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A pseudo-outbreak of *Burkholderia cepacia* complex in a Kentucky hospital

Chad C. Eldridge, DNP, RN[a,*], **Andrea H. Flinchum, MPH, BSN, RN, CIC, FAPIC**[a], **Doug Thoroughman, PhD, MS**[b,c], **Kevin B. Spicer, MD, PhD, MPH**[a,d]

[a]Healthcare-Associated Infection/Antibiotic Resistance Prevention Program, Division of Epidemiology and Health Planning, Kentucky Department for Public Health, Frankfort, KY

[b]Division of Epidemiology and Health Planning, Kentucky Department for Public Health

[c]Career Epidemiology Field Officer Program, Division of State and Local Readiness, Center for Preparedness and Response, Centers for Disease Control and Prevention, Atlanta, GA

[d]Division of Healthcare Quality Promotion, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, GA

Abstract

A cluster of *Burkholderia cepacia* complex cases from January to October 2020 among outpatients undergoing urologic procedures within a Kentucky hospital's operating rooms was investigated. This investigation included a laboratory look-back, chart reviews, exposure tracing, staff interviews, and direct observation of infection prevention and control practices. A significant protocol breach in a laboratory procedure led to contamination of surgical specimens submitted for culture with nonsterile saline. Pseudo-outbreaks often highlight gaps in infection control processes. Healthcare facilities can make substantial improvements in patient care quality and safety as they respond to identified gaps and improve systems and protocols.

Keywords

Infection prevention and control; Laboratory; Surgical specimen; Investigation; Culture of safety; Policy and procedure

INTRODUCTION

On October 12, 2020, infection preventionists working at a Kentucky regional acute care hospital notified the Healthcare-Associated Infection/Antibiotic Resistance (HAI/AR) Prevention Program at the Kentucky Department for Public Health (DPH) of a cluster of

[*]Address correspondence to: Chad C. Eldridge, DNP, RN, Healthcare-Associated Infection/Antibiotic Resistance Prevention Program, Division of Epidemiology and Health Planning, Kentucky Department for Public Health, 275 East Main Street, Frankfort, KY 40621. chad.eldridge@ky.gov (C.C. Eldridge).

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suspected *Burkholderia cepacia* complex (*B. cepacia* complex) infections among outpatients undergoing urologic procedures within the hospital's operating rooms. An internal investigation had revealed 5 cases that were epidemiologically linked through location, procedure, and/or staff between January 22, 2020 and October 8, 2020. With guidance from the HAI/AR team, facility staff conducted an investigation that included a laboratory look-back, chart reviews, exposure tracing, staff interviews, and direct observation of infection prevention and control practices. The Centers for Disease Control and Prevention (CDC) emphasizes the importance of discovering and investigating pseudo-outbreaks, including those caused by processing errors or contaminated diagnostic equipment, as the apparent infections often lead to unnecessary antibiotic prescriptions, diagnostic procedures, and other potentially harmful interventions to patients.[1]

Burkholderia cepacia complex is a group of Gram-negative β-proteobacteria found in soil and water that are often resistant to common antibiotics.[2,3] Although *B. cepacia* complex generally presents minimal medical risk to healthy individuals, these opportunistic pathogens can be devastating to those with impaired immune function and those with chronic lung conditions such as cystic fibrosis.[2–4] Transmission of *B. cepacia* complex occurs through person-to-person contact, contact with contaminated surfaces, and exposure to *B. cepacia* complex in the environment (eg, water, soil).[2] The spread of *B. cepacia* complex in the healthcare setting can occur through gaps in infection control.[4] Previous *B. cepacia* complex outbreaks have been linked to contaminated medical devices and contaminated liquids such as medications and saline solutions.[3,4] *B. cepacia* can survive for several months in solutions with low concentrations of nutrients as well as in products that contain antimicrobials such as mouthwashes and anesthetics.[3] Presentation of those infected can range from no symptoms to severe respiratory disease or sepsis.[2,5] Treatment of individuals infected with *B. cepacia* complex can be challenging due to its intrinsic resistance to many common antimicrobial agents.[2,3]

In a recent systematic review of *B. cepacia* complex healthcare associated outbreaks, a source was identified in 74% of the outbreaks. Over half (53%) of these were associated with medical solutions (eg, drugs, disinfectants) and another 17% with contamination of medical devices. The 111 published studies involved over 2300 patients and identified 20 outbreaks in Europe, 29 in Asia, 10 in the Middle East, 11 in South America, 3 in Australia or New Zealand, and 38 in North America.[6] A literature search revealed only 3 articles published since 2010 related to pseudo-outbreaks with *Burkholderia* species.

METHODS

A case was defined as a positive culture for *B. cepacia* complex in any specimen obtained from January 22, 2020 through October 8, 2020 during a urologic procedure at the facility. The investigation included examination of laboratory results, review of patient charts, interviews of staff, review of patient contacts and exposures, and direct observation of infection prevention and control practices.

RESULTS

The five *B. cepacia* complex positive cultures were obtained from specimens collected during urologic therapeutic and diagnostic procedures which included stent placement and removal, implantation of therapy devices, and tissue removal. Specimens submitted to the lab for culture included medical hardware, stents, and tissue. An additional culture positive for *B. cepacia* complex was identified during the defined time period. The additional culture was not from a urologic procedure and did not have a similar resistance pattern and was determined to be unrelated to the cluster.

The urologic procedures were performed by the same surgical team in the same surgical suite. There was no history of *B. cepacia* complex infections at other locations within the healthcare network where the surgeon performed similar procedures. Investigation of the knowledge and practice patterns of the surgical staff, their handling of equipment, and disinfection of the environment revealed no obvious or consequential infection control gaps. Three flexible cystoscopes and one flexible ureteroscope were cultured; all were negative.

During the investigation, laboratory staff reported a process breach in their broth production protocol. The staff had added the specimen to nonsterile saline designated for blood bank use to create a broth dilution for culture. Further investigation of the staff's use of the blood bank's bulk saline diluent identified additional process gaps necessitating remediation. It was found that the staff had reused the tubing and spigot from the previous bulk box of saline to access each new box, causing cross-contamination with each subsequent change. Additionally, the reusable saline bottles filled from the bulk diluent were not being cleaned routinely. The four bottles containing nonsterile saline from the previous diluent box, the most recent box of saline, and the reused tubing and/or spigot were cultured. All six were positive for *B. cepacia* complex and susceptibility patterns matched those of the clinical specimens. The facility's lab uses Vitek systems for both organism identification and for susceptibility testing. All isolates tested susceptible to ceftazidime, trimethoprim-sulfamethoxazole, and meropenem, and nonsusceptible to levofloxacin. Molecular typing of the patient specimens and the environmental samples would have strengthened the investigation; however, the specimens were not retained by the facility and thus were not available for additional testing. All specimens in question arrived at the laboratory after-hours due to late afternoon procedure start times. In each case, specimens arrived at the lab after the specialized microbiology laboratory technicians' shifts had ended, leaving after-hours staff to process all specimens meeting the case definition.

ACTIONS TAKEN

The critical intervention was to emphasize and reinforce that microbiology policies and procedures are to be strictly followed. The primary breach of protocol appeared related to two important factors. First, the staff lacked knowledge and understanding of the lab's policies and procedures. They did not appear to understand that saline obtained from the blood bank was nonsterile and would contaminate the specimens. Second, the blood bank's nonsterile saline setup was more convenient for the after-hours staff. The staff noted that the

blood bank's saline source could provide the large amount of diluent required for the tests more quickly and efficiently than if the saline was obtained from other sources.

The infection preventionists, the laboratory director, and the laboratory staff reviewed processes, developed action plans for improvement, and re-educated staff on policies and procedures. Several process corrections and improvements were developed. All nonsterile saline designated for use in the Blood Bank is to be used only in the Blood Bank for the purposes of blood typing. Each 20-liter bag of nonsterile saline is to be labeled with the date it was opened as well as the expiration date (30 days after opening), and each new bag requires a new spigot. The saline bottles that cultured positive in the Blood Bank were discarded and replaced with new bottles. Decontamination of the saline bottles used for blood typing will be completed weekly with 70% isopropyl alcohol decontamination solution with a de-ionized water rinse. Additionally, the importance of several key infection prevention and control measures were reinforced, including hand hygiene and cleaning and disinfection of workstations, high-touch items, and surfaces.[7]

DISCUSSION

Reason's Swiss Cheese model demonstrates how layers of errors from multiple organizational systems can align to increase the potential of patient harm.[8] The model suggests that patient safeguards are built into multiple layers of an organization's system and each layer is illustrated by a single piece of Swiss cheese. The holes in the Swiss cheese represent points of failure found in that layer of the system. Patient safety is more likely to be compromised when the holes from multiple layers align.

This pseudo-outbreak was the result of failures aligning at multiple levels within the system including at the organizational, technical, team, and individual levels. Organizational failures included the lack of policy awareness, education, and training for laboratory staff. Technical failures included an ongoing lack of proper maintenance to items found within the blood bank including saline boxes, bottles, spigots, and tubing. This error led to the successive transmission of *B. cepacia* complex from those items to others over the course of, at minimum, several months. The "holes in the cheese" represented by teams and individuals include a lack of training, poor communication, the misuse of opportunities of convenience, and the high amount of responsibility placed on nonspecialized, after-hours laboratory staff. Subsequently, over the course of 10 months, the holes in the cheese from multiple organizational layers aligned to increase the risk of harm to five patients. Fortunately, the individuals impacted by this pseudo-outbreak did not require change in pre- and post-procedure prophylactic antibiotic therapy and required no additional testing or procedures as they remained clinically stable. Additionally, there have been no further positive cultures identified at the facility after mitigating strategies were implemented.

Similar issues were noted in the most recent publication highlighting a pseudo-outbreak of *B. cepacia*. Three patients had positive blood cultures that were collected by members of a vascular access team in the Emergency Department of an acute care hospital. Members of this team were found to be using refilled ultrasound gel bottles that had been contaminated with *B. cepacia*.[9]

Pseudo-outbreaks can increase the risk of patient harm and lead to unnecessary treatments, procedures, and healthcare costs[1]. Pseudo-outbreaks often highlight gaps in infection control processes that allow healthcare facilities to make substantial improvements in patient care quality and safety.[1] The results of this investigation emphasize at least 4 important messages. These include: (1) necessity for healthcare facilities to actively review processes in sensitive areas; (2) the importance of ensuring that processes are clear and fully understood by all staff on all shifts; (3) the need for infection control awareness and training for those working in all healthcare patient impact areas, even when there is no direct patient contact; and (4) the importance of fostering a "culture of safety" in healthcare settings that provides "a blame-free environment where individuals are able to report errors or "near misses" without fear of reprimand or punishment."[10] It was the laboratory staff's willingness to report a critical breach in procedures that allowed the investigation to explain the *B. cepacia* complex cluster and identify additional areas for improvement.

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References

1. Christensen BE, Fagan RP. Health-care settings. In: Rasmussen SA, Goodman RA, eds. The CDC Field Epidemiology Manual. Oxford University Press; 2018:341–362.
2. Center for Disease Control [CDC]. *Burkholderia cepacia* in healthcare settings. 2021. Accessed August 1, 2021. https://www.cdc.gov/hai/organisms/bcepacia.html.
3. Tavares M, Kozak M, Balola A, et al. Adaptation and survival of Burkholderia cepacia and B. contaminans during long-term incubation in saline solutions containing benzalkonium chloride. Frontiers in Bioengineering and Biotechnol. 2020;8:1–18.
4. Brooks RB, Mitchell PK, Miller JR, et al. Multistate outbreak of *Burkholderia cepacia* complex bloodstream infections after exposure to contaminated saline flush syringes United States, 2016−2017. Clin Infectious Dis. 2019;69:445–449.
5. Held MR, Begler EM, Beardsley DS, et al. Life-threatening sepsis caused by *Burkholderia cepacia* from contaminated intravenous flush solutions prepared by a compounding pharmacy in another state. Pediatrics. 2006;118:e212–e215. [PubMed: 16785290]
6. Häfliger E, Atkinson A, Marschall J. Systemic review of healthcare-associated *Burkholderia cepacia* complex outbreaks: presentation, causes and outbreak control. Infect Prev Pract. 2020;2:1–6.
7. Arduino MJ, McDonnell G, et al. Disinfection and sterilization. In: Carroll KC, Pfaller MA, Landry ML, eds. Manual of Clinical Microbiology. 12th ed. Washington, DC: ASM Press; 2019:224–242.
8. CMPA. (2021). Quality improvement: Patient safety. The Canadian Medical Protective Association (CPMA), May 2021. Accessed August 1, 2021. https://www.cmpa-acpm.ca/en/education-events/good-practices/the-healthcare-system/quality-improvement-patient-safety.
9. Silmon T, Chapman D. What's in your bottle? Investigating a pseudo-outbreak of *Burkholderia cepacia*. [Abstract]. Am J Infection Control. 2019;47:58–59.
10. Agency for Healthcare Research and Quality (AHRQ). Patient Safety Network. 2021. Accessed August 1, 2021. https://psnet.ahrq.gov/primer/culture-safety.