates earned through online modules offer a unique addition to their resumes. As one student wrote, "They represented very manageable assignments, and were well-designed and interesting." A successful outcome of this course may be the fact that students have been employed by some of the same key agencies they identify in course exercises. For example, students have gone on to work for NGOs during the Ebola response and subsequent recovery work and for the CDC. One student wrote back from Liberia to thank us for preparing her for the work. Furthermore, one student, realizing the complexity and intensity of this work, commented that the work is far more demanding than she ever imagined and she would need to give it far more thought as a career choice.

Climate change, as a catalyst to insecurity, will have an impact on CHEs. Sherri Goodman, a former U.S. Deputy Undersecretary of Defense, sees climate change as "... a threat multiplier because it aggravates others tensions and conflicts that already exist" (Doherty, 2017, para. 2). In his confirmation hearing, James Mattis, the U.S. Secretary for Defense, stated, "Climate change is impacting stability in areas of the world ... " (Doherty, 2017, para. 25). As the impact of climate change increases the risks for natural disasters and CHEs, healthcare delivery and response will be compromised. Healthcare workers must have fundamental abilities and competencies. As the largest group of healthcare workers, nurses will be among the first to respond to disasters, "often working in difficult situations with limited resources ... serving as first responders, triage officers and care providers,

coordinators of care and services, providers of information or education, and counsellors" (World Health Organization & International Council of Nurses, 2009, p. iv). While not addressing the full set of request competencies, the course described in this article introduces students to the role of the nurse in CHEs. Educational courses (like the example described in this article) are of high relevance to future clinical practice. Students completing the course will be expected to integrate the information into their practice and be better prepared in the event of a humanitarian crisis associated with a climate change disaster.

Acknowledgment

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Clinical Resources

- DisasterReady on line courses: <https://www.disasterready.org/courses>
- The Sphere Project e-learning course: <http://www.sphereproject.org/learning/e-learning-course/>

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SPECIAL ISSUE ARTICLES

Health Impact of Climate Change in Older People: An Integrative Review and Implications for Nursing

Erwin William A. Leyva, MPH, RN¹, Adam Beaman, MPH², & Patricia M. Davidson, PhD, RN³¹ *Psi Beta*, PhD Student, Johns Hopkins School of Nursing, Baltimore, MD, USA and Assistant Professor, University of Philippines Manila, Philippines² Director for Planning & Strategic Initiatives, Johns Hopkins School of Nursing, Baltimore, MD, USA and PhD Candidate, University of Technology Sydney, Australia³ Professor & Dean, Johns Hopkins School of Nursing, Baltimore, MD, USA and Professor, University of Technology Sydney, Australia**Key words**

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Correspondence

Erwin William A. Leyva, Johns Hopkins School of Nursing, 525 N. Wolf St., Baltimore, MD.

E-mail: eleyva1@jhmi.edu

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Abstract**Purpose:** Older people account for the highest proportion of mortality from extreme weather events associated with climate change. This article aims to describe the health impacts of climate change on older people.**Type of Study:** An integrative review was conducted with 30 studies retrieved from PubMed, EBSCO, and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) on climate stressors, determinants of resilient capacity, risk factors, and health outcomes.**Findings:** Heat, temperature variability, and air pollution increase mortality risk in older people, especially from cardiovascular and respiratory diseases. Floods are linked with increasing incidence of post-traumatic stress disorder, depression, and anxiety. Facing these adversities, older people exhibit both vulnerability and resilience.**Conclusions:** Research gaps exist in understanding the full spectrum of the resilience experience of older people, and appreciating areas wherein nursing can play a pivotal role.**Clinical Relevance:** Recognizing the vulnerabilities of older people in the context of climate change is important. Identifying opportunities to promote resilience is an important focus for nurses to develop tailored and targeted nursing interventions.

Climate change has been associated with adverse health outcomes, and older people are disproportionately affected (Gamble et al., 2013; Haq & Gutman, 2014). Research has investigated the impact of climate change and health in the general population, but few studies have been conducted specifically investigating the impact on older people (Gamble et al., 2013; Hosking & Campbell-Lendrum, 2012). The World Health Organization (WHO, 2015) claims that climate variability and change has both direct and indirect effects. Direct effects include extreme weather events such as heat waves, cold waves, and natural disasters. Indirect effects include ecosystem effects (i.e., aeroallergens, increase in vector species), environmental effects (i.e., diminished air quality, compromised water supply), and socio-economic effects (i.e., food

and economic insecurity, relocation, and community disruption). These direct and indirect effects lead to rising morbidity and mortality related to cardiovascular diseases, other noncommunicable diseases, infectious and water-borne diseases, malnutrition, and mental health problems.

Most of the scientific literature describes health impacts in terms of morbidity and mortality—conceptualizing older people as vulnerable—and there are research gaps describing the older person's experience between the occurrence of a climate stressor and illness or death. Within this context, nursing theories and frameworks can be used to examine the human response to climate stressors over and above the morbidity and mortality discourse. These frameworks include Roy's Adaptation Model

(Roy, 2009), the Comprehensive Health Seeking and Coping Paradigm (Nyamathi, 1989), Resilience Ageing Model (Hicks & Conner, 2014), and Society to Cells Resilience Framework (Szanton & Gill, 2010). Of these four, the Society to Cells Resilience Framework provides a holistic lens that goes beyond the traditional deficit-based perspectives and considers the intersectionality of cellular to societal factors leading to resilience. In this context, resilience can be defined as resistance, rebound, and recovery of mental and physical health after a challenge. It is determined by resilient capacity, which is the potential or ability to be resilient resulting from interactions with societal, community, family, individual, physiological, and cellular factors across the life course (Szanton & Gill, 2010).

This review aims to describe the scientific literature pertaining to the health impacts of climate change in older people from a holistic standpoint. It likewise attempts to identify areas of resilience in older people where nurses can tailor interventions to prevent adverse health outcomes.

Methods

An integrative review of the literature was conducted to synthesize and critique the various methodologies used to investigate climate change and health outcomes in older people. The steps suggested by Whittemore and Knafelz (2005) were followed in the review: problem identification, literature search, data evaluation; data analysis, and finally data presentation. Review questions lifted from the Society to Cells Framework (Szanton & Gill, 2010) guided the literature search: (a) What are the climate stressors affecting the health of older people? (b) What health outcomes are associated with these stressors? (c) What factors contribute to resilience (resilient capacity) from cellular to societal levels? And (d) How are health impacts of climate change measured? A climate stressor is defined as an environmental change resulting from climate variability, such as extreme weather events and changes in air quality (Gamble et al., 2013).

An extensive literature search was conducted in electronic databases such as PubMed, EMBASE, and the Cumulative Index to Nursing and Allied Health Literature (CINAHL), as well as a manual search of available literature online in consultation with a health librarian. The key words climate change, global warming, health, vulnerability, resilience, coping, quality of life, older person, senior citizen, and elderly were used in the search. The inclusion criteria were original research-based (quantitative, qualitative, or mixed methods research) articles published in English from 2007 to 2017. Exclusion criteria included abstracts that did not mention older

people in the results and inaccessible full text. A manual search using Google Scholar was also implemented.

Using various combinations of the key words, the search yielded a total of 278 articles. Removing duplicates reduced this number to 230. Further applying the inclusion criteria reduced the number to 111 articles, removing those that were not in English or did not involve humans. From these, those that did not mention older people in the results of the abstract were excluded, resulting in 28 articles. Two more articles were included in the review from Google Scholar. The literature search and review process is summarized in **Figure 1**.

The studies were initially rated in terms of relevance on a 3-point scale: 2 for *relevant*, 1 for *somewhat relevant*, and 0 for *not relevant*. Studies rated "0" were eliminated. The 30 studies were also rated in terms of rigor, with the following criteria: (a) had validity/trustworthiness, (b) had reliability/confirmability, (c) had sufficient sample size, and (d) utilized appropriate data collection methods and analysis. Studies that did not meet the first two criteria were to be automatically dropped. None of the 30 studies were excluded, but threats to validity and potential sources of measurement error were noted, as were the strengths of the study.

Studies with similar themes were grouped according to the research question they answered. Initially, studies were grouped according to climate stressor. Themes were noted using Whittemore and Knafelz's (2005) elements of data analysis: noting patterns, seeing plausibility, clustering, counting, making contrasts and comparisons, discerning common and unusual patterns, subsuming particulars into general, noting relations between variability, finding intervening factors, and building a logical chain of evidence. Commonalities in health outcomes and determinants of resilient capacity were also noted.

Results

Twenty-four studies were quantitative, three were qualitative, and another three used mixed methods. Thirteen (43%) of the studies were from North America and Europe, another 13 (43%) from Asia, and the remaining 4 (14%) from Australia. Almost all of the retrieved studies were from high-income countries.

Climate Stressors

Three climate stressors attributed to climate change were reported in the studies. These were temperature-related changes (e.g., temperature variability, extreme heat, extreme cold), typhoons and associated flooding, and decreasing air quality. The most frequent of these was heat-induced health effects. Of the 30 articles, 13

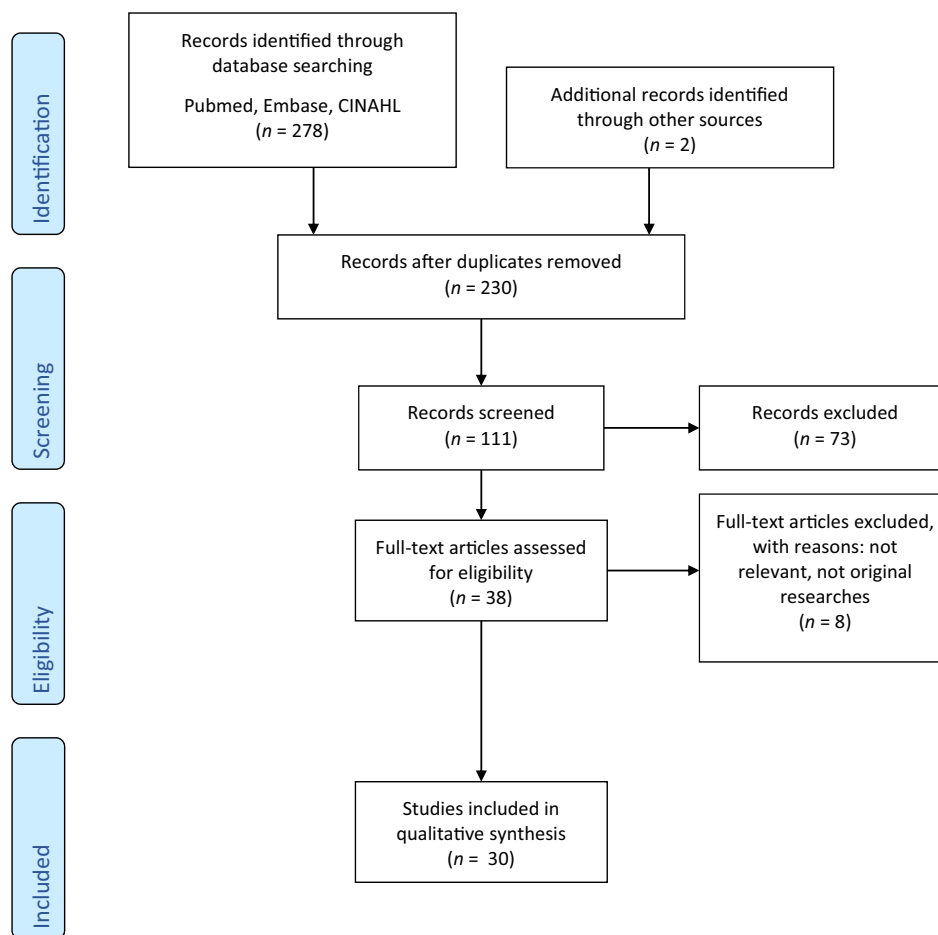


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram (Moher, Liberati, Tetzlaff, Altman, The PRISMA Group, 2009).

(43%) were on heat as a climate stressor, 9 (30%) were on temperature variability, 7 (23%) were on storms or floods, 3 (10%) included air pollution as an added factor, and another 3 (10%) were on climate change and disasters in general.

Perceptions on Climate Change and Health

Older people recognize that environmental changes resulting from climate change can affect their health (Ostapchuk, Harper, Cunsolo Willox, Edge, & Rigolet Inuit Community Government, 2015; Rhoades, Gruber, & Horton, 2017). Others are more skeptical about climate change and “believe it to be a hoax.” They do not perceive extreme heat as a threat due to available protective measures such as air conditioning equipment, and they are already accustomed to the changing weather patterns (Abrahamson et al., 2009; Loughnan, Carroll, & Tapper, 2014).

Health Impacts of Climate Change

Most frequently, studies on the health impacts on climate change (20%) examined mortality from cardiovascular diseases. This was followed by studies of mortality from respiratory diseases, resilience, hospitalization risk, and increasing mental health problems, which account for 10% of studies each. Fewer (6%) were on deaths from drowning and injuries, increasing vector-borne disease, effects on health-related quality of life, and successful ageing.

Thirty percent of the studies described health impacts of climate change in terms of morbidity and mortality using large datasets from surveillance or cohort data. In general, increasing temperature is associated with an increase in mortality (Cheng et al., 2014; Dong, Zeng, Ma, Li, & Pan, 2016; Son, Lee, Anderson, & Bell, 2012; Yin & Wang, 2017). Mortality due to cardiovascular diseases was reported to increase by 24% during periods of temperatures above 27.7°C lasting for more than

5 days (Dong et al., 2016), rising to a 94% increase on the 10th day of temperatures higher than 33°C (Yin & Wang, 2017). A 1.9°C increase in maximum daily temperature corresponds to a 3% increase in cardiovascular mortality (Cheng et al., 2014).

Another similarly designed study contends that increases in mortality per degree humidex above 35.7°C were only significantly different in people over 85 years old. When compared to the majority of findings, the differences in these studies were attributed to the contribution of relative humidity to the model (Isaksen, Yost, Hom, & Fenske, 2014) or when wind speed is considered, which mitigates adverse effects (Xu et al., 2013). Decreased air quality in combination with heat stress was reported to increase risk for chronic obstructive pulmonary disease (COPD) mortality 1.048 times for every 1°C increase in summer temperature (Zanobetti, O'Neill, Gronlund, & Schwartz, 2012). Harlan et al. (2014) reported that mortality increases exponentially at temperatures above 42°C for cardiovascular diseases and stroke, and at temperatures above 43°C for COPD. Other illnesses such as diabetes were reported less often, and no studies were conducted on the effect on nutrition.

Extreme heat events are associated with increasing risk for hospitalization (Bobb, Obermeyer, Wang, & Dominici, 2014; Chan, Goggins, Yue, & Lee, 2013; Chau, Wong, & Woo, 2014). Relative risk values were 2.14 for hospitalization for heat stroke and 1.18 for fluid and electrolyte disorders (Bobb et al., 2014). For ischemic heart diseases, Chau et al. (2014) asserted that colder temperatures pose a greater risk for hospitalization compared to warmer summer temperatures. For various diseases, hospital admissions increased by 4.5% for every 1°C increase in temperature. Admissions for infectious diseases increased among people ≥ 75 years of age during extremely hot or cold temperatures (Chan et al., 2013). For vector-borne diseases, a 1°C increase in the range between the maximum and minimum daily temperature increases the incidence of dengue fever by 11.9% in older people and 9.9% in the general population. The incidence of dengue fever was reported as 87 per 100,000 in people 60 to 69 years of age compared to 44 per 100,000 in those under 40 years of age (Xiang et al., 2017).

Morbidity and mortality related to typhoons and flooding are predominantly related to injuries, drowning, and mental health problems such as depression, post-traumatic stress disorder (PTSD), and anxiety (Bei et al., 2013; Myung & Jang, 2011; Sirey et al., 2017). Older people are at a higher risk for drowning compared to their younger counterparts (Ching, de los Reyes, Sucaldito, & Tayag, 2015; Myung & Jang, 2011). After a flood, 17% of older people reported PTSD symptoms that may require

management (Bei et al., 2013), while 14% tested positive for depression (Sirey et al., 2017).

Resilience and Quality of Life in Climate-Affected Communities

Only 4 (13%) of the studies investigated resilience and only one examined quality of life as outcomes of extreme weather events that are specific to older people. Three of the four studies were qualitative and examined the resilience experienced after a flood. In contrast to the stereotypes of frailty, older people were reported to be resilient or demonstrate characteristics of resilience after a flooding experience (Brockie & Miller, 2017; Cohen et al., 2016; Hrostowski & Rehner, 2012; Nitschke et al., 2013; Sirey et al., 2017). They reported "a new sense of commitment and belonging to their communities, interest and appreciation of life, and a rediscovery of their abilities to make valuable contributions" (Hrostowski & Rehner, 2012, p. 343). Community resilience was reported to be higher in those 61 to 75 years of age compared to their younger counterparts (Cohen et al., 2016). Older people perceive themselves as survivors rather than victims of floods and identified prior experience and social capital as determinants of resilience (Brockie & Miller, 2017). They were 4.49 times more likely to have an emergency evacuation plan and have a 3-day supply of medications compared to their younger counterparts (Kang, 2014). Older people reported changes in their quality of life after a flooding experience (Sirey et al., 2017; Wu et al., 2015).

Studies on heat as a climate stressor have not reported on resilience as an outcome, but rather they have focused on protective factors or behaviors of older people during extreme heat. These protective behaviors include taking showers, wearing light clothing, drinking more liquids (Nitschke et al., 2013), and using air conditioning equipment (Loughnan et al., 2014).

One study looked into successful aging (under climate change conditions) measured in terms of health status, performance of activities of daily living, and social activities. Though the study covered an interesting concept, its rigor could not be fully assessed with missing information on the methodology. They concluded that older people of low socio-economic status, those with poor health status, and those who were socially isolated were most at risk (Wanka et al., 2014).

Determinants of Resilient Capacity

Forty percent of studies mentioned certain determinants of resilient capacity. At the individual level, this includes personal disaster preparedness (Kang, 2014), coping strategies (Bei et al., 2013), personal strength

(Hrostowski & Rehner, 2012), perceived positive impact after flood (Sirey et al., 2017), and (personal heat) protective behaviors (Abrahamson et al., 2009; Loughnan et al., 2014; Nitschke et al., 2013). At the family and community level, social support (Brockie & Miller, 2017; Sirey et al., 2017) and connectedness (Nitschke et al., 2013) were reported. Those with two or more family members are 2.92 times most likely to have a 3-day supply of medications compared to those living alone (Kang et al., 2014). The physical environment, such as adequate green space, likewise provided additional protection (Zanobetti et al., 2012).

A huge proportion of studies on older people emphasized the concept of vulnerability. Describing risk factors, physiologic studies have reported that impairments in cardiovascular function result in increased mortality from cardiovascular disease (Ren et al., 2011; Stotz et al., 2014). Increasing age, low income, sex, disability, comorbidities, and living alone have been identified as contributors to vulnerability (Laverdiere et al., 2015; Nitschke et al., 2013; Rhoades et al., 2017). Isaksen et al. (2014) reported that non-Whites were at greater risk for heat-related mortality. At least one study each reported on either all men, all women, or subjects who were predominantly White. Males were at a greater risk to die from typhoons (Myung & Jang, 2011) and hospitalized for ischemic heart disease (Chau et al., 2014). Other studies documented that females are at a higher risk for heat-related deaths (Dong et al., 2016; Nitschke et al., 2013; Yin & Wang, 2017). This is in contrast to an epidemiologic study in China reporting higher risk in males (Cheng et al., 2014).

Using the literature search strategy, no studies were retrieved pertaining to physiologic indicators of resilience and access to care of older people during extreme weather events. Most of the studied risk and protective factors were shared with younger populations. No studies were retrieved on nursing interventions that promote resilience in this context.

Measuring Health Impacts of Climate Change

Heat as a stressor was measured differently: either as temperature variability (Harlan et al., 2014; Ren et al., 2011), temperature-humidity index (Dong et al., 2016; Isaksen et al., 2014), or the presence of a heat wave (Bobb et al., 2014; Son et al., 2012). Typhoons and flooding were more straightforward, measured by the presence of a storm or flood (Bei et al., 2013; Ching et al., 2015). However, the duration and intensity of these events were not quantified in the studies. Morbidity and mortality data were gathered from disease surveillance data or existing cohort studies.

Resilience was examined more qualitatively. Only one study used a quantitative measure—the Conjoint Community Resiliency Assessment Measure—to examine community resilience of older people (Cohen et al., 2016). Health-related quality of life was also reported to be measured by the SF-36 or the shorter version SF-12 (Bei et al., 2013; Wu et al., 2015). No tools were reported to measure determinants of resilient capacity as a whole in the reviewed studies, but rather, data on these determinants was gathered through structured questionnaires or qualitative methods.

Discussion

A considerable amount of literature is available describing the health impacts of climate change on older people. An emerging field of investigation is known as climate gerontology (Haq & Gutman, 2014). Though an attempt was made in this article to examine resilience in older people, it cannot be denied that the approach to this topic in the prevailing literature is still from the standpoint of the older person being a “victim” or being “vulnerable.”

One of the issues in the climate change and health discourse is the multitude of factors contributing to health outcomes including identified vulnerabilities of older people. Most of these factors are shared with younger age groups. It is therefore interesting to determine how much climate stressors contribute to explaining the variability between vulnerability and adverse health outcomes. Considering the complexities involved in this phenomenon of interest, researchers have the flexibility to utilize multiple methods from quantitative, to qualitative, to mixed approaches. Epidemiologic studies are appropriate in quantifying the risk posed by climate stressors on health outcomes, whereas qualitative methods give more in-depth information and meaning to the experience (Ostapchuk et al., 2015; Rhoades et al., 2017). Secondary analysis of existing cohort data or of disease surveillance data gives the advantage of large sample sizes; however, there may be limited flexibility in ensuring the quality of data that are available. Climate change skeptics have questioned these findings on the basis of the wide confidence intervals reported (Verner et al., 2016).

The results of this review are consistent with a scoping review conducted by Hosking and Campbell-Lendrum (2012) wherein the majority of the studies on climate change and health were from high-income countries. Research from low and middle economies are encouraged to identify country-specific factors that may affect both risk and resilience. Considering the different contextual factors that may come into play within and between

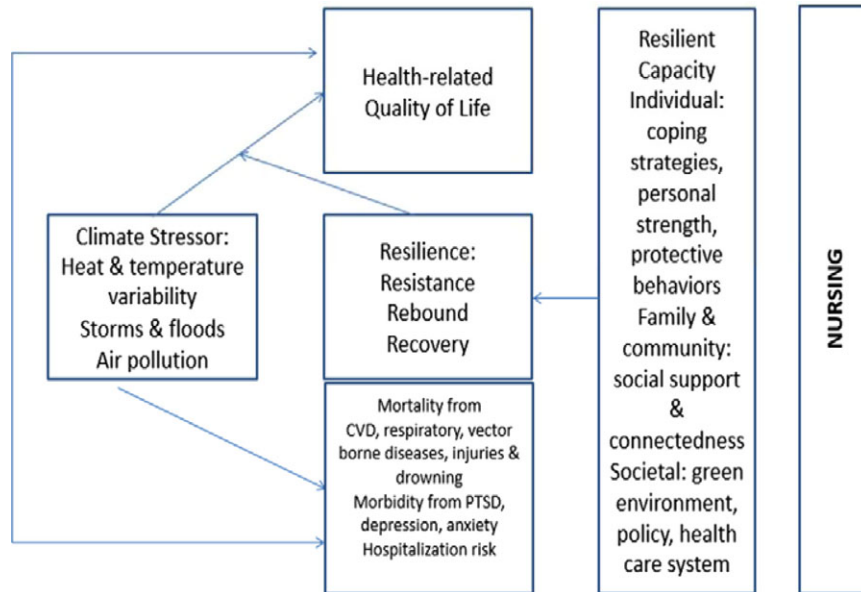


Figure 2. Climate change and health in older person.

countries, risk and resilience data may vary, as in the case of this review, which covers several countries across different continents (WHO, 2015).

Risk for mortality and hospitalization may also vary due to the different ways of measuring and defining hot and cold days and heat waves (which have at least 12 definitions across countries). The same can be said of the different measurements of temperature, such as average daily temperature, minimum and maximum daily temperature, and humidity index (Song et al., 2017). The risk may also vary depending on when data collection was done after the climate stressor.

This review supports the position that climate change is associated with adverse health outcomes and that older people are disproportionately affected (Alderman, Turner, & Tong, 2012; Bunker et al., 2016; Kenny, Yardley, Brown, Sigal, & Jay, 2010). There is a need to conduct more research on the resilience of older people in climate-affected communities—from the individual to the community level. Though qualitative studies have given useful insights into the resilience experience of older people, additional quantitative measures will be equally important in understanding the experience. At least three resilience instruments were found to be of good psychometric validity when used among older people: the Connor Davidson Resilience Scale, Wagnild and Young's Resilience Scale, and the Brief Resilient Coping Scale (Cosco et al., 2016). Available quantitative resilience measurements in later life are suggested to be validated in the context of climate change and country-specific factors. The relationship between resilience and

health-related quality of life likewise needs further exploration (Hicks & Conner, 2014).

Though the majority of the studies supported adverse health outcomes from climate change, the dissenting views of other older people warrants further examination. Statements that they are not at risk due to available resources for adaptation suggests some level of resilience. In the language of the Society to Cells Framework, the climate stressor viewed as a challenge is mitigated by resources contributing to resilient capacity (Szanton & Gill, 2010). This is an excellent opportunity for nurses to examine resilience characteristics such as hardiness, coping, and self-concept, and to build on these to achieve better client outcomes (Hicks & Conner, 2014). At the individual level, much can be done to maximize personal strength, adaptive coping strategies, and personal protective behaviors. At the family and community level, building social support from family and community-based organizations is an important measure. Ostapchuk et al. (2015) pointed out the importance of the role of older people as sources of wisdom and experience in the climate change and health discourse. At the societal level, much work is anticipated in advocating for policies to promote access of care and institute mechanisms for climate change–resilient healthcare systems (Haq & Gutman, 2014). As summarized in **Figure 2**, climate stressors result in morbidity and mortality among older people. Resilience moderates these outcomes as well as health-related quality of life. Resilience, on the other hand, is affected by resilient capacity, which is determined by cellular to societal factors (where nursing plays

an important role). In general, older people may have differing levels of vulnerability, but the outcomes will be determined also by their level of resilient capacity. This relationship is also indicative of the extent to which older people perceive climate change has the capacity to impact their health.

This review may be limited in terms of including only articles in the English language. Some literature in other languages may substantially contribute to what is known about the topic. It is likewise noted that the retrieved studies were from countries where the population is ageing. This may contribute to some form of bias and does not necessarily indicate that climate change is not affecting older people in other countries. Moreover, limitations may likewise occur from the set of key words and databases used in the search.

Conclusions

Older people are faced with unique challenges in the event of climate change. Nurse researchers play an important role in the scientific inquiry of building resilience and averting adverse health outcomes through practice and policy.

Clinical Resources

- Climate change and extreme heat events. <https://www.cdc.gov/climateandhealth/pubs/climatechangeandextremeheatevents.pdf>
- HelpAge Disaster resilience in an ageing world. <http://www.unisdr.org/2014/iddr/documents/DisasterResilienceAgeingWorld.pdf>
- Climate change and the health of older adults. <https://www.cmu.edu/steinbrenner/EPA%20Factsheets/older-adults-health-climate-change.pdf>
- Older persons in emergencies: An active ageing perspective. <http://www.who.int/ageing/publications/EmergenciesEnglish13August.pdf>
- Climate change and health in the Western Pacific Region. http://iris.wpro.who.int/bitstream/handle/10665.1/12401/9789290617372_eng.pdf
- Climate change and health. <http://www.who.int/globalchange/en/>
- Climate change. <http://www.who.int/topics/climate/en/>

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Mandate for the Nursing Profession to Address Climate Change Through Nursing Education

Jeanne Leffers, PhD, RN, FAAN¹, Ruth McDermott Levy, PhD, MPH, RN², Patrice K. Nicholas, DNSc, DHL(Hon.), MPH, MS, RN, ANP, FAAN³, & Casey F. Sweeney, PhD, RN, FNP⁴

¹ *Delta Upsilon and Theta Kappa*, Professor Emeritus, Community Nursing, University of Massachusetts Dartmouth, Dartmouth, MA, USA

² *Alpha Nu and Zeta Psi*, Associate Professor, Director, Center for Global and Public Health, Villanova University, Villanova, PA, USA

³ *Theta Chapter-at-Large, Epsilon Beta, and Upsilon Lambda*, Director of Global Health and Academic Partnerships, Brigham and Women's Hospital, Division of Global Health Equity and Center for Nursing Excellence, Professor, MGH Institute of Health Professions, School of Nursing, Boston, MA, USA

⁴ *Upsilon Lambda*, Assistant Professor, MGH Institute of Health Professions, School of Nursing, Boston, MA, USA

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Correspondence

Dr. Jeanne Leffers, 412 Seaview Avenue, Warren, RI 02885.

E-mail: jleffers@umassd.edu; jleffers@comcast.net

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Abstract

Purpose: The adverse health effects from climate change demand action from the nursing profession. This article examines the calls to action, the status of climate change in nursing education, and challenges and recommendations for nursing education related to climate change and human health.

Organizing Construct: Discussion paper.

Findings: The integration of climate change into nursing education is essential so that knowledge, skills, and insights critical for clinical practice in our climate-changing world are incorporated in curricula, practice, research, and policy. Our Ecological Planetary Health Model offers a framework for nursing to integrate relevant climate change education into nursing curricula and professional nursing education. Nursing education can offer a leadership role to address the mitigation, adaptation, and resilience strategies for climate change.

Conclusions: An ecological framework is valuable for nursing education regarding climate change through its consideration of political, cultural, economic, and environmental interrelationships on human health and the health of the planet. Knowledge of climate change is important for integration into basic and advanced nursing education, as well as professional education for nurses to address adverse health impacts, climate change responses policy, and advocacy roles.

Clinical Relevance: For current and future nurses to provide care within a climate-changing environment, nursing education has a mandate to integrate knowledge about climate change issues across all levels of nursing education. Competence in nursing practice follows from knowledge and skill acquisition gained from integration of climate change content into nursing education.

Calls to action for a response to the harmful health effects of global climate change drive the nursing profession to respond through nursing practice, research, advocacy, and education (Barna, Goodman, & Mortimer, 2012; Bell, 2011; Costello, Montgomery, & Watts, 2013; Kumaresan & Sathiakumar, 2010). Climate change education for nurses, both in practice and in academic educational programs, is critical to achieve this response. Climate change education expands the profession's ability to influence

policies at the individual, community, national, and global levels of practice. This article examines the calls to action and current status of climate change education in nursing to make recommendations for nursing education related to climate change and human health. Specifically, those recommendations include a proposed Ecological Planetary Health Model to serve as a framework for nursing education, as well as 10 broad recommendations to guide the development of curriculum design.

Background

Since the harmful health effects of climate change are already being observed (U.S. Global Change Research Program [USGCRP], 2016) and are expected to increase over time (Costello et al., 2009; Neira, 2015), nurses and interprofessional colleagues are being called upon to act as experts on behalf of patients, communities, nursing organizations, and policymakers. Frequent reports of the harmful effects of climate change impacting health and the environment reach both health professionals and the general public through scientific and public media with direct requests for a response (Adlong & Dietsch, 2015; Centers for Disease Control and Prevention [CDC], 2017; International Council of Nurses [ICN], 2008; Sayre, Rahzi, Carpenter, & Hughes, 2010; White House, 2015a, 2015b; World Health Organization [WHO], 2016). Specifically, the 2008 ICN document, *Nurses, Climate and Health*, the American Nurses Association (ANA) 2008 House of Delegates resolution, *Global Climate Change*, and the Canadian Nurses Association (CNA) initiatives on *Climate Change and Health* and *The Role of Nurses in Addressing Climate Change* (CNA, 2008, 2009) all urge nurses to address the greatest global health threat of our time (Costello et al., 2009). Their efforts are aimed at integrating mitigation, adaptation, and resilience strategies in nursing practice.

It is important to note that greenhouse gas (GHG) emissions that contribute to climate change continue to rise globally (Intergovernmental Panel on Climate Change [IPCC], 2014) and, depending on the gas, remain in our atmosphere from 12 to thousands of years. The IPCC report *Climate Change 2014: Impacts, Adaptation and Vulnerability* (IPCC, 2014) addresses global climate and its impacts upon food and water supplies; the frequency and severity of adverse weather events such as heat waves, droughts, hurricanes, cyclones, floods, and wildfires; changes in vector populations; and the particular impacts upon vulnerable populations (IPCC, 2014). The *Climate Change Impacts in the United States: The Third National Climate Assessment* (Melillo, Richmond, & Yohe, 2014) reports similar results of increased temperature, changes in precipitation, acidification of oceans, and extreme weather patterns. The impact of these environmental changes results in threats to human health globally. The more recent report of the USGCRP, *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* (USGCRP, 2016), highlights the health impacts related to air, food, water, extreme weather, vectors, and temperature-related deaths. The report also focuses attention on the social determinants of health, with special

attention to issues affecting vulnerable populations and the adverse effects on mental health and well-being.

Social determinants defined as “the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life” (WHO, 2017, para 1) can either improve or exacerbate vulnerability to poor health outcomes associated with climate change (USGCRP, 2016). For example, those who have access to adequate transportation in the event of evacuation, live in homes that are structurally sound, or live in communities with improved infrastructure with access to food and shelter are likely to fare better during weather-related disasters (USGCRP, 2016). The impacts of climate change can negatively affect existing health problems, but can also create new and unanticipated health problems.

Populations Most Vulnerable to Impacts of Climate Change

Increased vulnerability to climate change results from a combination of health status and socioeconomic factors, and the interaction of exposure, sensitivity, and adaptive capacity at both individual and population levels. This is particularly critical in addressing the challenge of climate change and its associated negative health sequelae (USGCRP, 2016; WHO, 2016). Vulnerable groups include older adults, children and pregnant women, those with existing or chronic health problems or disabilities, immigrant groups, communities of color, and indigenous populations (Allen, 2015). Globally, indigenous populations already burdened by limited access to food and clean water are more likely to be subject to droughts, salt-water intrusion, and rising temperatures, resulting in shortages of food, water, and traditional herbal medicines. Pregnant women are at risk for adverse pregnancy outcomes; children are at risk for heat-related diseases, diarrheal illness, and asthma; older adults at risk for extreme heat events as well as increased vulnerability to chronic illnesses. Social determinants of health such as lower income, immigrant status, poorer living conditions, increased burden of air pollution in neighborhoods, limited transportation, limited educational attainment, limited language proficiency, and limited access to health increase one’s risk (Sheffield & Landrigan, 2011).

Status and Challenges for Integration of Climate Change in Nursing Education

Because the negative health effects of a changing climate are likely to increase over time, health professionals must become expert resources for patients,

communities, and policymakers. Nurses are well positioned to respond to environmental-related health risks and outcomes (CNA, 2017). Although national nursing organizations have addressed the importance of education and advocacy, many nursing students are not adequately prepared regarding the health impacts of climate change and nursing profession response (Barna et al., 2012). Additionally, many practicing nurses are not formally educated in climate-related health and care delivery (Leffers, McDermott-Levy, Smith, & Sattler, 2014). Educating health professionals to address climate change-related health threats and outcomes is paramount to this goal (Bryce, Foley, & Reeves, 2016; Hanley, Bogart, Milburn, & Stafford, 2016; Johnsen, Torjesen, & Ennals, 2015).

Currently, no reported competencies are available to guide curriculum development for the integration of climate change into nursing education (Green et al., 2009; Maxwell & Blashki, 2016). However, many health professions' organizations have disseminated statements about expected environmental health competencies (Bell, 2010, 2011; Butterfield et al., 2014; CDC, 2017; Desmond, 2016; Frenk et al., 2010; Green et al., 2009; Horton, 2010; Johnsen et al., 2015; Maxwell & Blashki, 2016). Despite the lack of climate change competencies for nursing education, earlier work in other disciplines advocate for climate change competencies (Bell, 2010; Maxwell & Blashki, 2016; Rabinowitz, Natterson-Horowitz, Kahn, Kock, & Pappionau, 2017).

Challenges to the development and implementation of climate change competencies and content into nursing education predominately relate to the lack of engagement around climate change in nursing practice. There is also limited knowledge among many faculty and nurse leaders regarding the relationship between nursing practice and climate events. There may also be resistance to inclusion of climate health issues in curricula that are already burdened to meet program standards. Furthermore, much of climate change education includes the science of climate change, GHG sources, and mitigation strategies, which have not been commonly addressed in nursing education (Barna et al., 2012). Currently, there is limited focus on nurses' roles in adaptation and resilience strategies. It is essential that these challenges be addressed to facilitate effective climate change inclusion in nursing education and practice. In addition, competencies must be developed to facilitate the educational needs of nursing students and practicing nurses (Barna et al., 2012).

Nurse leaders currently engaged in climate and health-related issues urge nurses to address climate impacts in education and practice curricula (Anderko, Chalupka, & Afzal, 2012; Barna et al., 2012; Richardson, Grose, Doman, & Kelsey, 2014; Richardson, Grose, Jackson, et al.,

2014). Nursing education has a model for the development of competencies and specific curriculum insertion points for integrating environmental health content into pre-professional and graduate education (Leffers et al., 2015) that could be applied to educational design for climate change curricula. Despite arguments that nursing curricula and professional development offerings are too content burdened, nursing educators should move forward to develop competencies and integrated curriculum recommendations. For example, information related to air pollution and climate change can be inserted into educational content about respiratory and cardiac pathology already included in nursing education. Risks and vulnerability specific to pregnant women, infants, and children can be inserted into family or parent-child nursing education. Each challenge to climate change education for nursing can and should be addressed to assure competency for practice in a climate-changing world (Barna et al., 2012).

Recommendations for Nursing Education

In response to the calls to action and the important role of nurse educators to ensure educational preparation of the current and future generation of health professionals to address the health impacts of climate change, the following recommendations are offered.

First, a guiding framework offers wisdom for nursing and health professional education globally. This offers an important perspective that brings into nursing the global and ecological aspects of global climate change.

Second, a broad set of recommendations for nursing education address key perspectives, approaches, topic areas, and strategies to address the health impacts resulting from climate change. The recommendations will offer guidance to nursing educators as well as nursing organizations as they move forward to develop competencies for practice and goals and objectives for education. Subsequent to the foundational efforts to develop standards, competencies, and objectives, specific curriculum recommendations can be developed (Barna et al., 2012; Patrick, Capetola, Patrick, & Nuttman, 2012).

Proposed Framework for Climate Change Nursing Education

Most nurses practice in settings that address the needs of the individual, family, or community. However, nurses must be aware of state, regional, or national policies that influence health beyond their sphere of practice as well as factors related to the social determinants of health, such as economic, political, cultural, and environmental

influences (Patrick et al., 2012). Conversely, events and actions that occur at nurses' practice settings could have impacts at the state, regional, national, or international levels, and nurses should understand that influence. Therefore, an ecological model (Sallis & Owen, 2016) provides a framework to address the complex issues related to climate change while including the settings where nurses most frequently practice and the influence of the settings beyond the nurse's sphere of practice. Like areas of nursing practice, an ecological model is a systems model, as each level of the system is influenced by and influences the other. It is not prescriptive, in that specific features must be addressed; therefore, the nurse educator can include the variety of environmental, economic, political, cultural, and social factors that influence climate change specifically related to the location where the nurse practices. Consideration of the various factors that influence the environment as well as placing nursing's practice setting within a larger framework in relation to care of the natural environment and earth speak to the call for planetary health. Planetary health is the global attainment of the highest standard of health, well-being, and equity through awareness and thoughtful stewardship of the political, economic, and social systems, as well as natural ecosystems, that influence the ability of humans to thrive (Whitmee et al., 2015). The planetary health perspective has been adopted by public health, medical, and nursing disciplines and has an ecological systems perspective (Johnston, Rogers, Cross, & Sochan, 2005; Whitmee et al., 2015).

This concept of caring for the earth is not new to nursing. Nurse scholars have called for the nursing profession to consider the influence of the natural environment on human health beyond community and public health nursing practice, and to consider how the natural environment influences all areas of nursing (Avery, 1995; Kleffel, 1991). Their recommendations endorse an ecocentric approach to care (Anderko, Chalupka, & Anderko, 2014; Kleffel, 1996; Wells, 2004). Much like planetary health, the ecocentric approach relies on the existing holistic nursing paradigm but expands nursing to address the interconnectivity to the earth and natural environment to support and sustain our well-being (Kleffel, 1996). Therefore, it is important for nurses to broaden their views and include an interrelated global ecosystem (Laustsen, 2006). These broader environmental perspectives highlight the importance of the health of the natural environment and planet as part of nursing's role in meeting the health needs of the world's people. Addressing political, cultural, social, economic, and environmental interrelationships on human health and the planet within an ecological framework is essential for the education of nurses regarding climate change.

To support nursing education related to the influence of climate change on health, we propose the Ecological Planetary Health Model (**Figure 1**). Within our proposed model, there are six spheres of practice: individual, family, community, region/nation, international, and planetary/earth. At the individual level is the person's impact upon, as well as response to, a changing climate. At this level, individual behaviors such as using public transportation or walking to work can impact GHG emissions. Changing individual behavior is an area that nurses willingly include in their lifestyle (Barna et al., 2012). Climate changes, as noted previously, impact human health at the individual level in ways such as starvation from drought and the worsening of health problems such as asthma. The family level includes those who have a close personal interdependent relationship. Families can influence climate change by assuming individual behaviors and by sharing beliefs, knowledge, and action (Stevenson, Peterson, & Bondell, 2016). Further, their homes can be lost to adverse weather events. The community level comprises social organizations that influence the individual and family, such as schools, employers, faith-based organizations, and social and civic groups (Sallis & Owen, 2016). The regional/national and international levels are associated with geopolitical borders and include regional, national, and international organizations and regulations. The international level is the exchange between nations and includes international treaties and agreements as well as the impact of GHG effects across international borders. For community, region/national, and international levels, climate decision making is based on perceived population risk (Leiserowitz & Howe, 2015) and political, social, cultural, and economic factors within each level (Whitmee et al., 2015). The planetary/earth level is the level that includes the overall health and sustainability of the planet to support the global ecosystem and human thriving (Whitmee et al., 2015). At each of the levels are factors that can adversely affect the ecological level, and also impact organizations and interactions occurring at that level aimed at mitigation, adaptation, resilience, or exacerbation of our changing climate.

Political, social, cultural, economic, and environmental influences impact each of the ecological spheres of this model. These interrelated factors produce the determinants of health and affect the health impacts of climate change upon vulnerable populations. Political factors are related to local, state, national, and international policies that can support policies, tax, and provide subsidies for programs that support planetary health and human thriving (Whitmee et al., 2015). Social factors are the relations with groups of people, institutions, and organizations at community, state, and national levels. Cultural

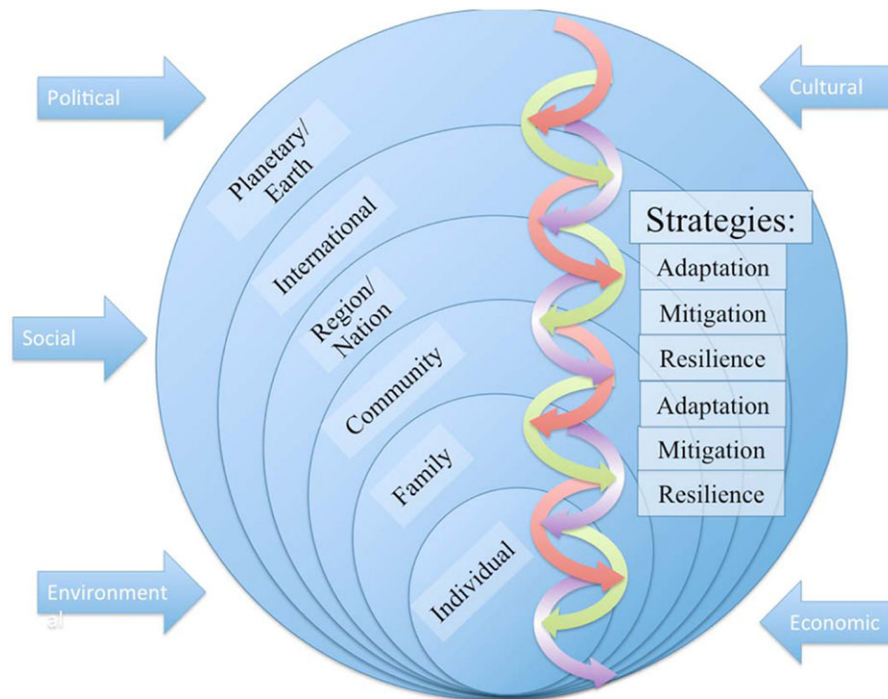


Figure 1. The Ecological Planetary Health Model, illustrated by concentric circles, highlights the interrelationship and multiple levels of influence that nurses have on behaviors and actions to address the health of our planet. Each climate strategy is depicted as a colored cord on an integrated trajectory demonstrating that each climate strategy occurs in concert with the other, and the climate strategies influence the interventions between all levels of the model. The arrows outside the circles represent the political, social, cultural, economic, and environmental influences on human health and the health of the planet. (Image credit: Sharon Roth-DeFulvio and Joran Ermilio.)

factors are the beliefs, values, morals, and practices that influence climate action (Frumkin, 2016). Economic influences constitute what is financially available at each of the ecological levels to influence planetary health. Environmental influences are the unique physical structures and trends that influence the health of a population, such as urbanization (Whitmee et al., 2015), or chemical, biological, and physical exposure risks, including geological landscapes such as mountains or plains (Frumkin, 2016). Collectively, these external factors shape risk, vulnerability, and resilience (Leffers et al., 2004).

The climate action component of this model includes the three climate change responses (or strategies) of mitigation, adaptation, and resilience, which can take place at individual, family, community, region/nation, and international levels with benefits across the six levels of the model. These climate strategies are not always discrete, but, instead, are interrelated and interdependent. Since GHGs can take from 12 years to thousands of years to leave the atmosphere (EPA, n.d.a, n.d.b), it is important that nurses be prepared to address climate mitigation to reduce additional GHGs, as well as adaptation and resilience to withstand the impacts of climate change that will continue to occur. The model illustrates both the

interrelationship of the three strategies and how each strategy can impact the six spheres of influence.

Climate mitigation efforts are methods to prevent or reduce strain on the planet related to GHG emissions (Bell, 2011; United Nations Environmental Programme, n.d.). Examples of climate mitigation for nurses could be reducing GHGs by transporting nursing staff to the hospital in energy-efficient public transportation. Climate adaptation is the nurse's response in assessing the impact of, planning for, and managing the health-related burden (Bell, 2011; EPA, n.d.a, n.d.b). An example of nurse climate adaptation would be the management of the health-related effects of rising asthma rates resulting from the impacts of air quality, including ozone, pollen, and particulates, or in emergency responses to adverse weather events. The third strategy is climate resilience. This relates to the ability of nurses and other health professionals to create and reorganize communities and health systems that are able to withstand and thrive in the face of our changing climate by building infrastructure and creating processes to reorganize and endure extreme weather patterns, food and water insecurity, emerging diseases, and displaced people. To achieve climate resilience, economic, social, communications, and political systems

must be responsive (Bajayo, 2012). The nurse's role in climate resilience includes facilitating organization and group cohesion and engagement in policies that strengthen communities, regions, nations, and international relationships.

To understand how the Ecological Planetary Health Model would apply to nursing education for climate change, it is helpful to utilize an example. Imagine that a region of a high-income country is hit with an extreme storm system caused by excessive moisture in the air from heat trapping of GHGs that results in widespread flooding and disruption of civil services, including emergency management, healthcare systems, shelter, and food distribution. As an example of the utility of this model, consider this storm at the individual level. Mitigation of personal practices such as reducing the use of an automobile or lowering the thermostat on the heater at home helps prevent the rise in GHGs that led to the storm. To adapt an individual approach would require activation of an emergency plan, including emergency supplies and evacuation strategies for the extreme weather event. Resilience at the individual level would include maintaining close connections with others, self-care, health maintenance, and interfacing with community resources to withstand the extreme weather event.

The ability to respond to each strategy and the type of response would be influenced by the perception of the risk, economic, political, cultural, and social factors for the population targeted at each level. Therefore, consideration of climate vulnerability related to financial situation, power of the population, cultural view related to the environment, and social connections must be included. To assure environmental and climate justice, nurses need the education to strengthen these factors.

Using this model, educators can teach nursing students and practicing nurses about climate change and the impact they can make to achieve planetary health.

Recommendations for Nursing Education Design

Without making specific recommendations for each type of educational curriculum (pre-professional, graduate, or professional development education), there are broad areas that must be considered. It is essential that educational designs begin with clear learning objectives tailored to the specific audience of learners (Maxwell & Blashki, 2016). From those goals and objectives, essential climate issues should be addressed. Our recommendations are detailed in **Table 1** and are broadly stated to ensure that nurses, globally and across all educational settings, will engage in and develop regional,

Table 1. Climate Change Recommendations for Nursing Education

1. Employ an ecological perspective built from the Ecological Planetary Health Model for Nursing to ensure the interactive nature of human actions upon global impacts as well as global effects upon individual human impacts.
2. Integrate climate change impacts and responses into pre-professional nursing education, graduate level nursing education, and professional development programs for nurses in practice.
3. Include both lifespan and social determinants of health approaches to identify individuals and populations most vulnerable to climate impacts.
4. Content for the care of children should be specific to the particular vulnerability of children to climate disasters, food and water insecurity, air pollution, vector-borne diseases, diarrheal diseases, and malnutrition.
5. Include climate vulnerability related to the care of pregnant women and children. In particular, pregnant women are more vulnerable to excess heat events and inhalation of particulate matter that can result in adverse birth outcomes.
6. Integrate into the care of adults content that addresses the increased vulnerability of various occupational groups and people living with disabilities. Additionally, the impacts of climate change upon those with pre-existing chronic conditions must be considered.
7. Include increased vulnerability to extreme heat events, climate disasters, poor air quality, and waterborne and vector-borne diseases into the care of older adults.
8. Consider the social factors that contribute to vulnerability for adverse health outcomes from the impact of climate change. Social determinants such as income, education, transportation, neighborhood, housing, language proficiency, social isolation, marginalization, and other social stressors impact health outcomes must be considered.
9. Include content regarding the policy and advocacy role of nurses to address health hazards in the environment and to develop policy to reduce climate change health risks through mitigation, adaptation, and resilience.
10. Integrate the climate change strategies of mitigation, adaptation, and resilience into all content areas for education and practice. This includes efforts to take personal and professional action for mitigation, to prepare for disaster and emergency response, and to work for climate justice to build resilience globally.

culturally appropriate, and professionally relevant competencies, curricula, and educational strategies to advance nursing education in addressing climate change and health. The recommendations include the adoption of the Ecological Planetary Health Model to guide curriculum development, the inclusion of climate change health effects and responses into nursing education, specific lifespan and social determinants of health approaches, age-specific health concerns, focus upon risks and vulnerabilities, and the adoption of an advocacy role for nurses.

Conclusion

The scientific evidence compels the nursing profession to educate nurses across all levels of academic and professional education to ensure competency in addressing mitigation, adaptation, and resilience strategies for nursing practice. Despite challenges in developing and implementing climate change content in nursing education, related to the lack of engagement with climate issues in nursing practice, limited knowledge about climate change among nursing faculty, and resistance to inclusion of climate health knowledge in the curricula of content-heavy programs, opportunities exist to move forward in response to mandates from the scientific community, governments, and nursing organizations. The recommendations addressed in this article offer guidance for national nursing organizations, educational programs, and practice settings across the globe to integrate climate change content into nursing education. Nurses must be competent practitioners, advocates, and change agents to ensure the public's health in the face of climate threats. It is critical to address political, social, cultural, economic, and environmental interrelationships on human health and the health of the planet, and the Ecological Planetary Health Model offers a valuable approach for education of nurses regarding climate change.

Clinical Resources

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SPECIAL ISSUE ARTICLES

Call to Action: The Case for Advancing Disaster Nursing Education in the United States

Tener Goodwin Veenema, PhD, MPH, MS, RN, FAAN¹, Roberta Proffitt Lavin, PhD, APRN-BC², Anne Griffin, MPH, BSN, RN, CNOR³, Alicia R. Gable, MPH⁴, Mary Pat Couig, PhD, MPH, RN, FAAN⁵, & Aram Dobalian, PhD, JD, MPH⁶

¹ *Beta Nu*, Associate Professor, Johns Hopkins University School of Nursing, Department Acute and Chronic Care, Johns Hopkins School of Nursing Center for Refugee and Disaster Response, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

² Associate Dean for Academic Programs, University of Missouri-St. Louis, College of Nursing, St. Louis, MO, USA

³ Clinical Investigator and Senior Program Manager, Veterans Emergency Management Evaluation Center, Office of Patient Care Services, Veterans Health Administration, U.S. Department of Veterans Affairs, North Hills, CA, USA

⁴ Senior Project Director, Veterans Emergency Management Evaluation Center, Office of Patient Care Services, Veterans Health Administration, U.S. Department of Veterans Affairs, North Hills, CA, USA

⁵ Program Manager/Emergency Preparedness & Nurse Residency, Office of Nursing Services (ONS), Veterans Health Administration, U.S. Department of Veterans Affairs, Washington, DC, USA

⁶ Director, Veterans Emergency Management Evaluation Center, Office of Patient Care Services, Veterans Health Administration, U.S. Department of Veterans Affairs, Director, Division of Health Systems Management and Policy, University of Memphis School of Public Health, Memphis, TN, USA

Key words

Disaster, education, health security, leadership, nursing

Correspondence

Dr. Tener Goodwin Veenema, Johns Hopkins University School of Nursing, 525 N. Wolfe Street, Office 532, Baltimore, MD 21205.
E-mail: tveenem1@jhu.edu

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Abstract

Purpose: Climate change, human conflict, and emerging infectious diseases are inexorable actors in our rapidly evolving healthcare landscape that are triggering an ever-increasing number of disaster events. A global nursing workforce is needed that possesses the knowledge, skills, and abilities to respond to any disaster or large-scale public health emergency in a timely and appropriate manner. The purpose of this article is to articulate a compelling mandate for the advancement of disaster nursing education within the United States with clear action steps in order to contribute to the achievement of this vision.

Design and Methods: A national panel of invited disaster nursing experts was convened through a series of monthly semistructured conference calls to work collectively towards the achievement of a national agenda for the future of disaster nursing education.

Findings: National nursing education experts have developed consensus recommendations for the advancement of disaster nursing education in the United States. This article proposes next steps and action items to achieve the desired vision of national nurse readiness.

Conclusions: Novel action steps for expanding disaster educational opportunities across the continuum of nursing are proposed in response to the current compelling need to prepare for, respond to, and mitigate the impact of disasters on human health. U.S. educational institutions and health and human service organizations that employ nurses must commit to increasing access to a variety of quality disaster-related educational programs for nurses and nurse leaders.

Clinical Relevance: Opportunities exist to strengthen disaster readiness and enhance national health security by expanding educational programming and training for nurses.

Our world has become increasingly complex, and the number and scale of disasters is increasing. According to the Centre for Research on the Epidemiology of Disasters, 371 disasters triggered by natural hazards (up from 337 in 2013) and 203 triggered by technological hazards (up from 192 in 2013) were reported worldwide in 2015 (International Federation of the Red Cross and Red Crescent Societies, 2016). The number of disasters triggered by natural hazards was the fourth highest of the decade, with the deadliest disaster of 2015 the Nepal Earthquake, which killed 8,831 people (International Federation of the Red Cross and Red Crescent Societies, 2016). Globalization and urbanization means infectious disease outbreaks are emerging and more difficult to contain (Forum on Microbial Threats; Board on Global Health; Institute of Medicine, 2014), and the impact of climate change is taking its toll—2015 was the hottest year on record, with 32 major droughts, double the 10-year average. Three major heat waves in France, India, and Pakistan alone caused over 7,000 deaths, collectively (International Federation of the Red Cross and Red Crescent Societies, 2016). Worldwide events such as 9–11, the 2004 Indian Ocean Tsunami, 2008 Cyclone in Myanmar, and the 2011 Fukushima Daiichi nuclear disaster have killed or injured thousands of people, the threat of terrorism is ubiquitous, and forced migration is at its highest level since the Second World War. In the aftermath of events such as these, the global need for nurses to be educated and prepared for disaster and major emergency response has become a compelling and critical need.

Nurses and midwives are recognized worldwide as healthcare providers who deliver the majority of health care and are essential to improving health outcomes (World Health Organization [WHO], 2013). In the United States (US), public health crisis leaders, federal health leaders, and the diverse nursing workforce are widely recognized to have key roles to play in supporting disaster preparedness (Gulley, Strauss-Riggs, Kirsch, & Goolsby, 2017). In fact, nurse readiness as well as nurses' willingness and ability to participate will be critical to the success of any large-scale disaster response and to maintain homeland security against other significant threats (Couig, 2012; U.S. Department of Health and Human Services, 2009a, 2009b). The US needs a national nursing workforce—both civilian and uniformed services—that has the knowledge, skills, and abilities to respond to any disaster or public health emergency in a timely and appropriate manner no matter where they occur in the world. U.S. nurse leadership and nurse readiness will impact the broader global nursing workforce and our capacity to contribute in international disaster response. The role of nurses should not be underestimated (Arbon, 2009), as disaster competence will be critical to

population outcomes (Schultz, Koenig, Whiteside, & Murray, 2012; Walsh et al., 2012). For that reason, in 2009 the International Council of Nurses (ICN) published a framework for disaster nursing competencies for the global nursing workforce and specifically to provide clarity and importance of the nurse's role in disasters (WHO, Western Pacific Region and ICN, 2009). Although the ICN Framework of Disaster Nursing Competencies has provided a foundation for global nursing education, its adoption has been limited and much work remains to be done (Hutton, Veenema, & Gebbie, 2016). Other groups have proposed competencies as well (**Table 1**), and while there is general agreement that nurses need education and training, there is a decided lack of concurrence regarding how all nurses will achieve disaster competency (Gebbie, Hutton, & Plummer, 2012), resulting in variability in disaster nursing competence (Nilsson et al., 2016). Internationally, the Nursing Section of the World Association for Disaster and Emergency Medicine (WADEM) articulates its vision "to be the organizational vehicle welcoming and representing nurses from all countries with an intent and desire to strengthen and improve the practice and knowledge of disaster nursing." Together with the World Society of Disaster Nursing, both organizations strongly advocate for global education and training for nurses in disaster response (WADEM, 2016).

In the US, the absence of a clearly articulated vision and framework for disaster nursing education is not without consequences. Despite earlier attempts to advocate for the inclusion of competency-based disaster education in nursing curricula (Littleton-Kearney & Slepski, 2008; Veenema, 2006; Weiner, Irwin, Trangenstein, & Gordon, 2005), studies have shown that many nurses lack experience with disasters, and the majority of the nation's nursing students (Schmidt et al., 2011) and nurses are inadequately prepared to respond to the complex demands of disasters (Baack & Alfred, 2013; Gebbie & Qureshi, 2006). The significance of this gap should not be underestimated. An unprepared nursing workforce has the potential to limit the effectiveness of local, state, regional, tribal, and federal response plans, limit organizational surge capacity, and negatively impact health outcomes in populations impacted by disasters (Centers for Medicare and Medicaid [CMS], 2013; National Advisory Council on Nurse Education and Practice, 2009). Organizations that neglect to provide adequate education and training may not meet the Centers for Medicare and Medicaid (CMS) enhanced emergency preparedness requirements issued in 2016 (CMS, 2016).

A collective vision for the future of disaster nursing (Veenema, Griffin, et al., 2016) suggests that U.S. nurses should possess a minimum knowledge base, skills, and

Table 1. Disaster Competencies

Title	Full source
All-Hazard Disaster Core Competencies for Acute Medical Professionals	Schultz, C. H., Koenig, K. L., Whiteside, M., & Murray, R. (2012). Development of national standardized all-hazard disaster core competencies for acute care physicians, nurses, and EMS professionals. <i>Annals of Emergency Medicine, 59</i> (3), 196–208.
Healthcare Worker Competencies for Disaster Training	Hsu, B. H., Thomas, T. L., Bass, E. B., Whyne, D., Kelen, G. D., & Green, G. B. (2006). Healthcare worker competencies for disaster training. <i>BMC Medical Education, 6</i> , 19.
Preparing Health Professions Students for Terrorism, Disaster and Public Health Emergencies: Core Competencies	Markenson, D., DiMaggio, C., & Redlener, I. R. (2005). Preparing health professions students for terrorism, disaster, and public health emergencies: Core competencies. <i>Academic Medicine, 80</i> (6), 517–526.
Public Health Preparedness & Competence Model	Markenson, D., DiMaggio, C., & Redlener, I. R. (2005). Preparing health professions students for terrorism, disaster, and public health emergencies: Core competencies. <i>Academic Medicine, 80</i> (6), 517–526.
International Council of Nurses Disaster Competencies ICN	World Health Organization, Western Pacific Region and International Council of Nursing. (2009). <i>ICN framework of disaster nursing competencies</i> . Geneva, Switzerland: Author. Retrieved from http://www.icn.ch/images/stories/documents/networks/DisasterPreparednessNetwork/Disaster_Nursing_Competencies_lite.pdf
Emergency Preparedness Competencies (annotated); Public Health Professionals	Gebbie, K. M. (2001, October). Core public health worker competencies for emergency preparedness and response. Presented at the 129th Annual Meeting of American Public Health Association. Atlanta, GA.
Core Competencies for Disaster Medicine and Public Health	Walsh, L., Subbarao, I., Gebbie, K., Schor, K. W., Lyznicki, J., Strauss-Riggs, K., . . . James, J. J. (2012). Core competencies for disaster medicine and public health. <i>Disaster Medicine and Public Health Preparedness, 6</i> (01), 44–52.

abilities regarding disaster and public health emergency preparedness and must be able to respond directly or provide indirect support (e.g., shift coverage for those deploying or perform critical data collection) in any type of disaster event or public health emergency. This vision is predicated upon the belief that nurses who possess at least a minimum knowledge base and skill set are better able to keep themselves and their patients, families, and communities safe or at least to minimize the harm that may occur, and will ultimately lead to communities that are more resilient to disasters. It provides recognition of the broad range of leadership and skills that nurses bring to disasters and includes all licensed nurses who provide both direct and indirect patient care.

Existing literature on the topic supports the compelling need for access to evidence-based, competency-driven disaster education for nurses in academic and life-long learning programs in order to enhance community, hospital, and health system surge capacity and improve population-based outcomes for victims of disasters (Gebbie & Qureshi, 2006; Littleton-Kearney & Slepiski, 2008; Slepiski, 2007; Stanley & Wolanski, 2015; Veenema, 2006, 2013). At a minimum, clear, concrete guidance for the provision of disaster nursing educational programming would establish a foundation for educational programming. In reality, however, this information has not been forthcoming and often has been absent from the leading organizations that provide oversight and accreditation of nursing education

in the US (Commission on Collegiate Nursing Education [CCNE] and the National League for Nursing Accreditation Commission). The Essentials of Baccalaureate Education for Professional Nursing Practice published by the American Association of Colleges of Nursing (AACN, 2008), which delineates the expected outcomes for all baccalaureate nursing education programs, currently requires disaster content to be included (risk communication, emergency preparedness, and disaster response including self-protection); however, faculty guidance and resources for presenting this material are presently inadequate. Given the absence of clear guidance, it is not surprising that current educational programs vary greatly, many are not evidence based (Gebbie, Hutton, & Plummer, 2012, and the processes for inclusion and integration of competencies in curricula are varied and limited (Daily, Padjen, & Birnbaum, 2010; Loke & Fung, 2014).

Action Items to Advance Disaster Nursing Education

A national panel of disaster nursing education experts published consensus recommendations that address disaster nursing education in the US (Veenema, Griffin, et al., 2016; Langan, Lavin, Wolgast, & Veenema, 2017). In continuation of this work, the national panel of disaster nursing education experts convened a series of semistructured conference calls to refine and endorse the

following action items to advance a national framework for delivering disaster nursing educational programming.

Clarify the Requirements for CCNE Accreditation Standards and the Basis for National Council Licensure Examination (NCLEX) Disaster Content

All colleges and universities that are accredited by the American Nurses Credentialing Center (ANCC) at the baccalaureate, master's (master of science in nursing [MSN]), or doctoral (doctor of nursing practice [DNP]) level must address the expectations and criteria of the ANCC essentials. *The Essentials of Baccalaureate Education for Professional Nursing Practice* lay the groundwork for what a bachelor of science in nursing (BSN)-prepared nurse should know about disasters within the context of clinical prevention and population health and the role of the generalist (AACN, 2008). The AACN Essentials expands these criteria to graduate education at the MSN and DNP levels with *The Essentials of Doctoral Education for Advanced Practice Nursing* (DNP essentials; AACN, 2006) and *The Essentials of Master's Education in Nursing* (MSN essentials; AACN, 2011). Together they provide the framework for advanced practice nursing curricula and the content criteria for programs addressing disaster education. One may conclude that both the MSN and DNP essentials show benign neglect with respect to disaster and emergency preparedness, and since it is not a priority during accreditation visits, it is likely suffering the same neglect from colleges and universities. The disaster skills and knowledge needed to "respond to an emergency event within the emergency management system of the clinical practice, institution and community" should be considered foundational for advanced practice registered nurses (APRNs), especially in consideration of the push for fully independent practice (National Panel for APRN Emergency Preparedness and All Hazards Response Education, 2007).

Preparedness is a fundamentally nebulous field populated by uncertainty (Sayre, 2011), and workforce development in preparation for disasters and large-scale public health emergencies may not be adequately appreciated by nurse educators as a critical component of a nursing education program. Because little importance is afforded disaster nursing as an area of study, the inclusion of disaster nursing content and practice in nursing curricula may be negligible and there may be limited interest in addressing this issue in the future (Usher & Mayner, 2011). Because many schools of nursing "teach to the NCLEX," expert panel members found that it may provide clarity to determine how and why disaster content is selected for inclusion in the NCLEX. It is conceivable that disaster

content in community and population health curricula receive limited attention by nurse faculty because there are so few questions related to it on the NCLEX. The panel members questioned the lack of emphasis on disaster questions that allows or even encourages faculty to skip over the content and assign it a low priority. The panel discussed two specific options related to the NCLEX: (a) add more questions specific to disaster and emergency preparedness, or (b) add a state-based addendum to the examination that covers this content. The panel recommended that the National Council of State Boards of Nursing should evaluate ways to include more disaster preparedness content in the NCLEX.

Create Disaster Preparedness Leadership Content for Nurse Administrators and Executives

Nurses serve as leaders in disaster preparedness and response at multiple levels: within their own homes and neighborhoods, at disaster scenes, and at the workplace (Knebel, Toomey, & Libby, 2012). The expert panel identified the critical call to action to prepare nurses in leadership positions (health systems administrators, executives, managers) for crisis conditions resulting from disasters and public health emergencies and proposed that core competencies be identified and validated specific to crisis leadership. Currently, disaster nursing leadership competencies are absent from the published literature (Veenema, Losinski, Newton, & Seal, 2016). While disaster nursing leadership is relatively new as a distinctive field, it was troubling that not a single article was identified in the published literature that addressed crisis nursing leadership competencies. Disaster content developed specifically for nurse administrators and executives and others in leadership positions would facilitate decision making in highly ambiguous or extreme situations, the ethical allocation of scarce resources (e.g., space, staff, supplies), and decision making regarding health systems event management, such as evacuation and patient transfers.

Establish National Guidance for Disaster Response for Schools of Nursing

Our expert panel proposed the establishment of national guidelines for deans and schools of nursing (SONs) regarding their responsibilities and opportunities in responding to disasters. These guidelines would be extremely helpful in providing legal and ethical clarity regarding the role of SON faculty, staff, and students should a disaster occur in their local community, region, or even nationally.

Establish a Coordinated Network of SONs for Disaster Response

A coordinated network of SONs should be organized pre-event. Participating SONs would provide evidence of meeting nationally established standards for SON disaster preparedness and would be prepared for rapid response. A coordinated network of SONs would ensure shared resources and timely and coordinated communications regarding emergency response needs, training and education updates, and other needs. This network would be composed of a national workgroup of key stakeholders in disaster nursing education working in collaboration with state boards of nursing and could be used to expand education and training opportunities.

Develop an Electronic Toolkit for Nurse Educators

The resource and learning needs of faculty as disaster preparedness nurse educators must be addressed as well (Stanley & Wolanski, 2015). After identifying a minimum set of disaster nursing competencies (National Library of Medicine, 2017), educational development opportunities would need to be developed along with an electronic toolkit that would provide resources (simulations, case studies, exemplars, and curricular guidelines) for faculty teaching in undergraduate and graduate nursing programs. The availability and use of the toolkit could be disseminated widely through journals and presentations at major nursing education conferences and webinars to encourage adoption across all schools of nursing.

Encourage Innovations in Disaster Nursing Educational Technology

Attention and investment should be made to incorporate new educational technology strategies across multiple platforms for preparing nursing students and faculty (e.g., Android, iPhone, iPad, Windows, web). Investigation and exploration of the potential role of teaching platforms such as distance learning, massive open online courses, virtual and visual simulation, team-based learning, gaming, a Kahn Academy (2016) approach, and recognition of experiential life learning should be encouraged. The panel proposed that nurse educators focus on student engagement and how people learn to design, deliver, and evaluate disaster educational programs that meet students' needs. Since knowledge turns over rapidly, it was proposed that the focus shift more towards teaching students and nurses in the workforce "how to think" rather than "what to think."

Recognize the Need for Experiential Learning

Nursing is a practice profession. Self-perceived disaster nursing competence is related to education and training, but also experience with disaster events (Alim, Kawabata, & Nakazawa, 2015; Nilsson et al., 2016; Olivia, Claudia, & Yuen, 2009). The panel proposed that students need to be exposed to experiential disaster training. While this may occur through simulation, community disaster exercises, hospital exercises, or tabletop exercises, the literature is inconsistent as to how effective simulation is in training for disaster response (Miller, Rambeck, & Snyder, 2014; Williams, Nocera, & Casteel, 2008). Whatever mechanism a school chooses to employ, it is important that students are exposed to the realities of disaster response. Even the most basic exercises can expose students to the importance of personal and family disaster plans, triage, use of personal protective equipment, and the process for decontamination.

Recognize the Need for Ethical Guidance for Disaster Nursing

For all nurses, the most difficult part of disaster response may be the ethical issues faced and understanding the chain of command within the Incident Command System. Clinical decision making and care rendered or withheld during disaster events may be characterized by ambiguity and conflicting demands. Nurses need education regarding interpreting triggers and putting into action crisis standards for care (National Academies of Science, 2012, 2013) and clarity regarding their ethical duty to respond (American Nurses Association, 2010).

Ensure Integration of Disaster Nursing Within the Broader Context of Interprofessional Education

Interprofessional education (IPE) is critical in preparation for a disaster when the roles of individuals may necessarily change to accommodate surge capacity (the sudden, unanticipated demand for health care). Previous IPE efforts have focused largely upon mass casualty events requiring trauma and critical care response. Important disaster topics such as mental health and social services are often omitted. An essential component of IPE for nurses to understand are the emergency support functions (ESFs) articulated in the National Response Framework that are most closely linked to nursing practice (Couig, Martinelli, & Lavin, 2005; **Table 2**). Nurses may be aware of ESF#8 Public Health and Medical (see **Table 2**), but few may be familiar with ESF#6

Table 2. Emergency Support Functions

Emergency Support Functions (ESFs) is the grouping of governmental and certain private sector capabilities into an organizational structure to provide support, resources, program implementation, and services that are most likely needed to save lives, protect property and the environment, restore essential services and critical infrastructure, and help victims and communities return to normal following domestic incidents. There are 15 ESFs, and the Department of Health and Human Services (HHS) is the primary agency responsible for ESF 8—Public Health and Medical Services. ESF 8 is coordinated by the Secretary of HHS principally through the Assistant Secretary for Preparedness and Response. ESF 8 resources can be activated through the Stafford Act or the Public Health Service Act.

ESF1	Transportation
ESF2	Communications
ESF3	Public Works and Engineering
ESF4	Firefighting
ESF5	Emergency Management
ESF6	Mass Care, Housing, and Human Services
ESF7	Resources Support
ESF8	Public Health and Medical Services
ESF9	Urban Search and Rescue
ESF10	Oil and Hazardous Materials Response
ESF11	Agriculture and Natural Resources
ESF12	Energy
ESF13	Public Safety and Security
ESF14	Long-term Community Recovery and Mitigation
ESF15	External Affairs

Note. ESF 8—Public Health and Medical Services provides the mechanism for coordinated federal assistance to supplement state, tribal, and local resources in response to an emergency. Retrieved from <http://www.phe.gov/preparedness/support/esf8/Pages/default.aspx>

Mass Care, Emergency Assistance, Housing, and Human Services. The ESF#6 annex in the National Response Framework defines “Human Services” as “Disaster assistance programs that help survivors address unmet disaster-caused needs or non-housing losses through loans and grants; also includes supplemental nutrition assistance, crisis counseling, disaster case management, disaster unemployment, disaster legal services, and other state and Federal human services programs and benefits to survivors” (Federal Emergency Management Agency [FEMA], 2013). The provision of education addressing the intersection of these two emergency support functions would increase the positive impact that can be made of the lives of disaster victims. Integration of disaster nursing within the broader context of IPE can help shift the paradigm from a focus on trauma or critical care to a more holistic focus that incorporates a broader group of service providers (Koltko-Rivera, 2006). The expert panel recommended the development of an IPE toolkit that could be used by faculty that includes online resources such as simulations, case studies, and exemplars. By stressing interprofessional practice, the resources may be more broadly adopted across academic programs within a college or university. Additionally, multiple government (federal and state) sponsored education and training programs exist (e.g., FEMA modules and National Disaster Life Support training), many of which are focused upon prehospital healthcare management or emergency

management. The focus of these programs could be broadened to better encompass a hospital and nursing focus. Finally, nursing and interprofessional groups that provide education and training and that respond to disasters have created resources that would be valuable additions to the creation of the toolkit (see Clinical Resources).

Conclusions

Novel action steps for expanding disaster educational opportunities across the continuum of nursing are needed now in order to meet the current compelling need to prepare for, respond to, and mitigate the impact of disasters on human health. U.S. educational institutions and health and human service organizations that employ nurses must commit to increasing access to a variety of quality disaster-related educational programs for nurses and nurse leaders and to enhancing collaboration across schools.

National disaster nursing experts have advanced consensus recommendations for advancing disaster preparedness nursing education in the US and have articulated clear action steps to achieve a desired vision of national nurse readiness. We are committed in our belief that national nurse readiness is critical to improving population health outcomes and protecting the safety and well-being of patients and families affected by disaster

events, and is directly related to the health security of the US. We invite our nursing faculty colleagues across all health educational settings and across the globe to join us in supporting this call to action.

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Clinical Resources

- American Red Cross Disaster Training: <http://www.redcross.org/take-a-class/disaster-training>
- Assistant Secretary for Preparedness & Response Technical Resources, Assistance Center, and Information Exchange (ASPR TRACIE): <https://asprtracie.hhs.gov/>
- Coalition of Nurses for Communities in Disaster: <http://www.endesastres.org/concid1.html>
- Disaster Medical Assistant teams: <https://www.phe.gov/Preparedness/responders/ndms/teams/Pages/dmat.aspx>
- Medical Reserve Corp: <https://www.ready.gov/medical-reserve-corps>
- National Voluntary Organizations Active in Disaster: <https://www.nvoad.org/>
- Society for the Advancement of Disaster Nursing: <https://disasternursing.org/>

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