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CASE AND COMMENTARY: PEER-REVIEWED ARTICLE

How Should Biocontainment Balance Infection Control With Practice Sustainaibility?

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Abstract

This case and commentary canvasses clinical, ethical, and public health considerations about integrated infection control and sustainability efforts of biocontainment units (BCUs). BCUs protect the public's health during infectious disease outbreaks, including accounting for downstream health costs of byproducts of patient care that leave a system as waste. However, environmental costs of BCUs' operations tend to get less attention than BCUs' specialized design to contain and control highly infectious pathogens. Human health promotion and environmental protection are values that sometimes complement each other but sometimes conflict in BCU management. When these values conflict, stakeholders must mediate and balance their implications in terms of individuals' immediate short- and long-term needs for health care, public interest in pathogen control and containment, and environmental impact.

Case

Dr K is medical director of a 5-bed patient care biocontainment unit (BCU) within a 600-bed urban hospital. Dr K is ultimately responsible for all aspects of pathogen containment, which includes but is not limited to BCU design; policy and procedure implementation, evaluation, and modification; personal protective equipment (PPE) selection and policy and procedure evaluation; supply chain administration; and category A and B solid and liquid waste management. Dr K and BCU staff (eg, clinicians and infectious disease scientists) have designed BCU protocols focused solely on evidence-based infection prevention and control (IPC), which emphasize patient safety and risk reduction for health care workers (HCWs) above all else and have paid little attention to BCU operations' environmental impact.

Dr S was recently hired as the hospital's chief sustainability officer with a mandate to position the organization—through waste reduction and carbon footprint minimization—as a stewardship and sustainability leader. Dr S is considering multiple organizational changes to improve environmental impact and is collaborating with Dr K during regular meetings to discuss possible changes to BCU operations, such as transitioning to low-

flow automatic faucets to save water, transitioning to automatic hand dryers to reduce paper waste, and reducing disposable personal protective equipment (PPE) use, each of which measures Dr S sees as key to sustainability. Dr K listens and considers Dr S's points but is, overall, convinced that long-term emphasis on stewardship and sustainability undermines evidence-based IPC's short-term prioritization of HCW risk reduction and patient safety.

Dr S wonders how to respond to Dr K's concerns.

Commentary

Health care is one of the leading polluting industries in the United States due to energy used in manufacturing hospital resources and hospitals' energy use, emissions, and waste volume.[1] If the earth's ecosystem is to continue to support human health, then each health care facility needs to provide care in ways that will sustain the earth's ecosystem and prevent further destruction.[2] The environmental costs of operating a BCU have never been fully evaluated, to our knowledge, but are likely to be substantially higher than standard medical care due to the higher energy usage in BCU engineering controls and BCUs' reliance on disposable PPE. These specialized treatment units have isolation capacity or negative pressure rooms designed for patients with highly infectious respiratory diseases and high-efficiency particulate air filtration systems to ensure that microorganisms do not spread beyond the patient rooms.

The United States currently has 10 regional treatment centers with high-level isolation units or BCUs, which are networked to provide an infrastructure of readiness for managing suspected and confirmed special pathogen incidents across our nation's public health and health care delivery system.[3] The Consolidated Appropriations Act of 2022 increased funding for the Office of the Assistant Secretary for Preparedness and Response of the US Department of Health and Human Services (HSS) to establish 3 new regional treatment centers,[4] and HSS' fiscal year 2022 budget justification included increased funding for other national programs (eg, the Strategic National Stockpile) that specialize in containment care readiness,[5] thus potentially increasing medicine's carbon footprint.

BCUs have the responsibility of designing IPC guidelines to ensure patient and staff safety and containment of highly infectious diseases, and BCU staff conduct regular trainings and annual exercises to test protocols.[6] However, the core requirements of containment care are not designed with sustainability in mind. The increased usage of disposable PPE, waste packaging, and patient personal items that are disposed of or destroyed rather than sterilized or decontaminated is associated with environmentally detrimental BCU policies that are designed to protect HCWs and patients.

Integrated IPC and sustainability planning for BCUs is critical. Climate change is a named cause of the decreasing interval between emerging infectious diseases,[7,8,9,10] making BCUs a central resource for health security even if they also contribute to environmental degradation. This case commentary examines the ethical tension inherent in environmentally responsible IPC practices, identifies several risk-neutral interventions to advance sustainability goals without a negative impact on IPC, and emphasizes the need for research and policy that enable BCUs to safely prioritize sustainability in containment care.

Environmentally Responsible Infection Prevention and Control

Dr S's concern about sustainability and protection of the earth's ecosystems underscores that BCUs should reassess their planning and protocols to mitigate environmental degradation. Balancing IPC with sustainability requires BCUs to consider environmentally responsible health care—efforts that include, but are not limited to, reducing waste incineration, recycling nonhazardous wastes responsibly, reducing water usage,[11,12] and reducing the use of disposable PPE. While Dr S highlights available environmentally sustainable practices, Dr K must grapple with whether the evidence base for sustainable practices is sufficient to secure health and safety.

Not all sustainability or product stewardship practices may be compatible within a BCU. Some BCUs may opt for automated faucets and hand dryers, which may be at odds with infection control and unintentionally increase the spread of infectious organisms.[13] Although automated faucets may conserve water, BCU care requires robust hand washing with ample soap and water, which can be negatively impacted by an automated faucet; a foot pedal-controlled faucet allows for greater control of the water and lessens the likelihood of cross-contamination of handles.[14,15,16] Additionally, although paper towels are wasteful and, when used in a BCU, cannot be recycled, they do not risk creating bioaerosols of the organism of concern as do hand dryers. Drs K and S must balance waste reduction against IPC by determining what changes they can feasibly implement without severely comprising one or the other.

Generally speaking, when promoting human health and protecting the environment are seemingly in conflict, stakeholders must mediate between and balance immediate health outcomes and long-term health implications.[17] Adequately addressing health means recognizing the interdependence of humans within a broader ecosystem, including the environment.[18] Sustainability in BCUs leans on some of the same core notions that are central to health security: a commitment to securing population health, whether through highly infectious diseases containment care or through IPC guidelines devised with safety and sustainability in mind.

While technologies for environmentally responsible IPC might not be available now, a commitment to funding research, innovation, and policies to address sustainability measures that can be integrated more robustly into BCU units is needed. However, in the case in question, the immediate health and safety of patients, BCU staff, and the community at large should take precedence over environmental sustainability, and the sustainability officer should respect the final judgment of the unit physician leader.

Waste Reduction and Product Stewardship

Waste reduction. There are several strategies to reduce waste and thereby the environmental burden of BCUs.

- When possible, items that are reusable and can be effectively decontaminated between uses should be substituted for nonreusable or single-use items (eg, scrubs, batteries, gowns, respiratory protection equipment).[19,20,21,22]

- Generally, once materials enter a BCU, they are either disposed of as waste or decontaminated for reuse; the nature of BCU care does not leave much room for recycling. However, prior to being taken into a BCU, excess packaging can be removed and recycled or disposed of as standard municipal waste.[23]

- Depending on which disease or pathogen BCU-associated waste contains, BCU waste is classified as category A (infectious substances) or category B (regulated medical waste).[23] Onsite BCU capabilities to transform category A waste into category B waste, either through incineration or autoclaving, allows suspected or confirmed highly infectious waste to be downgraded and processed with other medical waste. Reducing category A waste decreases the need for extensive, bulky, permit-approved packaging and reduces the energy and resources expended transporting it to a facility that accepts category A waste for ultimate disposal.[23]

Product stewardship. In recent years, product stewardship and sustainability have gained more traction among professionals (eg, sustainability officers, industrial hygienists, occupational health and safety specialists) responsible for product selection in their workplace. Product stewardship ensures that "those who design, manufacture, sell and use consumer products take responsibility for reducing negative impacts to the economy, environment, public health, and worker safety."[24] It entails creating and selecting a product with regard to not only its primary use but also its lifecycle impacts (eg, energy and material consumed in development and packaging, waste generation, toxic substances)—in what is known as an extended producer responsibility (EPR).[24] This is a mandatory product stewardship policy that incentivizes manufacturers to integrate environmental considerations into the product lifecycle and transfers financial and management responsibility for products from the public sector to the manufacturer with government oversight.[24] While EPR policies can be adopted at the state or federal level, in the United States they are far more common at the state level.[25] In the aggregate, these strategies can further decrease environmental burden.

Conclusion

At the institutional level, sustainability and IPC are not mutually exclusive but require coordination and collaboration between the departments responsible for them to arrive at mutually beneficial solutions. Sustainability solutions implemented within a BCU must not increase the risk of infection to BCU staff, patients, and the community, and, as such, not all sustainability solutions at this time are appropriate for the BCU space. At the federal level, continued expansion of BCU capacity must also be followed by appropriate preparedness planning that includes research on innovative protections designed with safety and sustainability in mind and that models how PPE and other workplace administrative and engineering controls can simultaneously be effective and sustainable. Currently, BCU operations are necessarily resource intensive, but, in the long-term, it is critical to integrate environmentally responsible initiatives into containment care to minimize the impacts on the environment and to safeguard the health of future generations.

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Editor's Note

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Conflict of Interest Disclosure

The author(s) had no conflicts of interest to disclose.

The people and events in this case are fictional. Resemblance to real events or to names of people, living or dead, is entirely coincidental. The viewpoints expressed in this article are those of the author(s) and do not necessarily reflect the views and policies of the AMA.

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