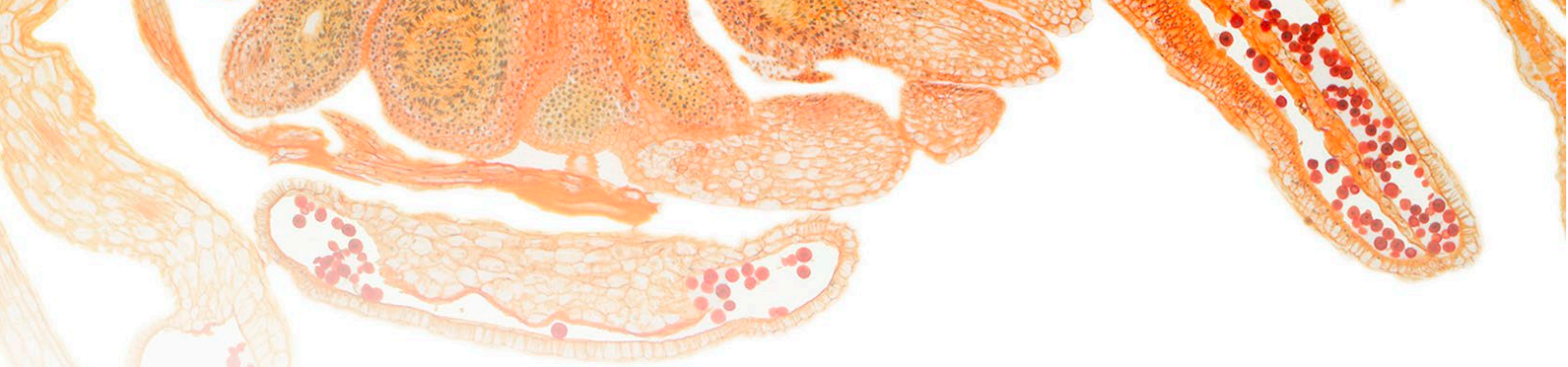

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How Should US Health Care Lead Global Change in Plastic Waste Disposal?

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Abstract

Disposal of health care waste is one of the biggest threats to global sustainable health care. Current practices of dumping domestic and international health care waste into the earth's *terra firma* and oceans also undermine global health equity by adversely affecting the health of vulnerable communities. While the United Kingdom works toward circular health care economy streams that produce minimal waste, the United States continues to amplify downstream environmental and health effects of health care organizational waste management decisions. This article suggests how to reframe social and ethical responsibility for health care waste production and management by assigning strict accountability to health care organizational leaders, incentivizing circular supply chain implementation and maintenance, and encouraging strong collaborations across medical, plastic, and waste industries.

Introduction

Waste management in the United States is both unethical and unsustainable. In 2018, the United States produced 292.4 million tons of municipal solid waste (MSW)[1] and sent 157 000 shipping containers of MSW to lower income countries (eg, Vietnam, Malaysia, Thailand, and China), dumping 1.07 million tons of plastic waste outside US borders.[2] In this article, we discuss the projected influence of plastic waste on planetary and population health. We also propose concrete changes in health policy, clinical practice, and industrial relationships, specifically in health care and waste sectors.

Plastic's Consequences

Inconsistent values across health systems enable the US medical supply chain to externalize the consequences of its plastic consumption and disposal. Under-resourced countries have historically imported plastic waste to create economic opportunities through waste collection and recycling services, and their weak regulations are exploited by wealthier countries. The direct influence on human health from mismanaged (eg, burning) plastic waste includes exposures to toxic pollutants and microplastic ingestion, flooding (eg, due to water flow blockage), and disease transmission (eg, by flies, mosquitoes, rats).[3,4] Between 400 000 and 1 million lives are lost each year in low- and

middle-income countries (LMICs) due to mismanaged waste.[4] As harms of plastic waste accumulate, we might hope for international pressure to mitigate waste importation and exportation. China, for example, once imported more than a quarter of the world's mismanaged waste, but in July 2017, it closed its doors to 24 categories of consumer waste, including postconsumer plastics and paper products.[5] Malaysia and Vietnam banned importation of plastic waste shortly thereafter,[6] and we can expect more countries to follow.

With only 633 materials recycling facilities in the United States and with the US's heavy dependence on plastic waste exportation, we can expect that importation bans will disrupt domestic waste processing.[7] US unpreparedness to manage waste generated internally, combined with a projected doubling in plastic production globally over the next 2 decades,[8,9] will also exacerbate negative health consequences. Moreover, LMICs, particularly those in South and Southeast Asia, are production sites of virgin plastic polymer and plastic products that meet demand in global and domestic markets. China leads in global production; and India, Bangladesh, Thailand, Pakistan, and the Philippines have increased investment in such plastic manufacturing.[10] In the United States, too, 30 petrochemical complexes lie close to poor neighborhoods and communities of color from the Ohio River Valley to the Gulf Coast, contributing to "asthma, lung cancer, brain and organ damage, vomiting, diarrhea, and cardiovascular diseases."[11]

Plastics in Health Care

Aside from a tremendous emissions footprint—accounting for 8% of total US emissions[12]—health care remains one of the largest waste-producing sectors. Hospital patients in the United States generate about 33.8 pounds of waste each day, which leads to about 6 million tons of waste annually.[13] While various materials (eg, metals, glass, food, paper) are used in health care, none have revolutionized the medical industry over the past century as have plastics used in syringes, intravenous bags, catheters, test kits, and gloves.[14] Plastic possesses several properties favored by the biomedical industry: it is low in cost, easy to process, and easy to sterilize.[15] Of the 14 000 tons of waste generated daily in US health care facilities, about 20% to 25% is plastic,[15] but 91% of plastics, including those used in health care, are not recycled and either reside in landfills or have infiltrated natural environments.[16,17]

At the beginning of the COVID-19 pandemic in March 2020, the World Health Organization projected monthly demand of 89 million medical masks, 76 million gloves, and 1.6 million goggles alone, leading to a 40% increase in disposable personal protective equipment (PPE) production.[18] Hazardous COVID-19 biomedical waste is contributing to plastic waste generation worldwide,[19] although there exists no compelling evidence that using single-use disposables reduce health care-acquired infections.[20]

Despite repercussions of plastic production and disposal, industrial disincentives to reuse plastics have proliferated plastic waste. Current regulations, such as US Food and Drug Administration (FDA) requirements for design and reprocessing of reusable medical devices, discourage reuse and motivate manufacture of single-use devices to avoid liability and generate profit.[21,20] Producers of single-use devices remain unpenalized for the excessive environmental impact of the waste they generate. Tremendous opportunity to remove unnecessary plastic in health care exists, but demand for single-use plastics continues to grow,[22] suggesting a misalignment between

waste generation practices in health care and the ethical obligation of the profession to do no harm.

Obligation to Do No Harm

In an updated version of the Hippocratic Oath, physicians swear: "I will abstain from all intentional wrong-doing and harm."[23] Yet, currently, the health care sector faces little liability for consequences of its supply chain decisions. As discussed above, the costs of its practices are passed to LMICs and communities of color, who experience increased health care costs, quality of life decline, and ecosystem degradation. When the health sector externalizes costs in ways that degrade health in marginalized communities across the world, it defeats health professional aims.

Some countries have recognized climate health action as part of health care's obligation to protect health, as demonstrated by the recent commitment signed by 50 countries at the 2021 COP26 United Nations Climate Conference.[24] The National Health Service (NHS) of Great Britain has set targets that include an 80% reduction in carbon emissions between 2036 and 2039 and a goal of net-zero by 2045.[25] This initiative includes a continued commitment to the NHS Plastics Reduction Pledge and a 10% reduction in clinical single-use plastics.[26] Nevertheless, the US health sector remains largely tethered to a "take-make-waste" economy that extracts resources, forms them into products, and disposes of them.[20]

Call for Action

Clinicians cannot remain complacent. We must speak up and apply pressure to hold health care organizations and manufacturers accountable to make supply chain decisions that prioritize environmental sustainability and incentivize use of quality, durable materials that can be easily reused or recycled. Institutionalizing these changes could enable transition from an unethical system of US health care waste disposal to a more sustainable one (see Table). Such strategies need to be shared across sectors to promote swift implementation and action. Collaboration among stakeholders is required to apply pressure on the Occupational Safety and Health Administration and the FDA to levy penalties for waste in health care supply chains.

Table. Opportunities to Transform the Health Care Waste Stream

Infrastructure and Operations	Policy	Research and Partnerships
• Implement stronger methods to predict and manage supply needs. • Develop pipelines to distribute unused medical supplies within local networks of institutions in order to reduce waste and financial spending. • Institutionalize educational programs for clinical staff on types of plastic waste and recycling and sorting procedures to maximize accordance with guidelines.	• Promote Extended Producer Responsibility policies whereby manufacturers and importers are made accountable for the environmental impacts of the products and packaging they produce and sell.[20] • Develop national guidelines for sustainable practices in institutions, including enforcing commitments to both sustainability and global health equity as a primary operational goal. • Require the public reporting of waste production by all health care institutions. • Mandate that hospitals comply with facility-level emission standards.	• Coordinate efforts with the medical device and plastics industries to make recycling and reusing medical plastics as economically viable as possible. • Increase funding for medical plastic design that is benign and recyclable. • Study the cost-effective production of bioplastics and other single-use plastic replacements. • Invest in local infrastructures to reprocess medical products and increase the production of value-added products while avoiding system-wide shortages.[20]

Aside from making waste reduction efforts, the health care system is also obligated to reduce harmful pollution that undermines population health. A robust health care system would consider population health as well as health care quality to further incentivize emissions reduction.[20]

Finally, since ineffective recycling and disposal procedures can deter upstream efforts to reduce waste, student and clinician education on waste and regulation is integral. Findings from a 2019 Massachusetts General Hospital study found that 85% of waste disposed of in regulated medical waste (RMW) containers was not RMW, for example. Most clinicians are likely unaware that poor disposal practice generates expensive hauler fees for processing RMW (10 times more than landfill fees and 30 times more than recycling fees) and generates organizational costs and fines that could exceed $100 000 annually.[27,28]

Waste Reduction Cost Savings

Waste reduction and proper disposal are not only ethical, but also cost efficient. Hospitals submitting data to the 2019 Environmental Excellence Awards saved an estimated $68 million on sustainability initiatives in 2018 “while reducing more than 309 million kBTUs of energy, diverting 146,750 tons of waste from the landfill, and avoiding 182 370 metric tons of carbon emissions through mitigation projects.”[29] As another case example, most PPE used in the United States is designed for single use and is made from polypropylene nonwoven fabrics that have poor biodegradability and

can result in harmful degradation byproducts upon incineration.[30] Not only can reusable gowns reduce environmental impacts by more than 60%,[31,32] but they also are cost efficient, as one hospital system's implementation of reusable gowns resulted in savings of more than $3.5 million over 4 years.[33] Despite concerns about inferior performance of cloth gowns, advances in textile engineering have allowed the production of high-quality cloth materials that meet stringent health care standards while reducing health waste.[34]

Extended product responsibility (EPR) policies that hold manufacturers and importers accountable by internalizing environmental costs associated with waste streams have also demonstrated promising cost-saving opportunities.[20] In British Columbia, Canada, EPR policies could save $14 to $17 million Canadian dollars due to incentives to recover waste and maintain inputs at highest-value application for as long as possible.[20,35]

Conclusion

Clinicians' obligations to not harm extend beyond the patient-physician interaction to health sector operations. Health care organizations and critical stakeholders, such as policymakers and supply industries, have ample opportunities to recover costs and reduce waste and emissions by embedding institutional sustainability goals in operational strategies to improve waste production and management in health care. Reducing health care waste generation will not only preserve environmental resources and improve global health in LMIC countries, but also enhance resilience against inevitable sociopolitical changes and supply chain shortages. Significant cost savings could also be realized by transitioning away from single-use items.

References

1. National overview: facts and figures on materials, wastes and recycling. US Environmental Protection Agency. Updated July 31, 2022. Accessed August 23, 2022. https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials
2. Dell J. 157,000 shipping containers of US plastic waste exported to countries with poor waste management in 2018. Plastic Pollution Coalition blog. March 6, 2019. Accessed September 16, 2021. https://www.plasticpollutioncoalition.org/blog/2019/3/6/157000-shipping-containers-of-us-plastic-waste-exported-to-countries-with-poor-waste-management-in-2018
3. Haub AS. China: A leader in plastic recycling? *Yale Environment Review*. April 9, 2019. Accessed October 1, 2021. https://environment-review.yale.edu/china-leader-plastic-recycling
4. Calderwood I. David Attenborough: plastic pollution is killing a million people a year. Global Citizen. May 14, 2019. Accessed October 10, 2021. https://www.globalcitizen.org/en/content/david-attenborough-plastic-health-report/
5. What does China's plastic ban mean for healthcare? Healthcare Plastics Recycling Council blog. June 11, 2018. Accessed July 25, 2021. https://www.hprc.org/single-post/2018/06/11/what-does-chinas-plastic-ban-mean-for-healthcare
6. Niranjan A. Whose fault is plastic waste in the ocean? *DW*. July 31, 2019. Accessed November 3, 2021. https://www.dw.com/en/whose-fault-is-plastic-waste-in-the-ocean/a-49745660

7. 2017 infrastructure report card: solid waste. Infrastructurereportcard.org. Accessed July 1, 2022. https://www.infrastructurereportcard.org/wp-content/uploads/2017/01/Solid-Waste-Final.pdf
8. Wen Z, Xie Y, Chen M, Dinga CD. China's plastic import ban increases prospects of environmental impact mitigation of plastic waste trade flow worldwide. *Nat Commun*. 2021;12(1):425.
9. Ellen MacArthur Foundation. The new plastics economy: rethinking the future of plastics. World Economic Forum; 2016. Accessed July 1, 2022. https://www3.weforum.org/docs/WEF_The_New_Plastics_Economy.pdf
10. Wilson M, Kitson N, Beavor A, Ali M, Palfreman J, Makarem N. Digital dividends in plastic recycling. GSMA; 2021. Accessed November 24, 2021. https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2021/04/ClimateTech_Plastic_R_WebSingles2.pdf
11. The plastic-production problem. Center for Biological Diversity. Accessed November 24, 2021. https://www.biologicaldiversity.org/campaigns/plastic-production/index.html
12. Shelton J. US health care emissions continue to rise. *Yale News*. December 7, 2020. Accessed November 10th, 2021. https://news.yale.edu/2020/12/07/us-health-care-emissions-continue-rise
13. Jenkins N. How to reduce waste by increasing use of reusable medical textiles. Sustainability Roadmap. Accessed September 10, 2021. http://www.sustainabilityroadmap.org/pims/pdfs/pim247_How_to_Reduce_Waste_NJenkins.pdf
14. BOSS Editorial Team. How healthcare facilities balance patient and environmental safety when it comes to single-use plastics. *BOSS Magazine*. Accessed September 10, 2021. https://thebossmagazine.com/single-use-plastics-healthcare/
15. Gibbens S. Can medical care exist without plastic? *National Geographic*. October 4, 2019. Accessed September 10, 2021. https://www.nationalgeographic.com/science/article/can-medical-care-exist-without-plastic
16. Parker L. A whopping 91 percent of plastic isn't recycled. *National Geographic*. July 5, 2019. Accessed September 10, 2021. https://www.nationalgeographic.org/article/whopping-91-percent-plastic-isnt-recycled/
17. Fishman Z. Plastic panic in the pandemic: how single-use items meant to protect us will harm the planet. *Medill Reports Chicago*. June 20, 2020. Accessed July 1, 2022. https://news.medill.northwestern.edu/chicago/plastic-panic-during-the-pandemic-how-single-use-items-meant-to-protect-us-will-harm-the-planet/
18. Shortage of personal protective equipment endangering health workers worldwide. News release. World Health Organization; March 3, 2020. Accessed August 23, 2022. https://www.who.int/news/item/03-03-2020-shortage-of-personal-protective-equipment-endangering-health-workers-worldwide
19. Duer J. The plastic pandemic is only getting worse during COVID-19. World Economic Forum. July 1, 2020. Accessed November 5, 2021. https://www.weforum.org/agenda/2020/07/plastic-waste-management-covid19-ppe/
20. MacNeill AJ, Hopf H, Khanuja A, et al. Transforming the medical device industry: road map to a circular economy: study examines a medical device industry transformation. *Health Aff (Millwood)*. 2020;39(12):2088-2097.

21. Factors affecting quality of reprocessing. US Food and Drug Administration. January 12, 2018. Accessed November 20, 2021. https://www.fda.gov/medical-devices/reprocessing-reusable-medical-devices/factors-affecting-quality-reprocessing
22. Peng Y, Wu P, Schartup AT, Zhang Y. Plastic waste release caused by COVID-19 and its fate in the global ocean. *Proc Natl Acad Sci U S A*. 2021;118(47):e2111530118.
23. Hippocrates. The Oath. In: Jones, WHS, ed. *Hippocrates Collected Works I.* Harvard University Press; 1868. Accessed July 1, 2022. https://daedalus.umkc.edu/hippocrates/HippocratesLoeb1/page.224.a.php?size=240x320
24. Countries commit to develop climate-smart health care at COP26 UN Climate Conference. News release. World Health Organization; November 9, 2021. Accessed November 20, 2021. https://www.who.int/news/item/09-11-2021-countries-commit-to-develop-climate-smart-health-care-at-cop26-un-climate-conference
25. NHS becomes the world's first national health system to commit to become "carbon net zero," backed by clear deliverables and milestones. National Health Service. October 1, 2020. Accessed October 15, 2021. https://www.england.nhs.uk/2020/10/nhs-becomes-the-worlds-national-health-system-to-commit-to-become-carbon-net-zero-backed-by-clear-deliverables-and-milestones/
26. Stevens S. *Delivering a "Net Zero" National Health Service*. National Health Service; 2020. Accessed July 30, 2021.
27. Hsu S, Theil C, Mello M, Slutzman J. Dumpster diving in the emergency department: quantity and characteristics of waste at a level I trauma center. *West J Emerg Med*. 2020;21(5):1211-1217.
28. 6 pain points that impact hospital journey to zero waste. Zabble blog. June 22, 2021. Accessed August 14, 2021. https://www.zabbleinc.com/blog-post/6-pain-points-that-impact-hospitals-zero-waste
29. 2019 sustainability data. Practice Greenhealth. Accessed August 20th, 2021. https://practicegreenhealth.org/tools-and-resources/2019-sustainability-data
30. Alvim-Ferraz MCM, Afonso SAV. Incineration of healthcare wastes: management of atmospheric emissions through waste segregation. *Waste Manag*. 2005;25(6):638-648.
31. Vozzola E, Overcash M, Griffing E. An environmental analysis of reusable and disposable surgical gowns. *AORN J*. 2020;111(3):315-325.
32. Karim N, Afroj S, Lloyd K, et al. Sustainable personal protective clothing for healthcare applications: a review. *ACS Nano*. 2020;14(10):12313-12340.
33. Waste reduction. UCLA Health. Accessed August 23, 2021. https://www.uclahealth.org/sustainability/waste-reduction
34. Overcash M. A comparison of reusable and disposable perioperative textiles: sustainability state-of-the-art 2012. *Anesth Analg*. 2012;114(5):1055-1066.
35. Diggle A, Walker TR. Implementation of harmonized extended producer responsibility strategies to incentivize recovery of single-use plastic packaging waste in Canada. *Waste Manag*. 2020;110:20-23.

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