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Pharmaceuticals in the Water: The Need for Environmental Bioethics

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Abstract
Pharmaceuticals are present in various water sources used by wildlife and as drinking water for humans. Research shows that certain pharmaceuticals, sold over the counter and by prescription only, can harm wildlife. Moreover, the human ingestion of water contaminated by polypharmacy presents a potential cause for concern for human health. Despite the wide scope of this problem, environmental bioethics has not adequately engaged with this topic and, instead, has concerned itself with healthcare waste products more generally. The present essay calls for more ethical investigation on the topic.

Keywords Environmental bioethics · Pharmaceuticals · Sustainable healthcare · Environmental health · Water contamination

Reports first published data on the presence of pharmaceuticals in the environment as early as the 1970s, but the topic did not garner great interest until the 1990s when concern was shown regarding the existence of pharmaceuticals in human drinking water (Kümmerer 2010). Despite this early scrutiny, pharmaceuticals continue to pervade the natural environment. According to Küster and Adler (2014), over 600 pharmaceuticals have been detected in the environment globally, and 156 pharmaceuticals have been discovered in surface water, groundwater, and drinking water in Germany alone. One route of transmission for these pharmaceuticals is human excretion; Ngqwala and Muchesa (2020) note that up to 90 percent of oral medications that pass through the human body end up in the water supply. Additionally, it has become common practice for patients and medical professionals to dispose of medications directly down the drain and into regional water supplies. For example, Vollmer (2010) discusses survey data on routes of pharmaceutical disposal and notes a German survey where 43 percent of unused or expired liquid medications were discharged via the sink or toilet. Similarly, a British survey found that 12 percent of respondents disposed of unwanted pharmaceuticals down the drain, and a Canadian survey discovered that 39 percent of surveyed households disposed of medications by burying, flushing, or including them in the garbage. Moreover, King and McCue (2017) discuss the reality that nurses

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often dispose of pharmaceuticals down the drain: "Many times during a typical workday, American hospital nurses routinely discard unused portions of narcotics and other controlled substances into municipal water supplies" (King and McCue 2017, 452). They mention that both the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) in the United States have authorized the disposal of pharmaceuticals in this way, making curbing the behavior that much more difficult.

Pharmaceuticals are in water supplies; they exist in regional drinking water and natural water sources, and they make their way there through uncontrolled disposal and human excretion. But is this contamination problematic and worth bioethical examination? John P. Sumpter (2010) asks this question, and although he ultimately attempts to solve the issue of contaminated water, he remains somewhat unconvinced that the presence of pharmaceuticals in water sources is a problem at all. I contend that water contamination is a problem for both human and non-human organisms. With respect to the impact on wildlife, Berg, Brunström, and Brandt (2012) note "that both EE_2 [ethinylestradiol] and LNG [levonorgestrel] are potent developmental toxicants at environmentally relevant exposures in frogs, giving rise to dysfunctional female sex organs with subsequent sterility." Aside from oral synthetic estrogens, psychoactive drugs have been linked with problematic behavior in fish; in a study conducted by Polverino and colleagues, guppies (Poecilia reticulate) exposed to environmentally relevant levels of fluoxetine showed a marked decrease in activity levels and behavioral repeatability (Polverino et al. 2021). Polverino and colleagues conclude that their finding is consistent with previous research showing that environmentally relevant levels of antidepressants can alter activity levels and risk-taking in wild fish, interfere with movement patterns and migration, and negatively impact antipredator responses. Furthermore, Cuthbert and colleagues (2007) conducted a survey study of veterinary practices and the use of NSAIDs in bird species (e.g., raptors, storks, cranes, and owls) and found that certain varieties of the drugs were toxic, including drugs like ibuprofen, ketoprofen, and diclofenac, which are administered to humans as well.

In addition to these problems concerning animals, there is a concern for humans, something which Sumpter (2010) downplays as potentially only affecting the infirm, the elderly, and fetuses because of their inability to effectively clear drugs from their bodies. Aside from these vulnerable populations, it does appear problematic that drinking water may contain dozens of different pharmaceuticals; even if the levels of contamination for each drug are minuscule, their combination may present negative health effects even for healthy individuals, especially if these drugs interact with other substances individuals may be consuming. Specifically, these medications include cancer drugs, diuretics, anti-epileptics, antidepressants, anxiolytics, tranquilizers, steroids, beta-blockers, antibiotics, analgesics, NSAIDs, lipid regulators, anti-ulcer agents, and proton pump inhibitors (Ngqwala and Muchesa 2020). The problem of polypharmacy contamination in water sources, which may include drinking water, is that the synergistic effect of the compounds is unknown; this may require invoking something like the precautionary principle. Since certain drugs in environmentally relevant quantities are harmful to wildlife, combining these compounds with dozens of others is likely not to be neutral when consumed by humans via drinking water.

Contrary to Sumpter's (2010) initial appraisal, pharmaceutical contamination of water and the environment more generally is problematic for the organisms that access the tainted water. Although the issue of pharmaceutical contamination has been known for some time, bioethical inquiry into the problem has been lacking. The most appropriate subfield to investigate the ethics of this issue is environmental bioethics, which recognizes that human medical practice is not bounded by hospital walls nor contained within the

physician-patient relationship but, instead, tends to infringe upon the natural environment (Irvine 2009). This line of thinking can be traced back to Van Rensselaer Potter and his seminal work in bioethics, which he saw as the bridge between human values (e.g., ethics) and the environment (Potter 1971; 1988). However, Potter's chief concern was overpopulation, making the relationship between medicine and the environment one of fertility control, as this would permit the world population to remain stable enough for the earth's resources to sustain it. Through fertility control, then, medicine can ensure a stable population best suited to inhabit the earth without stripping it of its resources and provide humans with the best quality of life.

More recent research into the relationship between medicine and the environment has taken the chief concern to be one of waste production, which includes pharmaceutical waste but does not explicitly acknowledge water contamination. The ethical need to incorporate environmental concerns into healthcare decisions has been acknowledged in general because of the impact that all human domains tend to have on the natural environment, along with the dependence humans have on the environment (see, for example, Whitehouse 1999; Erlich 2009; Wardrope 2019). Specifically, Jessica Pierce and Andrew Jameton recognize the relationship between human health and the health of the natural environment, such that hospitals ought to be designed and operate within a framework of environmental sustainability (see, Jameton and Pierce 2001; Pierce and Jameton 2004). To this end, they conceived of the green health center (GHC), which has the goal of decreasing the waste produced by conventional hospitals. This waste reduction is to be seen in the variety of products used to build the GHC (e.g., non-leaded paint), the products used to deliver care (e.g., no plastics with chemicals that can leach into medications), services offered (e.g., no wasteful surgeries), and resources used to provide care.

A pertinent example that highlights the need for GHC-inspired actions is the waste produced by personal protective equipment during the COVID-19 pandemic. For example, the organization OceansAsia estimated that, in 2020, 1.56 billion face masks entered our oceans (Phelps Bondaroff and Cooke 2020); Roberts and colleagues (2022) found an 80-fold increase in the amount of waste generated by face masks; and Peng and colleagues (2021) found the pandemic has produced 8 million tonnes of plastic, of which approximately 25,000 tonnes have ended up in our oceans. Although COVID-19 has presented many challenges to healthcare, one can seriously question whether the response could have been enacted with more forethought regarding the environmental impact of plastic waste. For instance, McInturf and Savoca (2021) highlight a review study that found 386 fish species are known to have consumed plastic debris; of those, 210 species are commercially caught. This issue—for the health and well-being of marine organisms and humans—is only exacerbated by pandemic-related plastic waste, further entrenching the need for more sustainable healthcare practices, including waste reduction.

Furthermore, work by Cristina Richie (2015; 2020; 2021) highlights the concern for environmental sustainability in the form of reducing healthcare's carbon footprint and positively impacting climate change. With respect to emissions, Pichler and colleagues (2019) studied the healthcare industry's carbon footprints around the globe from 2000 to 2014. They found that China and the United States were the highest polluters, with 600.6Mt and 479.7Mt, respectively, while India was fourth, with 74.1Mt. Moreover, Gao and colleagues (2019) discuss the use of coal in China's pharmaceutical industry, which witnessed an increase of 9.43Mt from 2000 to 2016; over this same period, the pharmaceutical industry's emissions increased by 140 percent. Healthcare and related emissions are produced at a staggering rate around the globe and may contribute to environmental racism (the disproportionate burdens shouldered by impoverished nations and minorities); this provides

additional reasons, stemming from distributive justice, to decrease emissions (Thiel and Richie 2022). The focus of Richie's work on healthcare and related emissions is foundational to environmental bioethics because of the scope of the issue and its impact on health; however, this does not mean other forms of pollution—such as water contamination—ought to be overlooked.

Environmental bioethicists are concerned with the wastefulness of healthcare, its unsustainable practices, and how pharmaceuticals contribute to these problems; they have also laid the groundwork for addressing water contamination despite not explicitly acknowledging it. What is needed is for ethicists to pivot and begin looking at pollution issues more broadly to account for air, water, and land contamination. I contend that this will entail integrating existing perspectives that acknowledge the importance of the environment for human and non-human health. One such view is offered by Lisa Lee (2017), who advocates that public health ethics (PHE) ought to bridge the gap between bioethics and the environment. According to Lee, PHE recognizes the relationship between health and the planet and aims to improve population health by following the principle of justice. This is integral to understanding that, even when medications benefit patients, such drugs can still harm marine life and humans.

Similarly, David Resnik (2012) offers environmental health ethics (EHE) as a theory that explains the relationship between environmental risk factors and human biology and focuses on using this understanding to prevent illness, decrease disease, and promote health. EHE is grounded by seven principles derived from moral concern for species, ecosystems, and the environment. Those principles are human rights, utility, justice, animal welfare, stewardship, sustainability, and precaution. Importantly, and in contrast with PHE, EHE is based on principles that incorporate the well-being of non-human organisms and take seriously the harms that may befall only non-humans, as this conflicts with the principles of animal welfare and stewardship. Although the GHC, PHE, EHE, and work by Richie do not explicitly acknowledge water contamination, their views, most likely in concert with one another, may offer a comprehensive view of water contamination, account for the immorality of it, and supply a tenable solution. I am not stating that these views offer a definitive answer; my aim in discussing them is to provide a first pass at the existing literature on the topic and how current environmental bioethics frameworks are used. That said, it would appear that frameworks scaffolded by principles such as distributive justice, sustainability, stewardship, and population health are best situated to tackle this issue. All views mentioned above offer something valuable to the equation and must be pursued collaboratively.

Notwithstanding the above views' potential in addressing water contamination, there may be reasons why ethical research has not yet expanded into water contamination. Firstly, the issue may be perceived as synonymous with healthcare emissions and waste more generally, and if those problems are solved, so will contamination. Although this is a possibility, understanding ethical issues entails descriptive and normative work; in particular, the problem space deserves explicit acknowledgment and argumentation supporting the idea that solutions apply generally. Secondly, it may be believed that water contamination involves more than prescription medications, and thus, attention to healthcare's role is of limited use. Even if other sources of contamination exist (e.g., agriculture, over-the-counter drugs, etc.), it is defeatist to neglect to address at least part of the problem, as any decrease is beneficial. Thirdly, altering prescription habits and patient expectations for the good of others and the environment may appear insurmountable. However, this perception is inconsistent with existing work in environmental bioethics that continuously fights an upward battle against excessive waste, emissions, and energy usage. Lastly, contamination may be

overlooked because incorrect disposal and excretion can be corrected using better wastewater technology. This solution fails to recognize issues in medicine that are driving contamination, such as overuse, over-prescription, drug dependency, lifestyle prescriptions, and a lack of preventive medicine (Richie 2021). Moreover, a technological solution assumes that implementation around the globe is feasible, something that is relatively unlikely. The fact that environmental bioethics has not engaged with water contamination may reflect the above barriers, but these are not defensible reasons for not pursuing the topic.

In short, pharmaceuticals are present in various water sources used by wildlife and humans alike. Research shows that certain pharmaceuticals, sold over the counter and by prescription only, can harm wildlife. Moreover, the human ingestion of water contaminated by polypharmacy presents a cause for concern for both individual and population health—this may also drive the use of even more medicine and worsen contamination. Despite the wide scope of this problem, environmental bioethics has not adequately engaged with this topic and, instead, has concerned itself with healthcare waste products more generally. However, due to the breadth of the problem, uncovering solutions will be difficult, as physicians, patients, and the pharmaceutical industry are all implicated in creating the problem and are more than likely necessary to prevent future harm. Environmental bioethics research geared toward better understanding waste generated by medicine ought to consider water contamination, as this problem is currently part and parcel of the medical industry.

Author contribution TM is the sole author.

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