

Addressing the Health Risks of Climate Change in Older Adults



“How could we explain to our grandchildren that we saw the threat coming, but did not do all we could to ensure that humankind took the necessary precautions?”

—*Michael Mann* (The Hockey Stick and the Climate Wars, 2013, p. 251)

Our climate is changing. Evidence clearly shows that humans are warming the planet, and these climate changes have a devastating impact on health, especially in the most vulnerable populations, such as older adults (Costello et al., 2009; Watts et al., 2015). Climate change is a health and nursing issue. Despite this evidence, there is a large gap in nursing knowledge of climate change and a paucity of nursing research on climate change and health. Few nurses understand climate science in an accessible way or can communicate why extreme weather events, including extreme and snowy winter weather, are related to climate change (Anaker, Nilsson, Holmner, & Elf, 2015; Polivka, Chaudry, & Crawford, 2012) and how these changes affect the health of older

ABSTRACT

Our climate is changing. These changes have an impact on health, especially in vulnerable populations such as older adults. Many older adults lack the physical, cognitive, social, and economic resources to avoid and/or mitigate the effects of exposure to extreme weather events. The purpose of the current article is to help nurses understand climate change and how that relates to the need for specific interventions to support climate adaptation for the older adult population. A model of exposure, contact to stressors, and adaptive capacity are used to address the health needs of older adults in the face of climate change. Gaps in nursing knowledge, resources for nurses, and a proposed agenda for research and practice in climate change are offered. Gerontological nurses are in an important position to lessen the harm of climate change in older adults through practice, research, and policy. [*Journal of Gerontological Nursing*, 45(11), 21-29.]

Ruth McDermott-Levy, PhD, MPH, RN; Ann Marie Kolanowski, PhD, RN, FAAN;
Donna Marie Fick, PhD, RN, FGSA, FAAN; and Michael E. Mann, PhD

adults. Because of these gaps, few nurses know ways to lessen the impact on older adults or interventions that can be tested in health care settings (Leffers, McDermott-Levy, Nicholas, & Sweeney, 2017). Climate change will impact the health of all populations, but for older adults there are unique vulnerabilities, such as normal physiological changes of aging, comorbidities, cognitive impairment, and mobility limitations. Gerontological nurses must be prepared to address these specific issues of older adults in all practice settings.

The purpose of the current article is to help nurses understand climate change and the need for specific interventions to support climate adaptation for the older adult population. What makes older adults particularly vulnerable and gaps in nursing knowledge will be discussed and resources for nurses and other clinicians and a proposed agenda for research and practice in climate change will be presented.

OVERVIEW OF CLIMATE SCIENCE

In October 2018, the United Nation's Intergovernmental Panel on Climate Change (IPCC), comprised of the world's leading climate scientists, issued a sobering report. If greenhouse gas emissions continue at the current rate, Earth's surface temperatures could rise to 2.7°F (1.5°C) above preindustrial levels by 2030 and this could have catastrophic impacts on human health (IPCC, 2018). Climate change is not something nurses typically think about, but it has the potential to influence the health of older adults in a significant way. As older adults experience changing weather patterns from climate change, gerontological nurses should be asking:

- How does climate change influence the health of older adults?
- How could gerontological nursing practices promote and main-

tain the health of older adults in relation to climate change?

To answer these questions, it is important for nurses to understand basic climate science and its impact on the older adult population.

There are naturally occurring and human (anthropogenic) factors that contribute to climate change. Naturally occurring factors include changes in the sun's warming energy on Earth (irradiance) and volcanic eruptions that eject sun-blocking particulates into the stratosphere (Mann & Kump, 2015; U.S. Global Change Research Program [USGCRP], 2018). Natural factors, however, cannot explain the recent warming that has been observed. Indeed, between 1951 and 2010, natural factors alone contributed to a slight cooling trend (between -0.18°F and 1.8°F and -0.1°C to 0.1°C) (USGCRP, 2018). The approximate mean 1°C (range = 0.8°C to 1.2°C) of global warming (i.e., the entire observed global warming trend) is attributed to human activity.

Anthropogenic greenhouse gas emissions are the dominant human-caused contribution to observed climate change. The dominant anthropogenic greenhouse gas is carbon dioxide (CO₂), whereas methane (CH₄) plays a secondary but important role, and ozone, nitrous oxide (N₂O), and halocarbons play a tertiary role (USGCRP, 2018). Burning fossil fuels (e.g., coal, gas, oil), agricultural practices, and deforestation are the greatest contributors of the two major greenhouse gases, CO₂ and CH₄. Greenhouse gases become part of Earth's atmosphere and they absorb heat. Atmospheric heat absorption by natural greenhouse gases is helpful to keep Earth habitable (i.e., in the absence of any greenhouse effect, Earth would be a frozen planet). However, when greenhouse gases reach high atmospheric levels, they act as if an extra blanket has been wrapped around Earth and too much heat is held on Earth's surface. Particulates known

as aerosols produced by coal-burning and other industrial activities (particularly sulphate aerosols) have a regional cooling effect and have offset some of the greenhouse warming during the past century, but the aerosol cooling has decreased in recent decades, leading to an acceleration of global warming over that time frame.

Increases in atmospheric greenhouse gases have led to a sick Earth with myriad symptoms that affect human health. Unprecedented weather extremes have been seen in the United States in recent decades, including record-strength hurricanes and super storms, floods, droughts, heat waves, and wildfires. These events are the result of a warmer atmosphere that can hold more moisture, which allows for more extreme precipitation events, including floods and winter blizzards, and stronger, more rainfall-producing hurricanes (Mann & Kump, 2015). The warming of the surface also leads to drying soil and worse drought in many regions. In addition, increasing atmospheric CO₂ has caused the oceans to absorb additional CO₂ and heat. In fact, the oceans have absorbed 55% of the industrial period CO₂ (Mann & Kump, 2015) and 93% of the excess heat energy (USGCRP, 2018), contributing along with the melting of glaciers and ice sheets to sea level rise. Rising sea levels along with more intense land-falling hurricanes have led to the inundation of coastlines. Increasing CO₂ levels have also led to acidification of oceans with decreased marine life and seafood (National Oceanic Atmospheric Administration, 2017). The latitudinal pattern of warming, and in particular Arctic amplification of warming due to melting ice and other feedbacks, may also be favoring stalled, extreme weather patterns. Thus, an extreme rain or snowstorm or heat wave may last many days (Mann, 2019; Mann et al., 2018) (**Figure 1**).

WHAT MAKES OLDER ADULTS VULNERABLE TO CLIMATE CHANGE HEALTH THREATS?

Climate change is an environmental stressor. Vulnerability to climate change, like other health risks, is determined by three elements: *exposure*, the contact people have with the stressor; *sensitivity*, the degree to which people are affected by the stressor; and *adaptive capacity*, the ability of people to adjust to the stressor (Crimmins et al., 2016). Many factors span all three elements; for example, socioeconomic status can impact exposure (poor housing), sensitivity (poor health due to lack of access to health care), and adaptive capacity (inability to afford air conditioning). Vulnerability also operates at individual, community, and national levels, and these levels are inextricably interrelated.

Climate change has a differential impact on subgroups of the population depending on their vulnerability. Older adults have been designated a population of concern because of their heightened vulnerability (Balbus & Malina, 2009; Layva, Beaman, & Davidson, 2017).

Exposure

The geographic distribution of older adults in the United States is such that more than one half live in areas that disproportionally experience the effects of heat waves, forest fires, hurricanes, and coastal flooding. California, Florida, Texas, New York, and Pennsylvania account for the top five states where older adults are concentrated (U.S. Department of Health and Human Services [USDHHS], 2018). Older adults who live in urban areas are vulnerable to the “*heat island effect*”—the relative warming of urban areas compared to rural areas due to the displacement of the natural environment with a built environment that traps heat. Trapped heat does not dissipate at night, leading to a disruption in the pattern of nighttime cooling when the body could recover

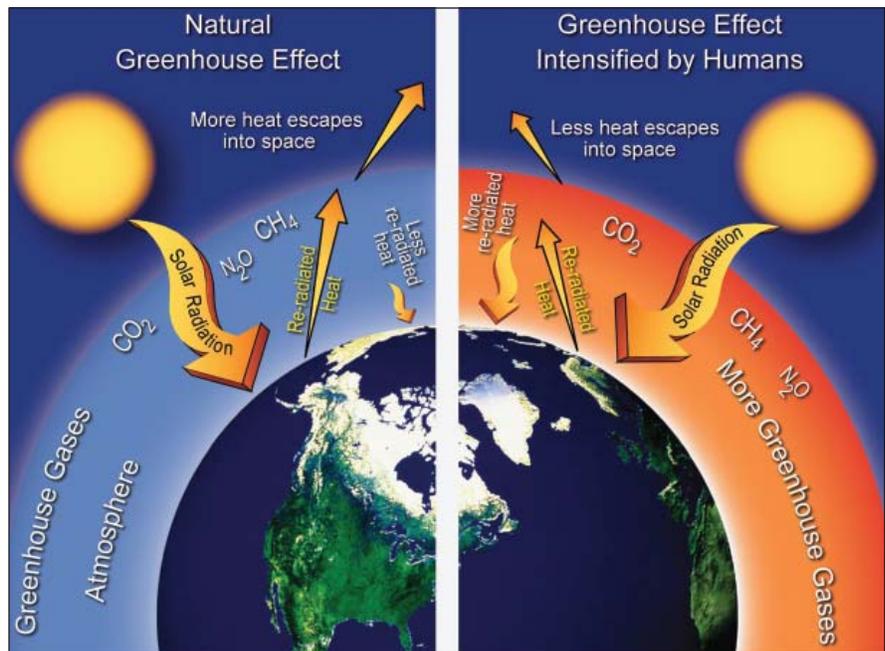


Figure 1. Human influence on the greenhouse effect. The left side depicts naturally occurring heat absorption that warms Earth by the sun and atmospheric greenhouse gases. The right side shows greater heat trapping that is occurring from increases in anthropogenic greenhouse gases in the atmosphere, thus leading to a warmer planet. From the Fourth National Climate Assessment (access <https://nca2014.globalchange.gov/report/appendices/climate-science-supplement/graphics/human-influence-greenhouse-effect>) (free to use with credit to original figure source).

from high daytime temperatures in cities (Opitz-Stapleton, 2014).

A substantial number of the 51.1 million older adults in the United States live on fixed incomes and >15 million are economically insecure—living at or below 200% of the federal poverty level (Cubanski, Koma, Damico, & Neuman, 2018). Poor housing and substandard communal living sites that lack basic necessities, such as air conditioning and access to social services during extreme weather events, increase older adults' exposure to the effects of climate change. Older adults' vulnerability to extreme weather events brought on by climate change was graphically illustrated during Hurricane Katrina when approximately 60% of the flood-related deaths were among people older than 65 (Jonkman, Maaskant, Boyd, & Levitan, 2009).

Sensitivity

Physiological age changes, comorbidities, loss of functional abilities,

certain medications, and social isolation increase older adults' sensitivity to the effects of climate change. Older adults have a reduced thermoregulatory response to heat and cold because of physiological changes in the regulation of core body temperature. The ability to sense heat, sweat, and increase skin blood flow are all reduced in healthy older adults. Risk for heat-related illness or injuries are compounded for older adults with obesity, cardiovascular disease, respiratory disease, and diabetes mellitus because of the deleterious effects these diseases have on normal thermoregulatory responses (Gamble et al., 2013).

Older adults often have a heavy drug burden due to their multiple comorbidities. Many of these medications can increase sensitivity to the effects of climate change by inducing diuresis, electrolyte imbalance, and sedation, and by reducing thirst recognition, sweat production, and cardiac output. Diuretics (especially

when combined with an angiotensin converting enzyme inhibitor or angiotensin II receptor blocker), anticholinergic, and psychotropic medication compromise thermoregulatory capacity and can lead to heat-related illnesses (Westaway et al., 2015).

Other factors increase older adults' sensitivity to climate change effects. A recently released govern-

ment report indicated that 49.8% of adults age >65 have a disability that places them at risk of being "invisible" during extreme weather events (Gamble et al., 2016). Older adults who have cognitive impairments or mobility problems may not receive the assistance they need to evacuate during a flood or wildfire. These problems become even more exaggerated in socially isolated areas where there are few available social services.

Adaptive Capacity

Many older adults lack the physical, cognitive, social, and economic resources to avoid and/or mitigate the effects of exposure to extreme weather events. Functional limitations and mobility impairments are more common in older women than men. Osteoporosis, impaired balance, and reduced motor strength make it difficult to evacuate and respond to weather emergencies. Women also experience higher rates of comorbidities and certain neurodegenerative diseases (e.g.,

Alzheimer's disease) that interfere with thermoregulation and the judgment necessary to assess and take action against risks associated with extreme weather events, respectively (Gamble et al., 2013).

Socioeconomic status directly impacts the susceptibility of older adults to climate change, and racial and ethnic populations are disproportionately represented among the

the health risks associated with climate change and ways to avoid negative health outcomes (Gamble et al., 2013). Gerontological nurses can leverage their expertise to inform older adults and their families, other health care providers, health facility administrators, community-based organizations, and policy makers of the unique needs of an older adult population. For example, gerontological nurses can address the preparation for and response to extreme weather events within the context of the geographic region (e.g., heat, flooding, wildfires) and older adults' living setting. Ability to access emergency information and early warning systems (e.g., television, radio, phone, internet) should be assessed to determine if older adults are able to protect themselves during and after extreme weather events. Older adults with special needs, such as those with cognitive impairments, mobility issues, or mental health problems, should be identified to local emergency management agencies to ensure they receive necessary evacuation assistance (Balbus & Malina, 2009; Federal Emergency Management Agency, 2006).

Poor air quality from the changing climate and extreme weather events (Fiore, Naik, & Leibensperger, 2015) can negatively influence older adults who already have decreased lung capacity (Miller, 2019). In the past 20 years, pollen season in the United States is earlier and with higher concentrations (Poole et al., 2019). In addition, in higher temperatures, pollen has greater immunoglobulin E binding, thus creating a stronger allergic response (Ahlholm, Helander, & Savolainen, 1998). For this reason, older adults may display new allergy symptoms during pollen season. Nurses should monitor and teach older adults or their caregivers to monitor the air quality index (AQI), which can be found in the newspaper, news radio, Environmental Protection Agency (EPA) website (access <https://airnow>.

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economically disadvantaged in the United States. They experience poorer health status, are often socially isolated, and have more limited access to health care, community resources, energy, food, and adequate housing than their more economically secure peers. These groups, and older adults in general, also have less access to technology, such as the internet, which supports rapid communication during emergencies (Paavola, 2017).

REDUCING THE HEALTH RISKS OF CLIMATE CHANGE IN OLDER ADULTS

The climate change being experienced poses risks to older adults' health, but there are actions that nurses can take to mitigate vulnerability. Some actions are short-term interventions that reduce exposure and improve adaptive capacity, whereas others are long-term and focus on eliminating the source of the problem.

There is an urgent need for public education to heighten awareness of

gov), or the EPA app AirNow. In rural areas, the air monitoring systems may be further from an older adult's residence. In such cases, decisions for outdoor activities, including transport from care settings, should be made based on the weather conditions and AQI reading in the closest geographical area.

Indoor air quality may be compromised from poor outdoor air quality. Indoor air quality is also influenced by mold. Severe storms and sea level rise have led to floods with the risk of mold in homes and care facilities. Health impacts of mold spores can range from mild allergic response, such as irritation of the mucus membranes, to long-term impacts, such as cancer or bleeding disorders (Jezak et al., 2016). Older adults are at greater health risk from mold due to weakened immune systems from aging (Miller, 2019). Monitoring ambient (outdoor) air quality can also provide a guide for indoor activities and give an explanation for older adults' physiological response.

During extreme weather events, prevention is paramount. Knowing the risk factors for heat illnesses (e.g., older age, presence of comorbidities, use of certain medications, dehydration) will help nurses identify target populations during heat waves. Older adults should be instructed to increase their fluid intake to at least 2,000 cc even if they are not thirsty; eat smaller, more frequent meals; wear light cotton non-restrictive clothing; limit their physical activity during the hottest hours of the day; and use air conditioning or move to an area where air conditioning is available, such as malls or libraries (Worfolk, 2000). Nurses working in inpatient settings must participate in disaster planning and assure that older adults can transition to a cool environment when discharged or when transported to appointments during heat waves. In addition, assuring plans to manage extreme heat should be part of discharge planning and home care instructions.

Climate change can also cause extremely cold weather. Accidental hypothermia can occur even without severe cold exposure in older adults who have mobility problems, comorbidities that interfere with heat production or impair thermoregulation (e.g., hypothyroidism, diabetes, stroke, acute illnesses), or are using medications that interfere with thermoregulation (e.g., tranquilizers, sedative/hypnotics, antidepressants, vasodilators). During cold periods, older adults should be instructed to dress warmly, layer clothing with high insulation value (avoid polyester), wear a hat indoors to prevent heat loss, and take advantage of fuel assistance programs in the community (Worfolk, 2000).

Emergency Evacuation Plan

During extreme weather events, such as hurricanes and wildfires, news reports frequently highlight the unique vulnerabilities of older adults. Access to services and mobility influence health risk for older adults. Nurses, along with other providers, can play an important role in supporting individual resilience in the face of emergencies by supporting coping strategies, personal strength, disaster preparation, and behaviors that support health (Layva et al., 2017). Gerontological nurses in all practice settings should assure that older adults and their caregivers are aware of community-level emergency procedures, communications, and evacuation plans. The Office of Homeland Security has partnered with other federal agencies to offer home emergency preparedness information in several languages, including Spanish, Arabic, Chinese, and Russian. In addition, there is a section that specifically addresses the needs of older adults (access <https://www.ready.gov/seniors>). Nurses must be aware of the federal, state, local, and agency-based emergency procedures in their region and assure that there are contingency plans for loss of power for home and clinical

settings, including hospitals; alternative evacuation routes; and a variety of communication methods that specifically address the needs of older adults with comorbidities; mobility, sensory, and cognitive problems; and supportive devices (e.g., oxygen tanks).

During disasters and emergencies, an 1135 Waiver can be requested for Medicare and Medicaid-funded health providers, laboratory services, skilled nursing care, hospital services, and mental health counseling (USDHHS, 2019). In some states, an older adult who requires assistance during emergencies can be registered through the state 2-1-1 Essential Community Service Hotline; in other states, the local emergency services such as police and fire would be made aware of the address of a person in the event of an emergency evacuation. AARP (n.d.) has a Livable Communities initiative that includes disaster planning to support older adults in advance of an extreme weather event. Gerontological nurses should support the adoptions of Livable Communities locally and institutional-level (e.g., nursing home, hospital) disaster plans that include the unique needs of older adults.

Adapting Plan of Care

Climate change impacts require modifications in health plans for older adults. As mentioned above, prolonged heat will require greater needs for hydration, but comorbidities must be considered. Individuals with heart failure and renal disease will require astute nursing assessments to monitor the balance of hydration and electrolytes while not leading to fluid overload or electrolyte imbalances in the presence of extreme heat. Older adults with or at risk of heat stroke and dehydration should be assessed for delirium (Oh, Fong, Hshieh, & Inouye, 2017).

In addition to fluid balance, older adults with cardiovascular and respiratory conditions must have pro-

TABLE 1**RESEARCH, PRACTICE, AND POLICY AGENDA FOR CLIMATE CHANGE**

Research Agenda	Practice	Policy
Develop research designs for studying the impact of health and climate change with older adults as partners	Assess and document factors that may impact older adults' response to extreme weather	Join or start a Green Team (or Sustainability Team) at your local hospital to address climate mitigation and adaptation
Identify predictors that make older adults more vulnerable to specific health impacts of climate changes (e.g., pollution, extreme weather)	Identify and address (assess and act on) key areas of vulnerability and risk in older adults in regard to climate change including: hydration, temperature control, adapting the plan of care, medications, and mental health and intellectual disability issues	Advocate at the local, state, and national level for policies and resources that support older adults related to disasters or extreme weather events
Establish interdisciplinary research teams to develop comparison groups nationally and internationally and support nurse scientists in this arena	Locate resources in your area and local disaster plans before extreme weather events occur	Support and learn about organizations that address climate change and health such as Alliance of Nurses for Healthy Environments and Health Care Without Harm/Practice Greenhealth
Develop measures to better understand the climate-related experience of older adults	Educate about and work with your local community to understand who is most at risk and how to mitigate and adapt to climate risk	Partner with local aging agencies and national organizations such as AARP to address the needs of older adults and climate change
Establish cost-effective replicable programs to lessen the impact of climate changes on older adults	Educate for climate mitigation: ways to reduce greenhouse gases individually and conserve energy, minimize waste and pollution, support local food sources, and commute in ways that decrease carbon emissions	Support local policies and officials who support addressing climate change and sustainable communities
Identify programs to better understand how nurses can decrease greenhouse gases in their health systems	Encourage health systems to join Practice Green Health and Health Care Without Harm (see Table 2 for websites) Nurses should join Alliance of Nurses for Healthy Environments Climate Change Committee and the Nurses Climate Challenge (https://nursesclimatechallenge.org)	Educate your professional organizations and community about climate change. Support collaboration within the American Academy of Nursing expert panels (e.g., Aging, Environment and Public Health, Health Systems Excellence, Primary Care)
Test effective methods of climate risk communication for older adult populations	Address barriers to and facilitators of hyperthermia and hypothermia in your local setting and community	Translate climate risk and mitigation research into effective policies to decrease harm to older adults

visions in their plan of care for bad air days. Outdoor activities should be limited when the AQI is >50 for any criteria air pollutant (EPA, n.d.). Astute cardiovascular and respiratory nursing assessments and responses are needed to maintain homeostasis for older adults. Plans of care that involve taking the older adult outdoors when the AQI is >50 for someone with cardiovascular or respiratory disease may need to be modified.

The stress and anxiety created by extreme weather events and disasters can affect the mental and cognitive health of older adults. Disruption of services and relocation as the result of an evacuation can be anxiety provoking and confusing to a person with dementia (Miller, 2019). These events may precipitate delirium. Well-trained and sufficient nursing staff and volunteers can help reduce confusion and anxiety. Planning for and supporting personal and com-

munity resilience before events can reduce stress and its effects at the source.

Medications are an important part of disease management and prevention of disease complications. In addition to heat-related impacts to medications listed above, nurses in all practice settings must consider medication storage and medication accessibility during disasters and evacuations. Medications that do not need to be refrigerated should

TABLE 2**RESOURCES AND WEBSITES TO LEARN MORE ABOUT CLIMATE CHANGE AND HEALTH**

Organization	URL
Alliance of Nurses for Healthy Environments Free resources for nurses about climate change and tools to educate other nurses.	https://envirn.org
Fourth National Climate Assessment U.S. scientific report of human, natural, and social impacts of climate change. This quadrennial report was mandated by Congress in 1990.	https://www.globalchange.gov
Gray is Green An online community of older adults sharing sustainable practices.	http://grayisgreen.org
Global Consortium on Climate and Health Education Resources for educators to include climate change in curricula.	https://www.mailman.columbia.edu/research/global-consortium-climate-and-health-education
Health Care Without Harm Information and strategies regarding climate mitigation and adaptation for health care systems.	https://noharm-uscanada.org
Practice Green Health Health system member organization. Resources for health system mitigation and resilience.	https://practicegreenhealth.org
The Medical Society Consortium on Climate and Health Practice-oriented organization, which addresses the health impacts of climate change.	https://medsocietiesforclimatehealth.org
Yale Program on Climate Communication Provides research findings of climate communication and perceptions of climate change.	http://climatecommunication.yale.edu

be kept in a dry place. A review of medication storage advisories in the media during heat waves found that medications should be stored at room temperature between 58°F and 86°F (14.4°C to 30°C) (Smith Caldwell Drug Store, 2015). To maintain potency, medications should not be in areas >86°F (Konrad, 2011); therefore, if it is hot in the home or clinic, medications need to be stored in a cooler place. Nurses should teach older adults to keep medications together, refilled, and have a current list of medical problems, health providers, and medications (dose and frequency) available and a copy with family or a friend in the event of an emergency evacuation.

IMPLICATIONS FOR PRACTICE, RESEARCH, AND POLICY

There is a growing body of evidence on the impact of climate change on health and the health

of older adults. The current article seeks to help nurses understand climate change and the need for specific interventions that support adaptation for the older adult population. Climate change is a direct threat to the health of older adults and there are interventions that can be implemented individually and collectively by nurses to lessen the burden for older adults. Older adults are particularly vulnerable to cardiovascular, respiratory, heat, and dehydration issues. Climate change requires a response that includes not just nursing but also government, communities, health care systems, society, and the world as a whole. There is much more work to be done; hence, the following research, practice, and policy agenda is proposed for nurses and health care leaders to consider in addressing climate change (Table 1).

Recent studies have addressed the issue of nurses and climate change

(Cook, Demorest, & Schenk, 2019); however, the current article is one of the first to identify practice, research, and policy issues for climate change in older adults. Nurses play an important role in policy and practice in being aware of and educating others on the threat of climate change on the health of older adults, taking steps to lessen the harm and burden to older adults, altering their own behavior to slow the trajectory of climate change, being active in societal efforts to address climate changes, and being aware of steps to take within their own practice or health care system to reduce their pollution and waste and conserve energy. Nurses can design and participate in research to better document and measure the harm and impact of climate change on older adults and can advocate for policies that support older adults in disasters or extreme weather events. Nurses can also join

or learn more about organizations that are resources for education about climate change, address best practices for health care organizations, and share sustainable practices within their own communities and with older adults (Table 2).

CONCLUSION

It is everyone's responsibility to learn about climate change and participate in slowing the trajectory of climate change. Gerontological nurses are in an important position to lessen the harm of climate change in older adults in practice, research, and policy.

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ABOUT THE AUTHORS

Dr. McDermott-Levy is Associate Professor and Director, Center for Global and Public Health, M. Louise Fitzpatrick College of Nursing, Villanova University, Villanova, Dr. Kolanowski is Professor, and Dr. Fick is Elouise Ross Eberly Endowed Professor, College of Nursing, and Director, Center of Geriatric Nursing Excellence, and Dr. Mann is Distinguished Professor of Atmospheric Science and Director of the Earth System Science Center, Penn State University, University Park, Pennsylvania.

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Address correspondence to Ruth McDermott-Levy, PhD, MPH, RN, Associate Professor and Director, Center for Global and Public Health, M. Louise Fitzpatrick College of Nursing, Villanova University, 800 Lancaster Avenue, Villanova, PA 19085; e-mail: ruth.mcdermott.levy@villanova.edu.

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