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Building a Bioarchaeology of Pandemic, Epidemic, and Syndemic Diseases: Lessons for Understanding COVID-19

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ABSTRACT As we enter the third year of the COVID-19 pandemic, the scientific community has met the SARS-CoV-2 virus with efficient and effective responses in epidemiology, molecular biology, genetics, vaccine development, and new treatment options. Yet the toll of the virus on public health has been uneven globally and within nations to an extent that has led STEM professionals to inevitably conclude that a truly effective response requires insights and mobilization from across the social sciences and humanities. It is hard to express how much the pandemic has impacted almost every aspect of life in human communities and how it has laid bare longstanding social problems, like social inequalities. The pandemic has also illuminated the extent of more recent pernicious social forces, such as disaster capitalism, and provides an ominous window into how some governments and societies will meet challenges such as climate change. This introduction presents six commissioned articles that demonstrate the power of an anthropological approach to the biocultural and evolutionary aspects of pandemic and epidemic diseases in the past. In this article, we also frame a path for bioarchaeologists to contribute to incredibly important questions and debates about the global pandemic by situating the articles into holistic theoretical approaches.

Keywords: bioarchaeology; pandemics; COVID-19; SARS-CoV-2; zoonoses; social inequity

The recent outbreak of COVID-19, a disease caused by infection with a novel coronavirus SARS-CoV-2, began as an epidemic in Wuhan, China. COVID-19 was first recognized as a new infectious disease in December 2019 (Petersen et al. 2020; Zheng 2020), and the Chinese government rapidly moved to put Wuhan under a strict lockdown to try and confine the outbreak. Later that month, the disease was recognized in the state of Washington, in the United States, in an individual who had recently traveled to Wuhan. Cases multiplied in outbreaks around the globe through the months following and countries began instituting travel bans to try to control the spread of what was quickly becoming an epidemic disease. COVID-19 was declared a pandemic by the World Health Organization (WHO) on 11 March 2020, when cases of COVID-19 in China had increased 13-fold and the disease had been found in 114 countries with more than 118,000 cases, and people fighting to save lives in many hospitals. At this time, there were 9,000 cases in Iran and more than 7,700 in South Korea (WHO 2020; Chappell 2020). In the majority of European countries, hospitals were overwhelmed with cases; in Italy, more than 630 people had died of COVID-19 at

that time. The country had 10,000 cases, second only to China, and the world soon watched as Italians sang to one another from their balconies while in quarantine (Rudan 2020). The recent and ongoing global pandemic shut down societies around the globe as cases multiplied exponentially, and it became clear the toll COVID-19 would have in terms of morbidity and mortality.

The COVID-19 pandemic has illuminated social forces that affect the transmissibility, susceptibility, and outcomes of infection with this virus, including syndemic effects with degenerative diseases, obesity, diabetes, hypercholesterolemia, and coinfection with other coronaviruses, influencing susceptibility and outcomes for COVID-19 patients; social determinants of health, creating deep disparities in access to vaccines as well as in the risk of serious disease; significant physical impairment for people with "long COVID"; and coevolutionary processes creating more endemic and more infective strains of the virus. The impacts of this pandemic extend far beyond the risk for infected individuals and have resulted in financial and economic repercussions rippling through global economies, widespread mental health challenges in adults accompanied by developmental and learning deficits for children, and extreme social divisions, distrust for authority, "othering," and targeting of already vulnerable groups, even escalating to physical violence.

We have yet to fully grasp the demographic and evolutionary consequences of the pandemic, although it is becoming clear that genetic, social, and environmental factors play a role in susceptibility to severe disease (see, e.g., Anastassapoulou et al. 2020; Godri Pollitt et al. 2020; Sironi et al. 2020), and there may also be impacts on pregnant women and infants that will be felt in the coming generations (Wastnedge at al. 2021). COVID-19 has highlighted the role of caregiving in disease susceptibility (Connor et al. 2020; Gausman and Langer 2020; Wade et al. 2021) and gender inequality in this labor (Fortier 2020). The pandemic has put a spotlight on enduring racism and discrimination (Khazanchi et al. 2020), the health impacts of racism (Devakumar et al. 2020), and other forms of structural violence (Nandagiri et al. 2020; Samra et al. 2020; Singer and Rylko-Bauer 2021). It is also challenging our conception of disability (Banks et al. 2021; McKinney et al. 2020) as those known as the "long-haulers," in particular, face substantial hurdles to their physical and cognitive ability that will necessitate new systems of care for these individuals and their families (Baig 2021; Dorfman 2021; Rubin 2020; Smith 2022). The COVID-19 pandemic has also had consequences for how we view our relationship with the so-called natural world, with debates, for example, about the importance of regulating human–animal interaction and wet markets (Aguirre et al. 2020; Fine and Love-Nichols 2021; Mizumoto et al. 2020).

There have been developments too that might be considered positive, which have resulted from the pandemic, with scientific breakthroughs in RNA research and vaccine development that will certainly bring a renaissance in the treatment of a large number of diseases and conditions (Pardi et al. 2018). The vaccine development and rollout were only made possible through the collaboration between governments and scientists across the globe, although there is more work to be done in ensuring equitable rollout among countries. As noted, COVID-19 has revealed the harsh realities of significant structural inequalities and barriers to health care, the vaccine rollout, education, housing, and food, and we see some positive reactions from some organizations and governments to addressing these structural inequalities. The unfortunate spread of disinformation on COVID-19 vaccinations has led to support on various social media platforms for science and public health informed perspectives (e.g., Twitter's COVID-19 misleading information policy). With Zoom becoming a common venue for academic and other meetings during COVID-19 travel restrictions, longstanding concerns are finally being acknowledged about accessibility for people with young children or other care responsibilities, underlying health conditions, disabilities, or who cannot afford to travel for conferences.

The current global COVID-19 pandemic presents an opportunity for bioarchaeologists to contribute long-term perspectives toward understanding and responding to the current-day global crisis in health. Bioarchaeology is uniquely poised to give insights to each of the aforementioned aspects of research on the COVID-19 pandemic because of our focus on the history and evolution of infectious diseases in the past and our recognition of humans as biocultural organisms embedded within larger historical-environmental-social-cultural (HESC) contexts. We have at our disposal evidence from mortuary, skeletal, molecular, and isotopic sources that can provide a direct source of evidence about past epidemic diseases (DeWitte 2016). The articles in this special issue of *Bioarchaeology International* create sophisticated histories of epidemics, pandemics, and syndemics, which inform larger questions about human health in medical, epidemiological, evolutionary, biological, sociological, historical, policy, planning, and human security discourse. In this introduction to the special issue, we summarize some of the lessons learned from bioarchaeological research on the pandemic, epidemic, and syndemic diseases of the past and how our research informs an anthropological perspective on COVID-19.

The articles in this special issue are instructive as to how bioarchaeologists and paleopathologists approach epidemic, endemic, and pandemic diseases from a variety of social and cultural theories, and evolutionary and demographic perspectives. When an infectious disease affects a wide swath of a population, we call it an epidemic. Epidemic diseases have become an increasingly important evolutionary pressure on modern humans over the course of the Holocene as we settled in villages and developed socio-sanitation problems, began to closely associate with animals, and relied more heavily on a few staple cereal crops for our principal source of calories (Armelagos et al. 2005). A pandemic is an epidemic infectious disease that has spread across a larger region, affecting multiple countries and continents. It differs from an endemic disease in that a pandemic is an acute event, rather than a longstanding event/disease burden. For instance, malaria is widespread around regions of the world, but it is a disease that has lingered, affecting a large proportion of many human populations for an extended duration, a period of time that exists on an evolutionary timescale.

This special issue brings anthropological and bioarchaeological perspectives to bear on pressing social science and biological questions that are currently relevant in the context of the COVID-19 global pandemic. Here we provide a brief review of theoretical concepts that are at work in the different articles in this issue, explicitly in some (e.g., social determinants of health and critical medical anthropology concepts, such as structural violence) and implicitly in other cases (e.g., the concept of syndemics, not explicitly used much in bioarchaeology to date). These theoretical approaches can be usefully incorporated into more traditionally applied evolutionary and demographic approaches to past epidemics and pandemics as bioarchaeologists turn our data toward addressing problems of contemporary relevance, such as the consequences of HESC forces and human behavior in a pandemic. The articles in this special issue offer holistic models for understanding the evolution and demographic consequences of pandemics, including sophisticated models for assessing the role of human mobility processes and animal–human–environment interactions.

A Syndemics Approach to Infectious Diseases

Syndemics theory focuses on synergisms within the biosocial complex that perpetuate and exacerbate negative health outcomes by promoting co-morbidity, altering disease ecology, and contravening healthy epidemiological landscapes, often across the life span and intergenerationally (Singer 1994, 2009). Stemming from her work on multigenerational impacts of substance abuse during pregnancy (Singer and Snipes 1992), anthropologist Merrill Singer developed the concept of syndemics to describe the multitude of factors driving the AIDS epidemic, focusing specifically on the co-occurrence of substance abuse and violence in communities most susceptible to HIV and AIDS (Singer 1994).

This model is widely used in global health research (Mendenhall 2017) and medical anthropology (see Singer and Erickson 2015 for a review), and the notion of syndemics powerfully encapsulates the role of vulnerability and socioeconomic inequality in shaping the disease experience for COVID-19 patients (Caul 2020; Horton 2020; Singh et al. 2020). This concept has only occasionally been invoked in paleopathology as a useful interpretive framework to explain evidence for co-morbidity, for example. The concept of syndemics has been explicitly promoted as an interpretive path to explore when we encounter evidence for disease in human skeletal remains (Crespo 2020); it has been applied to bioarchaeological research on a suite of epidemic diseases in post-Columbian North America (Jones et al. 2021) and to the connection between tuberculosis (TB) and diabetes in present-day communities in New Zealand (Littleton et al. 2014).

In a recent review article about the concept of syndemics and its use in research on the history of disease, Newfield (2021) makes an important observation that "most of the ever-growing body of historical epidemiological scholarship misses the syndemic mark in that it quarantines the history of one disease, or disease event, from all other diseases. Few historians of disease or medicine interrogate co-morbidities or multi-morbidities, or, therefore, seek to identify the factors that cause diseases to cluster in the first place." This criticism also applies to bioarchaeology. In part, this is a weakness of skeletal data; bone can only respond to disruptions in homeostasis in a few limited ways because of the structural-functional qualities of the tissue. This makes it difficult to disentangle co-morbidities in an individual, and there are also interpretive issues due to the so-called osteological paradox—in which chronic conditions are more likely to be expressed and heterogeneous frailty biases our interpretation (DeWitte and Stojanowski 2015; Wood et al. 1992). In part, it is also a limitation of the archaeological samples, or populations, we work with, which are not representative of a living whole but of the preserved and recovered non-survivors.

While a syndemics perspective has not frequently been explicitly applied in many bioarchaeological studies, this special issue demonstrates how syndemic

thinking is already at work in our understanding of epidemic and pandemic diseases of the past and their lessons for research on COVID-19. The syndemic concept or "syndemic thinking" (Newfield 2021) has been implicitly used in some bioarchaeological research to examine a wide variety of factors that have promoted or constrained the spread of disease in the past, including the influence of perception and cultural beliefs about sickness (Marstellar et al. 2011) and disability (Byrnes and Muller 2017), gender ideology (Zuckerman 2017), social determinants of health across the life course (Gowland 2015), social marginalization (Mant and Holland 2019), climate and environmental conditions (Robbins Schug 2020), and human–environmental interactions (Aufderheide et al. 2004).

It is important when considering syndemics to view disease from a holistic perspective, reconstructing life span epidemiology, focusing on the likelihood of concurrent conditions, the influence of entangled HESC forces, perceptual and semiotic aspects of health, the embodiment of mental and emotional states, and personal agency as a force for specific disease ecologies in past populations. The articles mentioned above and by those in this special issue consider a holistic perspective of disease in our understanding of epidemic and pandemic diseases of the past and their lessons for research on COVID-19, whereby endemic, epidemic, and pandemic diseases are socially and culturally contextualized, particularly using theoretical frameworks of disability studies, social determinants of health, intersectionality, critical medical anthropology, epidemiology, and evolutionary biology.

Bioarchaeology, Disability Studies, and "Long COVID"

As Byrnes and Muller (2017:1) point out in their volume devoted to a *Bioarchaeology of Disability and Impairment*, disability has received little attention in bioarchaeology until recently because the concept has conflicting definitions. Disability is often imagined to exist at an intersection between functional (or "biological") impairment, the culturally influenced meaning and perception of impairment or impaired people, and social forces such as political economy, medicalization, and discrimination. However, contemporary debate in the wider field of disability studies centers on ability as a discursive field within the civil rights movement (Owens 2015). Ability is also one aspect of our intersectional identity (Crenshaw 1989, 2017); it is defined by habitus and enacted through our thoughts, perceptions, and actions (Bourdieu 1977:179). Ability can also be perceived as a form of diversity (Ginsburg and Rapp 2020), a subjective lived experience (Cascio 2015), or as "otherness" and "difference" that is a social fact with material consequences. Ability is also a category that is situated within a nexus of power relations (Kasnitz and Shuttleworth 2001; Owens 2015).

Anthropological engagement with Disability Studies is "focused on all stakeholders in local contexts and committed to an ethic of social justice" (Kasnitz and Shuttleworth 2001:27). This focus on ethics and critical medical anthropology situates the concept of disability in the wider phenomenon of medicalization, a process through which, beginning in the eighteenth century, health and disease became recognized and difference became signified and imbued with meaning (Foucault 1961, 1963). Medicalization is an idea derived from and something that cannot be distinguished from a discourse about power relations, and this too is true for the concept of disability, which invites an analysis of social structures and power relations in a variety of contexts, including medicine, law, government, and religious institutions.

Heather Battles and Rebecca Gilmour's (2022) work informs the question of how disability intersects with infectious disease epidemics in the past. In "Beyond Mortality: Survivors of Epidemic Infections and the Bioarchaeology of Impairment and Disability," they engage with disability theory to discuss the long-term impacts and chronic health problems associated with the poliomyelitis (polio) epidemics of the mid-twentieth century. Polio, like many infectious diseases, is only symptomatic in a small percentage of cases, and the form most recognizable in human skeletal remains, the paralytic form, only affects 2% of cases. The disease may be recognized by alterations to morphology associated with disuse—limb shortening, atypical torsion or curvature of limb bones, or bone atrophy, a set of skeletal changes that have a very broad-ranging set of conditions making differential diagnosis difficult. However, Battles and Gilmour point out the high likelihood that this disease was endemic in large urban populations of the past and how it would likely have taken on epidemic proportions each time it was introduced to a new population.

Battles and Gilmour powerfully combine three "bioarchaeologies"—the Bioarchaeology of Care (Tilley 2015), Personhood (Boutin 2016), and Disability and Impairment (Byrnes and Muller 2017)—to create what they deem the survivor-lens approach. Using the sequelae associated with polio as their example, they demonstrate a new way to conceptualize the long-term impacts of epidemic and pandemic diseases in the past. Battles and Gilmour offer a way for bioarchaeologists to engage with the long-term consequences of infectious epidemics in the past, including a consideration of how these outbreaks can shape individual

embodied experiences, how they constrain or challenge barriers and abilities, and how they may open a door to sociocultural change in past societies. Using the survivor-lens approach, bioarchaeologists can go beyond the evidence of a physical difference or functional impairment, to seek evidence for distorted power relations and their embodiment in the skeleton.

We are confident that, in the coming years, Battles and Gilmour's model will be useful for other diseases in bioarchaeology. For example, leprosy is a disease that can leave significant physical disability, leaving sufferers missing fingers and toes or lacking sensory abilities (blind, unable to smell or taste). The stigma of this disease, beyond the physical manifestations, limits the potential for many of its sufferers while simultaneously opening a path to an unprecedented degree of freedom for others (Roberts 2020a; Staples 2005). This disease was recognized and was signified as a mark of "spiritual corruption" by at least the second millennium BC (Robbins Schug 2016).

Battles and Gilmour also demonstrate how the polio epidemic offers important insights into the current pandemic. Polio, like a wide range of other past epidemics, offers a long-term perspective on public health given these sequelae and their impacts on health throughout the life span. The major focus of research on COVID-19 so far has understandably been on morbidity and mortality in the short term, but we already know that "long COVID" or "COVID long-haulers" are suffering and will continue to suffer debilitating symptoms into the future, including loss of taste and smell, neurological problems, extreme shortness of breath upon exertion, and other potential sequelae (Mendelson et al. 2021; Nikhra 2021; Sudre et al. 2021). The survivor-lens approach offers a conceptual framework for studying those potential impacts and their meaning.

Who Suffers? Social Determinants of Health, Intersectionality, and Structural Violence

The social determinants of health framework demonstrates how personal and social identity intersects with socioeconomic inequality, marginalization, and structural or institutional violence to create inequities in health outcomes and access to care. Vulnerability to epidemic and pandemic disease is strongly determined by HESC processes that increase the likelihood of exposure to pathogens, decrease access to treatment and care options, and undermine the trust necessary for successful public health interventions. In the COVID-19 pandemic, we have seen Black, Hispanic, and Indigenous people at greatest risk for morbidity and mortality, in part due to preexisting health disparities resulting from marginalization and also due to economic inequalities in who becomes an "essential worker" versus who has the luxury of staying home (Abrams and Szefler 2020; Alcendor 2020; Ataguba and Ataguba 2020; Dalsania et al. 2022; de Souza Santos et al. 2021; Debopadhaya et al. 2021; Fathi et al. 2021; Hasan Bhuiyan 2021; McNeely et al. 2020; Singu and Acharya 2020; Tai et al. 2021). People in underrepresented communities in the United States have been denied access to medical care (Egede et al. 2021), cannot always logistically or financially access necessary care (Tai et al. 2021; Vargas and Sanchez 2020), and have directly suffered from mistrust of medical and government institutions that creates attitudes and behaviors that contravene preventative measures (Kricorian and Turner 2021; Malik et al. 2020; Scharff et al. 2010). The lack of representation of Black, Hispanic, and Indigenous providers in the national health care and scientific infrastructure in the United States not only creates opportunities for discrimination (Daley et al. 2021; James 2017) but also suggests significant lost opportunities for innovative solutions to the crisis (e.g., Ramirez 2021; Sweeney 2021).

The social determinants of health framework is used to demonstrate how social, economic, and political processes give rise to stratification by income, education, occupation, gender, race, ethnicity, and other factors. These socioeconomic positions, in turn, shape specific determinants of health status where certain epidemic diseases can "feedback" to affect the functioning of those social, economic, and political institutions. COVID-19 research has been shaped by these perspectives (e.g., Abrams and Szefler 2020; Ataguba and Ataguba 2020; Bambra et al. 2020; Singu et al. 2020). This is true not only for the impact of the pandemic on people of diverse racial or ethnic identities but also based on disparities in class, gender, mental health status, ability, and rurality (e.g., McQuaid et al. 2021; Paul et al. 2021; Shakespeare et al. 2021; Sharma et al. 2020; Turner-Musa et al. 2020). One highly stigmatized and marginalized group that has received less attention in COVID-19 research today includes people who are institutionalized—in prisons, group homes, and other such settings (e.g., Hege et al. 2021; Upshaw et al. 2021). This has been previously pointed out in historical research on pandemics, such as the 1918 influenza pandemic (Mamelund and Dimka 2021). This issue is critically important as we know the largest single-site outbreaks of COVID-19 in the United States were in prison populations (https://covidprisonproject.com/), yet stigma prevents substantial research focus on these populations. The effects of institutionalization and pandemics are explored from a bioarchaeological perspective in this special issue.

Molly Zuckerman's (2022) article, "Institutionalization within the Context of Pandemic Infectious Disease: Examining Social Vulnerability to the 1918 Influenza Pandemic amongst Individuals Institutionalized in the Mississippi State Asylum," uses historical demography to explore disability. She demonstrates how individuals within congregate settings who have been deemed inconvenient or unfit are most vulnerable to the impacts of pandemic disease, and they are most likely to be forgotten in pandemic preparedness planning. This article combines concepts from intersectionality, structural violence, and social determinants of health frameworks to demonstrate how social forces created elevated risks for mortality from influenza for young adults, particularly Black residents, who were overrepresented in the institutional population compared with the demography of Mississippi at that time. Although higher mortality rates for Black adults were consistent with a nationwide trend, Zuckerman's article demonstrates how Black patients were more likely to become institutionalized, and thus at greater risk for influenza in the first place, through a confluence of discriminatory, structurally violent, racist, and ableist forces in Mississippi and throughout the South of the United States.

Zuckerman presents an analysis of data from the Mississippi State Asylum, which has housed more than 30,000 residents and for whom detailed records were kept. Of these, more than 2,200 death records are available for the period circumscribed by the pandemic. This type of detailed, longitudinal data is one of the principal advantages of taking a historical bioarchaeology approach to social determinants of health in pandemic diseases. Respiratory-related deaths—tuberculosis, asthma, pneumonia, and influenza—represent a typical syndemic of health issues frequently seen today in institutionalized people worldwide (Basu et al. 2011; Gostin 2006; Licata et al. 2021; Simpson et al. 2019). Disability, poverty, racism, and insufficient care work in synergy to increase the risk of mortality. Although detailed descriptions of the life and death of Black Mississippians are unavailable in such a large number for the nonresident population, this article does explore how the greater risk of exposure in the first wave of the pandemic led to co-immunity in subsequent waves, which buffered Black communities despite malnutrition, co-morbidities, and health consequences of structural violence and racism.

Zuckerman's approach focusing on disabilities and institutionalized populations will be valuable to epidemiological research on COVID-19 and is an important contribution for bioarchaeologists interested in syndemics, even though this concept was only implicitly used. The article demonstrates that as we assess identity and social categories of difference, it is critical that we acknowledge the multiplicity of identity that is described by the concept of intersectionality (Crenshaw 2017). Intersecting identities work together in a reciprocal fashion to form systems of oppression (Collins 2015).

"Intersectionality and the Interpretation of Past Pandemics" by Samantha Yaussy (2022) operationalizes this concept for the study of pandemics in past populations in an attempt to encourage additional research in this area within the field of bioarchaeology. She begins with a review of the development of the field of intersectionality and some of the issues with the adoption of this approach in bioarchaeology. She explains the significant number of identity categories and relationships of inequality among these social divisions, which include race, gender, class, education, relationship status, parenthood, sexuality, gender identity, Indigeneity, and disease (Springer et al. 2012; Yaussy 2022), that may exist in conflict and be differentially expressed cross-culturally and through time. Yaussy also explores how intersectionality is employed in sociology, anthropology, and public health, again using approaches that are implicitly but deeply informed by the concept of syndemics.

The incredibly valuable contribution of this article is that Yaussy developed three quantitative methodologies for bioarchaeologists to explore and understand the multiplicative effects of intersecting identities, particularly within the context of paleopathology. She describes specifically how statistical methods already widely used in the field can be adapted to elucidate the intersecting, overlapping, and accumulating impacts of identity in shaping susceptibility, risk, and impacts of pandemics in the past. Prior to this special issue, Yaussy could identify no published works in the bioarchaeological literature that explicitly combined the concept of syndemics, intersectionality, and the social determinants of health framework to explore past pandemics, although there have been allusions to such an approach, and certainly scholars have used these frameworks individually (e.g., Byrnes and Muller 2017; Geller 2017; Gowland 2017; Mant et al. 2021; Torres-Rouff and Knudson 2017; Yaussy 2019). Yaussy directs bioarchaeologists to the potential for this type of research on the Black Death and tuberculosis, in particular.

These three articles by Battles and Gilmour, Zuckerman, and Yaussy demonstrate that the root of theoretical frameworks like social determinants of health, intersectionality, disability, and syndemics is the critical medical anthropology concept of structural violence. Structural violence describes how social relations, structures, and institutions constrain human agency and work to impinge upon human potential, denying some people or groups access to

basic resources and contributing to increased susceptibility to disease. Structural violence is arguably the leading cause of human suffering, morbidity, and disability today (Farmer 2004), and this social suffering is exacerbated in situations of increased social stress, including warfare, climate change, and epidemics and pandemics, including COVID-19 (Barrientos et al. 2021; Cabatbat 2021; Kabel and Phillipson 2021; Morgan and Rose 2020; Nandagiri et al. 2021; Saldino et al. 2020; Samra et al. 2020; Singer and Rylko-Bauer 2021; Singh and Singh 2020).

As we mentioned above, there is important research already being done on how structural violence and syndemics inform our understanding of COVID-19, and that work has already been synthesized in an excellent comprehensive review by Singer and Rylko-Bauer (2021). In bioarchaeology, structural violence as a framework has been explicitly employed since Carlina de la Cova articulated how gender, race, and class formed the basis for physical violence against certain bodies as opposed to others (de la Cova 2008, 2011, 2012, 2020). Since that groundbreaking work, structural violence has been applied to other documented skeletal collections derived from marginalized communities (Watkins 2012, 2018a, 2018b; Watkins and Muller 2015), often assembled despite a lack of consent (Dunnavant et al. 2021). Over the past decade, structural violence has been used as a guiding framework for bioarchaeological research in undocumented archaeological assemblages of human remains from a variety of cultural and social contexts, both historic and ancient (Ellis 2020; Filipek et al. 2021; Geber 2015; Klaus 2012; Martin and Harrod 2020; Martin et al. 2010, 2012; Nystrom 2014, 2017; Nystrom and Robbins Schug 2020; Robbins Schug 2017; Robbins Schug et al. 2012; Sheridan and Gregoricka 2020; Stone 2012; Tegtmeyer and Martin 2017; Torres Rouff 2020).

Unfortunately, social suffering is embodied most frequently by mothers and infants in the modern context and probably in the past as well (Ellis 2014; Filipek et al. 2021; Geber 2015; Halcrow and Robbins Schug in press). In bioarchaeology, skeletons of infants and children are regularly used as a proxy for social determinants of health (Halcrow and Tayles 2008; Halcrow et al. 2017; Robbins Schug 2011; Robbins Schug and Blevins 2016; Robbins Schug and Goldman 2014; Snoddy et al. 2017; for a review, see Mays et al. 2017; Halcrow and Ward 2017). The conceptualization of health and care for mothers and babies in the past draws on anthropology as a holistic field, not a set of subdisciplines, to advance a more holistic understanding of the evolutionary, social, and health significance of inequality (Halcrow et al. 2020). A model of health care for mothers and babies in the past has recently been proposed, drawing on different anthropological subdisciplines to advance a more holistic understanding of the evolutionary, social, and health significance of this practice (Halcrow 2020; Halcrow et al. 2020). This model considers a number of social facets of care and methods from a range of disciplines, including the archaeology of grief and emotion; aspects of identity, including social inequality, gender, community support and alloparenting, infant feeding, and maternal and infant health; environmental factors such as pathogen load; and life history theory.

Unequal access to health, safety, and medical care during early life also has effects across the life course and intergenerationally (Agarwal 2016; DeWitte and Yaussy 2017; Gowland and Halcrow 2020). Thus, research on social determinants of health in bioarchaeology can be informed on a conceptual level by the Developmental Origins of Health and Disease (DOHaD) hypothesis and life history theory. The DOHaD hypothesis describes how environmentally induced physiological changes during fetal development and infancy can have long-term consequences on morbidity and mortality later in life (Cheverko 2020:66). Early life adversity is embodied in the skeleton through pathophysiological markers commonly referred to as "biocultural stress markers" (Klaus 2014). Although molecular epigenetics is not well understood to a degree we can employ these concepts in bioarchaeology, on a conceptual level, we can use skeletal populations to examine the intersection of evidence for early life stressors, disease susceptibility, and the potential for intergenerational effects on plasticity and morphology (Gowland 2015).

It is unclear to a large extent what the risks are for the maternal–fetal nexus from COVID-19. There is evidence that pregnancy influences immune response to SARS-CoV-2 infection (Ovies et al. 2021), and pregnant women also mount a robust reaction to the mRNA vaccines (Atyeo et al. 2021; Bordt et al. 2021). The possibilities for and the likelihood of vertical transmission are still unclear (Ashraf et al. 2020). Premature birth has not been decisively demonstrated as a likely outcome in cases of gestational COVID-19 (Pirjani et al. 2020; Takemoto et al. 2020), nor has increased risk for cesarean section or elevated chance of fetal mortality been conclusively linked to COVID-19 (Mullins et al. 2020); however, these results do not necessarily hold true across all cultural contexts (Vizheh et al. 2021). There is some clinical evidence for placental injury and neurological damage in children (Lin et al. 2021; Wong et al. 2021). Although pregnancy outcomes appear good in many cases, available data are primarily on pregnant women infected in their third trimester (Yang et al. 2020). Studies indicate that newborns from COVID-19–infected mothers have a significantly higher risk of morbidity and mortality, and

pregnant women themselves can suffer serious and debilitating symptoms and sequelae (Villar et al. 2021). These issues have yet to be resolved as it will take time to see these effects.

Although few specific direct impacts from the SARS-CoV-2 pathogen have been demonstrated thus far, what has become very clear is that social determinants of health led to an increased risk of death for some pregnant women who had co-morbidities that are all strongly tied as well to social inequality (Dongarwar et al. 2020; Fathi et al. 2021; Siqueira et al. 2021). Other than elevated risks related to advanced age, in the majority of cases, elevated risk for pregnant women with COVID-19 is due to preexisting conditions—obesity, diabetes, and asthma—which are exacerbated by social conditions of poverty and marginalization due to race or ethnicity, which are also responsible for higher rates of prematurity even in the absence of a global pandemic (Hessami et al. 2020).

There are many other ways in which the pandemic shapes risk for people who identify as women in regard to violence, immigration, access to health care, and reproductive justice (e.g., Chandrasekaran et al. 2020; Hernández 2020; Moreau et al. 2021; Pandya and Redcay 2021; Todd-Gher and Shah 2020). The pandemic, stay-at-home orders, and threats to reproductive justice harm people who already live at risk from domestic violence, unequal access to health care and other resources, or mother–infant and family separation (Alemi et al. 2020; Anarudran et al. 2020; Blue et al. 2021; Busch-Hallen et al. 2020; Piquero et al. 2021). Psychosocial effects on mothers in the COVID-19 environment are also becoming apparent, including significant negative associations resulting from separation/isolation and infant developmental factors (Wang et al. 2020).

There have been calls for a nuanced biosocial anthropological approach to COVID-19 with a number of recent publications focusing on the maternal–infant nexus, maternal–child health, and the potential for transgenerational effects (Leonard 2020). For example, a 2020 special volume in the *American Journal of Human Biology* emphasized deleterious effects on maternal stress; immune function; low birth weights; psychosocial stress; infant feeding, growth, and development; and potentially later-life health outcomes (Bogin and Varea 2020; Gildner and Thayer 2020; Palmquist et al. 2020). Anthropologists too have explored the impacts of unpredictability and insecurity on the social networks that allow humans to successfully care for our offspring (Nelson 2021). These impacts are vastly different for women and children depending on their social position. This work underscores the importance of the comparative, anthropological, and evolutionary perspectives in providing the necessary context for understanding how COVID-19 is shaping maternal–child health over the long term.

Evolution, Demography, Mobility, and Animal–Human Interactions in Paleoepidemiological Models

The final three articles in this special issue tackle paleoepidemiology of infectious diseases, human–pathogen co-evolutionary processes, and the role of cross-cultural differences in human–animal interactions as they shape the risk for zoonotic disease transmission. Paleoepidemiology is by definition an interdisciplinary area that examines the incidence, distribution, and spread of communicable diseases in past populations, when medical interventions were limited in effectiveness and variation in the natural history of different diseases is thus more visible (Waldron 2007). Paleoepidemiology is at the root of bioarchaeological research on infectious disease (Zuckerman and Armelagos 2014), but it is complicated by a large number of factors (e.g., population interaction, residential mobility, population density, climate change, and subsistence) that play into the population-level experience of a disease. Bioarchaeological research on this topic has the potential to inform present-day questions about biosocial and cultural factors that shape disease transmission and who is more or less at risk, particularly because of our focus on social determinants of health and structural barriers to health. Access to resources within society will shape possible responses to pandemic disease, including opportunities for migration or the ability to limit interactions with the "outside world," which then become intrinsically interlinked with disease transmission and the risk for morbidity and mortality (Singu et al. 2020; Thakur et al. 2020; Varkey et al. 2020).

What has become clear with the current COVID-19 pandemic is that human mobility and interaction are at the core of its transmission, which is typically the case with globalization and infectious diseases (Saker et al. 2004). Migration due to climate, environmental, or social crisis creates elevated risks for communicable disease and is often responsible for altering disease ecology in ways that will enhance transmission; this is particularly true in cases of labor migration, forced displacement, and resettlement or in situations where rural people resettle in urban slums (McMichael 2015). Mobility that does not involve relocation (travel) was the principal driver of the global pandemic spread (Choi et al. 2020; Furukawa et al. 2020; Ng et al. 2020).

The link between human mobility and epidemic outbreaks is a longstanding one, which is explored in Melandri Vlok and Hallie Buckley's (2022) article

"Paleoepidemiological Considerations of Mobility and Population Interaction in the Spread of Infectious Diseases in the Prehistoric Past." These authors provide a critical new tool for understanding the anthropological dimensions of disease transmission over the long term through a novel theoretical model that considers the interplay of climate suitability, population density, residential mobility, and human interaction levels using paleoepidemiological data from prehistoric samples from Japan, northern Viet Nam, and Mongolia ($n = 343$). These sites offer a range of different settlement types and mobility processes, and their analyses showed that higher levels of population interaction between sedentary populations in the past are associated with greater frequency of skeletons that demonstrate evidence of infectious disease. Highly mobile populations in the past demonstrate higher levels of pathogen diversity.

This article illustrates a powerful approach to assessing the co-evolution of disease and interaction of people, provides an essential theoretical review of definitions of human mobility processes (relocation/migration, trade, intermarriage, warfare, religious pilgrimage or diplomatic mission, exploration, and resource procurement), and considers different parameters and levels of human interaction in the assessment of the epidemiological impact on different populations in the past. Although their article focuses on the biological and health impacts of human mobility, importantly, they note that social and environmental contexts have impacts on these health outcomes, particularly migrant health and agency. As the authors allude to, this model of mobility and interaction could be strengthened in the future through the analyses of social determinants of health and structural violence, especially as it is so integral to health experiences and outcomes in the context of migration.

Sharon DeWitte and Amanda Wissler's article in this special issue, "Demographic and Evolutionary Consequences of Pandemic Diseases," reviews the literature on the Second Pandemic of Plague (fourteenth to nineteenth centuries C.E.) and the 1918 influenza pandemic, two of the most significant pandemics in global history. Through their detailed examples of the demographic and evolutionary consequences of these two pandemics, DeWitte and Visser provide important examples of how bioarchaeologists can examine our data within the wider context of larger structural barriers of poverty, structural racism, and past social interventions. They show how selective mortality acts along the axes of age; socially defined race, ethnicity, and Indigeneity; socioeconomic status; rural and urban areas; and pregnancy. They also illustrate that selective mortality is associated with TB (again implicitly invoking and illustrating the importance of syndemics theory). Selective frailty has been illuminated in DeWitte and Wood's (2008) exploration of the Black Death of 1347–1351, which was the deadliest known epidemic in human history. They found through analyses of victims from the East Smithfield Black Death cemetery in London compared with normal, nonepidemic cemetery samples from two medieval Danish towns that the Black Death was selective with respect to frailty (DeWitte and Wood 2008).

Dewitte and Wissler (2022) insightfully note that the current range of exposure risks, symptoms, and mortality in the current COVID-19 pandemic is not surprising from what anthropologists and historians have learned from past pandemics. They show this with case studies that illustrate the way sociocultural and environmental contexts shape human experiences of disease during pandemics. Based on these selective evolutionary findings from the pandemic examples in their article in this special issue, they stress the responsibility we have to relay these findings and predictable effects to the public response to the pandemic:

> As important as further study on past pandemics is for clarifying their effects at the individual and population level, it is also crucial for the general public, scholars, and policy makers today to gain and sustain awareness of what we already know about our previous experiences of diseases, attend to those factors that affected morbidity and mortality in the past and that persist today, and devote resources toward maintaining and building pandemic responses in the future. For example, previous research has revealed the possible effects of poverty on risks of death during the Second Pandemic and the 1918 flu, and we are witnessing the ways in which poverty, structural racism, and social marginalization are increasing susceptibility to and risks of death from COVID-19 (Laster Pirtle 2020; Patel et al. 2020; Rodriguez-Lonebear et al. 2020). These effects are both predictable and theoretically preventable. The positive impact of non-pharmaceutical interventions such as mask wearing, social distancing, and banning large gatherings is evident from studying the course of the 1918 pandemic.

The public is now more aware of the importance of zoonotic diseases with the COVID-19 pandemic as an emerging infectious disease of probable animal origin (Haider et al. 2020; Zhang and Holmes 2020). Some estimates suggest that 75% of new or emerging infections derive from our interactions with other species of animals (Ogden et al. 2017). Although not yet conclusively demonstrated, the SARS-CoV-2 virus closely resembles a virus that infects bats (Zhang and Holmes

2020), and it has been suggested that the spillover event occurred at a wet market in Wuhan, China, in late 2019 (Henley 2020). Anthropogenic climate and environmental changes—including global warming, deforestation, habitat destruction, road-building activity, poaching, and population growth—are not only impacting biodiversity and driving the sixth mass extinction event but also altering patterns of human–animal interaction, which creates new threats for disease transmission (Henley 2020). This is such a critical juncture that it is leading to new paradigms for understanding public health, including the One Health framework, which seeks transdisciplinary collaboration to attain optimal health conditions for humans, other animals, and the environment (e.g., Bonilla-Aldana et al. 2020; Henley 2020; Schmeige et al. 2020).

Interactions between humans and other animals are not only the most likely source of coronavirus infections (Salata et al. 2019; Ye et al. 2020); other animals also play a role in viral evolution (e.g., El-Sayed et al. 2021; Lundstrom et al. 2020), the development of medical coping strategies (e.g., Christie et al. 2021; Dua et al. 2020; Luo et al. 2021), and the human coping mechanism for mental health during quarantine (e.g., Nagendrappa et al. 2020; Ng et al., 2021; Ratschen et al. 2020). Unfortunately, the threat of future zoonotic spillover is also creating challenges for animal and habitat conservation (e.g., Lu et al. 2021; MacFarlane and Rocha 2020; Zhao 2020). Many of these same issues will be identified in paleopathological research that focuses on humans and our interactions with other species in the past (e.g., Littleton et al. 2015, 2021).

The One Health framework is beginning to be more recognized as an attractive approach to bioarchaeology. The University of Edinburgh One Health Archaeology Research Group, for example, combines a wide range of disciplinary approaches to investigate human, animal, and ecosystem health through time (https://www.ed.ac.uk/history-classics-archaeology/research/research-groups/one-health-archaeology). Recently, bioarchaeologists Bendrey and Martin (2021) edited a special volume of seven articles on One Health approaches to bioarchaeology in the *International Journal of Osteoarchaeology*. These articles cover bacterial, viral, and parasitic pathogens from global case studies spanning the Holocene and its epidemiological transitions related to farming, industrialization, and modernity. In their outline of a research agenda for a One Health framework for bioarchaeology, Bendrey and Martin (2021) call for a greater focus on wildlife and domestic animal sources of infection and human health risks in the past using zooarchaeology, ancient DNA, and paleoepidemiological approaches to paleopathology. Similarly, Agarwal (2022) has discussed an anthropological-adapted One Health approach in an invited symposium piece for *Economic Anthropology* responding to the question, "How can economic anthropologists contribute to our understanding of pandemic responses and recovery?" Population increases and urbanization have led to a "livestock revolution" with intensive livestock production and the large-scale trade of live animals, and the clearance and destruction of land for agricultural crops have had devastating impacts on the environment. Through the lens of anthropogenic violence and inequality, Agarwal reviews the significant social inequality in global food production having significant health and ecological impacts on the countries and specific communities within countries that are producing for the more affluent countries and communities. At the heart of the problem of the environmental and health impacts for disadvantaged countries and populations is intensive livestock consumption. As such, Agarwal calls for an ecojustice approach to curb the consumption of meat in the Global North.

Judith Littleton and colleagues (2022) make an important contribution to the consideration of zoonotic endemic, epidemic, and pandemic diseases in the past in this special issue with their article entitled "Human–Animal Interactions and Infectious Disease: A View for Bioarchaeology." They argue that it is important in bioarchaeology to understand the emergence, evolution, and persistence of zoonotic diseases and to appreciate the interaction between human, animal, and environmental health, particularly drivers of resilience and buffers to exposure (Larsen 2018; Roberts 2020b). They point to the critical need for a focus on human–animal interactions in paleopathology and also to some challenges of the paleopathological study of zoonotic infections. They recognize the complex ecology of diseases at the human–animal interface, and the issues of interpreting these interactions in archeological settings are problematic. They argue that many zoonoses today are unrecognized or underdiagnosed, with sufferers often having chronic nonspecific symptoms and can also co-occur in individuals with other diseases (Maudlin et al. 2009). These zoonoses are often neglected tropical diseases that mostly affect communities that live in poverty and unfortunately disproportionately affect women, infants, and children (WHO 2010). These diseases cause devastating health, social and economic consequences to more than one billion people and a high rate of mortality, with affected people suffering in silence with little political voice (WHO 2010).

Littleton and colleagues (2022) argue for integrative and collaborative, transdisciplinary approaches offered by a One Health perspective (Centers for Disease Control and Prevention 2018), which acknowledges the complex interactions between social and

ecological systems (Waltner-Toews 2017), and an anthropological consideration of human–animal interactions (taking into account their biocultural complexity) moving beyond purely biomedical approaches (Zinsstag 2012). As mentioned briefly above, the One Health perspective is a transdisciplinary and collaborative approach that explicitly "recognizes the connection between people, animals, plants and their shared environment" and calls on a diverse array of experts in human, animal, and environmental health to work together. Although this is not a new approach, it is increasingly becoming recognized as being important for today's human society. Human populations are growing and expanding into new geographic areas with more people living in close contact with wild and domestic animals, providing more opportunities for diseases to pass between animals and people with major social and environmental changes experienced worldwide, including changes in climate and land use, such as deforestation and intensive farming practices, also providing new opportunities for disease transmission. Increases and changes in human mobility and the movement of animals and animal products also result in diseases that can spread quickly around the world. Similarly, these social contexts and changes can be assessed in the past.

The One Health approach acts to move theoretical considerations beyond a simplified paleoepidemiological association of infectious zoonotic disease with the agricultural transition and domestication of animals (Barrett et al. 1998; D'Anastasio et al. 2011; Fournié et al. 2017; Hershkovitz et al. 2008, Larsen 2018; McMichael 2004; Mitchell 2003) and contribute to the context-specific deep time histories argued to be essential to understanding disease emergence (Wallace et al. 2015). A recently published example that illustrates the importance of considering zoonoses in the specific social and ecological system, moving beyond this simplified paleoepidemiological transition (agricultural) model, is the research by Vlok et al. (2022) of hydatid disease (*Echinococcus granulosus*) in individuals from the pre-agricultural site of Con Co Nga in northern Viet Nam dated to 7,000 years B.P. The authors suggest that the presence of wild canids and the management of wild buffalo and deer increased the risk of disease transmission to humans and revealed subsistence complexity among hunter-gatherers living millennia prior to the adoption of farming in Southeast Asia (Vlok et al. 2022). Similarly, Littleton and colleagues acknowledge that TB and brucellosis have been identified through paleopathological and molecular analyses of hunter-gatherers in the Americas (Bos et al. 2014; Jones 2019), in pre-Neolithic settlements in Syria (Baker et al. 2015), and even in a late Pliocene specimen of *Australopithecus africanus* (D'Anastasio et al. 2009).

Littleton and colleagues review modeling of outbreaks and advocate for studies that incorporate zooarchaeological, geospatial, climate, ethnographic, and historical data alongside traditional paleoepidemiological analyses of mortality and morbidity to provide a fuller picture of the circumstances leading to epidemics and pandemics (e.g., Fournié et al. 2017; Gowland and Western 2012; Marciniak et al. 2018; Smith-Guzmán et al. 2016). The authors eloquently describe three examples of animal–human–disease interactions: pigs in Papua New Guinea, TB and possums–bovine–humans in New Zealand, and the Balinese people and long-tailed macaques (*Macaca fascicularis*). These examples demonstrate the complex sociocultural, political, economic, and ecological relationships that can exist between humans and animals.

Littleton et al. (2022) acknowledge that the One Health perspective fits well with other approaches used in bioarchaeology and paleopathology (e.g., biocultural perspectives including socioeconomic relationships and human agency approaches). This perspective could, therefore, be incorporated with syndemics and social determinants of health frameworks. The burden of zoonotic diseases is higher for populations living in poverty (Molyneux 2011). In addition, poorer populations are also marginalized within health systems, and often the impact of endemic animal diseases is mainly felt at the farm level, in terms of disease but also economic impact (Seimenis 2012). Indigenous populations are also disproportionately affected by diseases associated with the environment and animals (Riley et al. 2021). There has been a recent call for the incorporation of Indigenous values and leadership into One Health research for more effective results (Riley et al. 2021).

Conclusion

As we have all come to understand very well, a pandemic is a disease outbreak leading to a sudden and extreme increase in the number of cases that spreads across a large region, including multiple countries, and rapidly affects a large proportion of the population. A crisis of this magnitude can lead to a variety of different responses in human populations, depending upon their HESC circumstances. It is social scientists, and anthropologists in particular, who can offer perspectives that have increasingly been recognized as extremely critical, especially given the chaotic, inefficient, and unhelpful social responses to COVID-19, particularly in the United States and, to a lesser extent, in the United Kingdom and Europe. As remarked by Francis Collins, the outgoing director of the National Institutes of Health (NIH) in a recent interview, the

politicization of science in the United States has recently grown:

> . . . much worse. And it's a reflection of the fact that polarization is much worse—and tribalism is much worse. We're in a really bad place. If science happens to produce a result that a political perspective doesn't like, then science has to be attacked. That's exactly what we see now happening, to the detriment of getting the facts out there. This has turned out to be a much more severe situation than I would have imagined a year ago. I wish we had more insights from behavioural social science research into how this has come to pass, and why it could have gotten so completely widespread. I want to call this out as one of my most major concerns as I stepped down from the NIH, of looking at the situation in our nation. Somewhere along the way, our political hyperpolarization began having a lot of really dangerous consequences, where in many instances we seem to have lost a sense of how to tell the difference between a fact and an opinion—or some Facebook post that's, frankly, a lie. That's truly dangerous. That's another epidemic that is not going to go away even if we triumph over COVID-19. We need to figure out what happened here, and how to bring ourselves back to a place where our nation has a more stable future. (Subbaraman 2021:373)

The articles in this special issue present novel, sophisticated, and holistic approaches to the study of epidemics and pandemics in the past, which demonstrate the powerful ways in which bioarchaeology is positioned to address current-day issues, including disparities in infection rates and health outcomes of COVID-19. These authors demonstrate how knowledge of the past provides opportunities for developing a more nuanced and rich understanding of modern epidemiological factors. These articles demonstrate that research on the biology and epidemiology of human diseases requires a biocultural perspective. Medical solutions, such as vaccines, will never be enough to end a global pandemic. We must attend to the HESC context, which deeply shapes the complex manner in which individuals, groups, and populations experience the impacts of and respond to infectious diseases.

Pandemics are crises that lay plain the contours of social inequality and have an especially acute power to create profound suffering for already marginalized groups and, over time, to shape the course of our evolution. However, these conditions create social suffering and shape our evolution even in the absence of pandemics, just more quietly. Social inequality is the variable of interest (Graeber and Wengrow 2021). In a capitalist society, it is not surprising that infectious diseases will be allowed to kill "essential workers" to save the economy (Harvey 2020); this is a normal state of affairs, prior to the pandemic (e.g., Whyte 2020), and it has been for thousands of years (Graeber 2012). It is hardly news that people with disabilities are treated as expendable (e.g., through widespread beliefs that the Omicron variant of COVID-19 is "mild" unless you have preexisting conditions); this ideology has a long history (Mant and Holland 2019). The preexisting conditions that make some of us more vulnerable to COVID-19 are also exacerbated and made more common by capitalism itself (Braveman and Gottlieb 2014; WHO 2013; Wilkinson and Marmot 2008).

Capitalism and related phenomena of imperialism, colonialism, slavery, and social inequality have been causing social suffering for centuries, and bioarchaeology demonstrates this history (e.g., Barrett and Blakey 2011; Blakey 1998, 2001, 2020; de La Cova 2008, 2010, 2011, 2012, 2014, 2019, 2021; Dent 2017; Geber 2015; Geller 2015, 2021; Geller and Stojanowski 2017; Godde et al. 2020; Gowland et al. 2018; Hutchinson 2016; Hutchinson and Mitchem 2001; Larsen and Milner 1994; Larsen et al. 2001; Mant et al. 2021; Miller et al. 2020; Murphy and Klaus 2017; Newman and Gowland 2017; Nystrom 2017; Tremblay and Reedy 2020; Watkins 2012, 2018a, 2018b; Wesp 2020). Values of individualism and social isolation in some societies have deeply limited the range of possible coping mechanisms (Nelson 2020; van Bavel et al. 2020), which bioarchaeology too would predict (e.g., Schrenk and Tremblay 2022; Tilley 2015; Tilley and Schrenk 2017). Social scientists are not surprised when—in societies founded upon inequality, capitalism, genocide, and slavery—science and medicine will only receive respect and trust when they serve the interests of capital. That has been true in regard to the climate crisis for decades. The question is not when or how this inequality emerged but rather why we feel stuck in our current socioeconomic and political configurations (Graeber and Wengrow 2021).

We end this introduction with a call for bioarchaeologists and paleopathologists to consider the importance of their work to modern-day, pressing human health issues and disparities in health outcomes by making explicit links from their work to public health concerns and to social science discourses more broadly (e.g., Bendrey and Martin 2021; Buikstra 2018). Our past and present are thoroughly intertwined, and the lessons from the past are particularly relevant to creating solutions rooted in social justice today (Buikstra 2018), in what is arguably the worst health crisis of the twenty-first century, in terms of the immediate mortality rate, morbidity, ongoing health and socioeconomic effects, and for exacerbating

inequalities within and among populations (*The Lancet* 2020). Although we can never incorporate every theoretical model into our work in paleopathology, this set of articles offers a comprehensive set of approaches to choose from and potentially refine to meet the goals of research in specific contexts. It is this type of research on past epidemics and pandemics that will make a real contribution to understanding and perhaps controlling present-day emerging diseases, such as COVID-19, which will become more common in the context of global warming and climate change. An understanding of epidemiology and anthropological contextualization of epidemic and pandemic disease through the exploration of the origins, evolution, the relationships of disease with social factors, and effects of interventions during past outbreaks can be used in a predictive manner to investigate the factors promoting emerging diseases (Bendry and Martin 2021; DeWitte and Wissler 2022).

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