INTRODUCTION
Climate Change and the Legal, Ethical, and Health Issues Facing Healthcare and Public Health Systems

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Climate scientists have overwhelmingly concluded that recent global warming is caused by human activity such as deforestation, changes in land use and burning of fossil fuels, despite continued political debate on the exact origins. This agreement is based on the meticulous evidence-based research from the Intergovernmental Panel on Climate Change (IPCC) and from the National Academies of Science of 80 countries.[1] In their Fifth Assessment Report, the IPCC determined that human influence on the climate has caused the global average temperature to increase by 0.85°C between 1880 and 2012.[2] The IPCC's Sixth Assessment Report, currently underway, is due to be released in October 2022; though in 2018 the IPCC released their Special Report 'Global Warming of 1.5°C' (SR1.5) that assessed knowledge on what a world with 1.5°C warming would look like, compared to pre-industrial levels. This Special Report focused on strengthening the global response to climate change threats, sustainable development and efforts to eradicate poverty.[3] The 1.5°C threshold is in reference to the 2015 Paris Agreement, which aimed to pursue efforts to limit global temperature increase at or below 1.5°C, through international agreements.[4] While the Paris Agreement was a landmark global framework for addressing climate change, achievements in greenhouse gas reductions, to limit global warming, have been slow. Additionally, the exit of the United States from the agreement could further jeopardize the full realization of achieving a reduction in global average temperatures at or below 1.5°C[5] and likely to infringe upon the process of global climate cooperation and governance.[6]

The concept of Anthropocene, first formulated in 2002 by Paul Crutzen[7] to explain the impact of humans on the environment has become a conceptual framework to better understand the climate crisis as a human-generated one and to emphasize the impact and scale of human activity on the planet in tandem with climate change. The era of committed climate change and our role in it is the defining issue of our time with healthcare and public health systems continuing to wrestle with the challenges of climate change and all of its attendant and interacting stresses. The initial analysis of our health care and public health systems policy response to the COVID-19 pandemic is not an encouraging marker of the resiliency of our legal and policy systems.[8] What does it mean to have average global temperatures increase? How is global warming and climate change affecting health, global economies, biodiversity, and human rights? What are the major legal and bioethical issues raised by anthropogenic climate change? These are some of the questions that are explored in this special issue of the *Journal of Law Medicine & Ethics,* sponsored by the Department of Health Sciences at California State University, East Bay.

We conceptualized this issue in the latter-half of 2019 as we were discussing ways to bring attention to the critical and legal issues that would arise for healthcare and public health systems as the climate crisis unfolded and to bring attention to our efforts to launch an interdisciplinary center on climate and human health at Cal State East Bay. The implications

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of climate change for our societies and for our healthcare systems have been known and discussed for some time. Yet, despite the growing importance and relevance of the topic and the special issue being widely advertised, we had a shortage of submissions (we received 14 abstracts; 9 of them were invited to submit an article for the special issue). The abstract selection process was completed in January 2020. By March, COVID-19 began to impact the United States and all of our lives were radically altered; the editors, like the authors, struggled to care for their families and themselves as we moved institutions of higher education in a matter of a few days from in-person operations to virtual operations. We, like many others, had our lives upended and submissions were delayed as everyone adjusted. The final article deadlines were in the middle of the global COVID-19 pandemic; extreme wildfire outbreaks in California and along the West Coast; and multiple hurricanes in the Gulf region. Though often feeling overwhelmed by personal and professional impacts of the pandemic, authors, reviewers and editors navigated these unprecedented times, by communicating promptly via email, reviewing manuscripts with quick turn-around and extending deadlines when possible. We raise these issues here to reflect not only on how unprepared our health care and public health systems are for the pressures and challenges of the Anthropocene but also how unprepared we are as individuals to grasp intellectually, emotionally, and physically the immensity of the challenges before us where the disruptions of the climate crisis move both slowly and quickly and compound each other. Adam Tooze made this observation in a recent interview, "I think I had been predisposed to understand the Anthropocene as a war of attrition. But it turns out this challenge also has an element of blitzkrieg: In a timescale of days, it can mess with you irrevocably [...] it means we need a whole different approach to the problem."[9] We imagine that had we made a call for abstracts in the summer or autumn of 2020, the response would have been different. We hope that the events of 2020 have brought the necessary focus and attention to the issues of climate change and the Anthropocene so that we as a global community begin to take earnest steps to mitigate our greenhouse gas emissions and to adapt our societies to an era of committed climate change. As scholars in this field, looking at the impacts of climate change on human health, we hope that these issues will not be a topic of future symposia issues but instead the defining issue for all of us as we move forward.

This special issue presents 6 articles on the impacts of climate change: Richie provides us a vision for green health care reform laying out opportunities and challenges for patients, physicians and payers alike; Lookadoo and Bell delve into drought events around the United States, conducting a series of workshops engaging drought and climate experts, presenting policy actions for each sector; Krueger and Lawton explore the intersection of public health law with agricultural law and environmental law in order to change the natural environment and mitigate impacts of climate change; Johnson explains the relatively new concept of precision public health, its uses in climate change and potential legal and ethical implications of using precision public health in climate responses; Halabi reviews the growing threat of vector borne diseases, role of existing surveillance systems and presents solutions, and Ferguson argues for the inclusion of environmental ethics into a modern bioethics. In all, the articles in this issue delve into the complexity of these challenges that result from our changing climate.

The health impacts of climate change have been well documented and can be grouped into direct impacts, environmental system mediated impacts, and socially mediated impacts.

As a prologue, we briefly set the stage as to how climate affects human health and our environment. Our understanding of global warming and climate change is based on key concepts of weather, climate, solar radiation, greenhouse gases, and energy balance. Weather is defined as atmospheric conditions at a certain time and place with reference to temperature, precipitation, wind, and other key metrological elements.[10] Climate is defined as the average weather over a period of time (months to years) and includes the associated frequency and trends to describe meteorological phenomena, like annual rainfall. Climate change refers to the "change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period...".[11]

The Earth's climate is powered by solar radiation. As the global temperature has been relatively con-

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stant, the incoming solar energy is nearly in balance with the outgoing radiation. This balance has allowed us a deeper understanding of the Earth's climate systems. Outgoing radiation, from the Earth's surface, is absorbed by clouds, and atmospheric gases — water vapor, carbon dioxide, methane, and other greenhouse gases. As the outgoing radiation encounters these gases, some is reflected back to the Earth's surface, heating the lower atmosphere — this is referred to as the greenhouse effect. This changes the energy balance, allowing more heat in the atmosphere, increasing average global temperatures and affecting our climate. The addition of known greenhouse gases to our atmosphere through the burning of fossil fuels has been identified as the major contributor towards the change in this balance and resulting climate effects. While this is a rudimentary explanation, it identifies the root causes of why our climate is changing and the increase in global temperatures as well as the increase in frequency and intensity of extreme weather events.[12] The evidence of rapid climate change is compelling and is demonstrated though rising temperatures, extreme events, high greenhouse gas concentrations and other climate indicators. The recent conclusions are that global warming will like reach 1.5°C by 2030, on early estimates, and continue to increase if efforts are not made to reduce or stop GHG emissions.

Increases in ambient temperatures, extreme weather events, and long-term climate changes have direct and indirect impacts to human health and public health systems. Public health and healthcare systems will be challenged by climate-related hazards and climate influences on other social determinants of health. The COVID-19 pandemic highlighted the struggle of health systems in managing increased demand, which may be a precursor to how health risks due to climate variability will further stress healthcare systems, highlighting their lack of adaptive capacity.[13] Public health and healthcare systems will not be the only systems impacted by climate change. In the IPCC's SR1.5 the authors highlight four substantial societal asymmetries or concerns that we face in how we address climate change.[14] The first and second concern identify the differential contributions to the underlying problem and differential consequences. For instance, industrialized nations have benefited the most from the historic use of fossil fuels and should bear a greater responsibility in addressing climate change than countries that have not. In contrast, those countries that have contributed the least to the problem bare a disproportionately higher burden of impacts related to climate change. The third and fourth concern continue in this vein and highlight that those most affected are both at risk of being left behind as the world transitions to a low-carbon economy, but also they are not well represented in this conversation. This also draws out issues regarding climate equity and human rights considerations, particularly for vulnerable and marginalized populations, in how climate change is addressed, through both mitigation and adaptation.[15]

Efforts to reduce emissions (mitigation) will require transitions in energy and land use, transportation, and industrial systems to reduce reliance on fossil fuels. Additionally, substantial investments are needed to build resilience and adaptive capacity (adaptation) in systems and populations, which already are impacted by climate change, and will continue to be affected by these events in the near future. Reduction of GHG emissions can and should occur across all sectors. These include transition to renewable energy sources, such as solar, wind, and electrical energy storage. Electrification and the use of hydrogen and bio-based fuels are important areas for the reduction of emissions in the transportation sector. Alterations in agriculture, forestry, and animal husbandry practices can address land-use mitigation, while downstream dietary choices can influence these practices as well. Advancements in technology have produced carbon capture and storage systems, energy efficiency in buildings, and development of climate-resilient crops. Many of these transitional changes towards lowering GHG emissions are already underway in many systems, but for reduction in emissions to have a real impact on global warming, nations would need to increase both the rate and scale of these changes the next decade. This also represents the core legal and ethical challenge of climate change for human health.

Mitigation efforts are needed to reduce GHG emission, though the effects of climate change will still be felt even if we stopped all emissions immediately. Adaptation is the process of adjusting to the changes that will occur in the climate. Adaptation is often specific to location and the individuals in that region given its socio-demographic, environmental and societal characteristics. Adaptation will allow individuals to adjust to climate change to minimize negative outcomes. Examples of adaptation include early warning systems, such as heat-wave warning systems or drought early warning information systems, which allow people to prepare for climate events that will occur. Institutionalizing adaptation and preparation programs for climate-related events in local and state governments is also an example of how adaptation is used to reduce and prevent the negative consequences associated with climate change. Sea walls, mangroves, flood plain zoning restrictions are also forms of adaptation, particularly around storm surge and inland flooding. Adaptation methods will need to have both

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a top-down and bottom-up approach, as there is no one-size-fits all in how a community or an individual will be able to adapt to a changing climate. It is an iterative process that is informed by scientific and local knowledge that identifies the most effective ways to minimize the impacts of climate change.

Health Impacts of Climate Change

The health impacts of climate change have been well documented and can be grouped into direct impacts, environmental system mediated impacts, and socially mediated impacts.[16] Direct impacts are those caused due to increased frequency and severity of weather events. Climate change increases both the frequency and intensity of extreme events, leading to warmer summers and milder winters, and tens of thousands of premature deaths per year across the US and internationally.[17] Exposure to extreme heat results in increased hospital and emergency room admissions and is especially detrimental to those suffering from mental health conditions.[18] Climate change also affects the quality of the air that we breathe, both outdoors and indoors due to increased particulate matter, higher pollen counts and increasing ozone levels resulting in negative health outcomes such as asthma, rates of which have increased significantly in recent years[19] with minorities and lower income individuals disproportionately impacted.[20]

Environmental system mediated impacts include high temperatures and humidity levels leading to accelerated microbial growth thereby increasing the exposure of food to pathogens and toxins leading to disruptions in food distribution and infrastructure. Climate change also leads to longer seasonal distribution and activity of vectors like ticks, fleas and mosquitos and the risk of vector-borne diseases such as Lyme disease, West Nile virus, etc. Additionally, increases in water temperatures and extreme precipitation lead to increases in pathogens such as viruses, bacteria, and toxins produced by harmful algae that result in water borne illnesses ranging from diarrhea to septicemia. Finally, the socially mediated effects of climate change are substantial. These include lower food production in and access to food sources especially in poor countries, leading to undernutrition and stunting of children. The extreme temperatures and humidity levels also make livelihood increasingly difficult for those who rely on outdoor jobs further affecting global economies. Overall, the health risks due to climate change are significant and affect low-income individuals, minorities, women, children, older-adults, individuals with disabilities to a much greater extent than others.

The World Health Organization declared COVID-19 a pandemic on March 11, 2020, within a couple of months it had spread to 188 countries. By mid-September 2020, there have been over 28 million identified cases, with close to 1 million deaths globally.[21] Initially, in response to the pandemic, many countries imposed travel restrictions and shelter-in-place orders for their citizens, reducing the spread of COVID-19, but also slowing their economies. This had an immediate effect in reducing global CO2e emissions, but once COVID-19 cases were reduced enough, economies and emissions resumed. Recent research noted that the immediate effect of COVID-19 restrictions on global CO2e emissions was negligible and there were no lasting effects.[22]

Therefore, the global climate crisis raged on, but now with a global pandemic. Climate change can affect the transmission of vector-borne diseases with some speculating that COVID-19 may be linked to a warming planet and hotspots of the human-animal interphases.[23] While each crisis requires a robust public health response, some regional responses were diametrically opposed to each other. In July 2020, the US South and Southwest experienced record high temperatures, individuals that were told to shelter-in-place because of COVID-19, especially those without air conditioning, now needed to congregate in cooling centers.[24] Similarly, in August 2020, as Hurricane Laura approached the Gulf Coast more than 1.5 million were under evacuation orders with many having to go to large evacuation shelters,[25] increasing their risk of COVID-19. In areas of California, a multitude of disasters occurred in early September 2020 with record high temperatures, wildfire smoke exacerbating poor air quality, and continued pandemic conditions,[26] each adding to the increased risk of COVID-19 transmission as populations congregated in cooling centers or evacuation centers and wildfire smoke increased susceptibility to respiratory infections.[27] In addition to the physical health impacts of both the pandemic and climate change, both have profound effects on societal mental health with practitioners and researchers calling for enhancements and transformations in how we address mental health during these crises.[28] The Anthropocene as an era is characterized by this phenomenon as unrelated events interact with each other to intensify their effects on human health and welfare and together begin to exacerbate long-standing health inequities.

As with COVID-19, climate change threatens everyone around the globe, but highlights the inequities of how society has responded. Both global crises present themselves in different ways, but each have similarities in their vulnerabilities, in particularly the exacerbation of poverty and other social inequities and the lack of preventative measures and a robust response.[29] The

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failure of the U.S. pandemic response has been shown through the highest number of cases and deaths associated with COVID-19.[30] The U.S. response to climate change has been a similar failure with increased GHG emissions over the past four years and withdrawal from the Paris Climate Agreement and a retreat from global engagement to address this threat.[31] While behavioral changes and societal transformations are needed to address these threats, these transformations are not just through individual choices. Policies, laws, and regulations that strengthen our commitments and guide our responses to mitigate, adapt, and build a resilient society are needed from a committed government.

> appropriate degree of mitigation ambition —the acceptable level of climate risk we, as a global community, are willing to endure.[33]

Each of these goals of action, which we are calling: direct adaptation, resiliency, linking public health to adaptation planning, and values clarification — are pursued in the context of our institutions. Our institutions and our legal system are the context for action. The initial steps have been taken in understanding what policy solutions are required; the next crucial step is the exploration of the legal contexts that will "shape and limit whatever might be done."[34] In their recent book on law, climate change and health, Burger and Gundlach summarize the recurring problems that are common to each domain of direct adaptation and represent what we might call the context problems: "policy silos…governance gaps…lacking institutional capacity…costly information and underinformed policy choices."[35] Each of these context problems must be addressed as we pursue each goal of law in the Anthropocene.

As we have seen with the COVID-19 pandemic, law and ethics have a critical role to play in the health implications of the climate crisis. On the day-to-day level, the complexity and speed at which legal issues arose and continue to arise has been daunting. From issues related to the authority of state and federal governments; to complex issues of supply chain and logistics; to the regulation of drugs and tests; to complex ethical issues around triage and the distribution of scare resources, the law and ethics community has been challenged in unprecedented ways.

Law and Policy

Law has a critical role to play in how we address the health impacts of the climate crisis. The WHO framework on resiliency organizes the effects of anthropogenic climate change on human health using three conceptual pathways: direct effects, environmentally mediated effects, and socially mediated effects.[32] These pathways can be useful categorization tools to think about the role of law. Law has a role to play in each of these pathways, as both in direct action as a tool to implement policy and shaping the context for action, particularly in the socially and environmentally mediated effects of climate change. The role of law in addressing these various pathways is complex, but an emerging consensus is taking shape as to the key goals of law in the era of the Anthropocene. As Burger and Gundlach outline them, they are:

> Fortifying public health infrastructure against climate change impacts, making public health systems more resilient, coupling public health considerations to any and all mainstreaming of climate change adaptation planning, as well as using the public health frame to inform the

Direct Adaptation

Law is the tool that we use to effect direct changes in our institutions and environment in order to adapt them to the effects of climate change. This is a comfortable framework for action and focuses on the day-to-day issue and shorter term (five to ten years) of planning.

Resiliency

As communities approach the challenges of the climate crisis, resiliency must be the core principle. Resiliency requires more than short term fixes to problems and challenges. Resiliency as a value urges us to use our legal systems to build a healthcare system and public health system that can not only adapt to but

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also can respond to and improve from the stresses it experiences. This includes adaptation but also seeks to improve the response of the healthcare system rather than just adapt it to the change.[36]

Linking Health to Adaptation Planning

There are a number of conceptual frameworks and legal and regulatory structures available to facilitate the linkage of health to adaptation planning. Health in All Policies, the One Health Framework, and health impact assessments are three notable examples. Health in All Policies (HiAP) is a framework that was developed from work on the social determinants of health. The HiAP approach urges policy makers to incorporate public health into their decision-making across all policy domains.[37] One Health is another framework that focuses on inter-sector collaboration that focuses on human health, animal health, and environmental health. Within existing legal frameworks, health impact assessment, regulatory impact assessments, and other required assessments provide possible tools to link health to adaptation planning.

Values Clarification

The legal and policy approaches to the existential challenges of Anthropocene requires that we not only have a broad view of the horizon of issues that must be addressed but also must have a deeper view of the issues. Mitigation is a core component of climate policy. If we take an aggressive approach to mitigation, this will require tradeoffs in the economy and expectations around health and well-being. A less aggressive mitigation strategy, or no mitigation strategy, will result in deeper and more severe health impacts that will also require significant tradeoffs.

Conclusion

The pressures of the climate crisis on our human systems require that we explore the complex ethical and values questions that we will face. Bioethicists have begun to explore these issues in depth. One of the most important ethical issues that we will face is understanding and addressing the impact of healthcare and public health on the climate.[38] The COVID-19 pandemic has demonstrated with great insistence how critical these ethical issues are.[39] The pandemic has also demonstrated to what extent our healthcare systems and public health systems are not prepared conceptually for the implications of climate disruption for human health.[40]

As we have outlined above, the health impacts of the climate crisis and the legal, policy, ethical and values implications cannot be understated. However, this is not a crisis that must be addressed only at the level of day-to-day media analysis nor at the level of social causes and conditions. The health implications of the climate crisis implicate our shared world-views and our deepest held beliefs and stories.

As we have seen with the COVID-19 pandemic, law and ethics have a critical role to play in the health implications of the climate crisis. On the day-to-day level, the complexity and speed at which legal issues arose and continue to arise has been daunting. From issues related to the authority of state and federal governments; to complex issues of supply chain and logistics; to the regulation of drugs and tests; to complex ethical issues around triage and the distribution of scare resources, the law and ethics community has been challenged in unprecedented ways.

Even as we grapple with the litany of problems related to the climate crisis, we must also rely on the social conditions that either amplify or reduce the impacts of the crisis. Again, the COVID-19 pandemic is illustrative. The impacts of the pandemic were not evenly felt and those impacts varied from community to community.

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