



How did Active Epidemiological Surveillance Control a Hospital-Acquired Clostridium Difficile Outbreak? Associated Clinical and Economic Impact

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Abstract

Introduction: *Clostridium difficile* is a common cause of healthcare-associated infections, with significant clinical and economic impact. Epidemiological surveillance is a key tool in infection prevention and control programs for the early detection and control of outbreaks.

Objective: To describe an intrahospital outbreak of *Clostridium difficile* and to analyze its clinical and economic impact.

Methods: Investigation of a *Clostridium difficile* outbreak within the framework of institutional epidemiological surveillance. Study period: July 31, 2024 – August 23, 2024. The investigation included case identification and registration, temporal analysis using epidemic curves, and implementation of control measures. The cumulative incidence rate of infection during the outbreak period was compared with the historical incidence rate of the preceding period, and the relative risk (RR) was calculated. A control case was used to evaluate the associated costs.

Results: The index case was identified on July 31, 2024. Five secondary cases with a confirmed diagnosis of *Clostridium difficile* infection were recorded during the outbreak period. The historical incidence rate of *C. difficile* is $1/2279 = 0.000439$, and the rate during the outbreak period is $5/591 = 0.00846$, $RR = 0.00846/0.000439 = 19.27$ (95% CI: 2.26–164.73; $p = 0.0018$). $RR = 0.00846 / 0.000439 = 19.27$. A secondary case was taken and the increased costs due to *Clostridium difficile* infection were evaluated, resulting in ARS 5,047,006 and prolonging hospitalization for 11 more days.

Conclusion: *In this study, the outbreak generated a significant clinical and economic impact: +11 days of hospitalization and 19 times greater risk of infection. Active epidemiological surveillance made it possible to detect the outbreak early and control its spread.*

Infection Prevention and Control measures were essential to contain it and reduce its impact. Continuous surveillance, the antimicrobial stewardship program (ASP) / ASPs, hand hygiene, environmental cleaning, and training are key to preventing new outbreaks, highlighting the importance of infection prevention and control programs in patient safety.

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Introduction

Clostridium difficile (C. difficile) is a leading cause of healthcare-associated infection (HAI), particularly in hospitalized patients, older adults, and individuals exposed to broad-spectrum antibiotics. This infection is estimated to cause hundreds of thousands of cases annually worldwide, with significant morbidity and mortality and a substantial impact on healthcare systems. Several studies have shown that approximately 1 in 11 patients over 65 years of age with healthcare-associated C. difficile infection die within 30 days of diagnosis [1, 2]. Transmission of C. difficile occurs primarily via the fecal-oral route, through the ingestion of spores present in the hospital environment. These spores possess high resistance to adverse conditions and can persist for months on inanimate surfaces, bedding, medical equipment, and the hands of healthcare personnel, facilitating cross-transmission when cleaning, hand hygiene, and isolation practices are not optimal [3, 4].

Active epidemiological surveillance is an essential tool within Infection Prevention and Control (IPC) programs, as it allows for the early detection of unusual increases in cases, the identification of outbreaks, and the timely implementation of control measures. Scientific evidence supports that structured and sustained IPC programs significantly reduce the incidence of healthcare-associated infections (HAIs), mortality, and associated costs [5, 6]. This paper describes the investigation and control of a C. difficile infection outbreak that occurred in August 2024 in a general inpatient service, with emphasis on the measures implemented during and after the

outbreak, as well as the analysis of the clinical and economic impact of a case.

General objective

- To describe an intrahospital outbreak of *Clostridioides difficile*, analyzing the contribution of active epidemiological surveillance to its control and the associated clinical and economic impact.

Specific objectives

- To analyze the economic impact associated with a case of C. difficile infection acquired during the outbreak period in order to highlight the problem.
- To epidemiologically characterize the outbreak by analyzing cases according to time, place, and person.
- To Describe the prevention and control measures implemented to contain the outbreak.

Materials and methods

Study design

A descriptive observational study was conducted to investigate a *Clostridioides difficile* outbreak within the framework of institutional epidemiological surveillance. Study period: July 31, 2024 – August 23, 2024. The investigation included case identification and registration, temporal analysis using an epidemic curve, and implementation of control measures. Epidemiological surveillance tools were used, consisting of a case definition, an epidemiological investigation form, a case timeline, an epidemic curve, and a timeline. Information was obtained from medical records, microbiology laboratory records, pharmacy records, and the institutional information system.

The cumulative incidence rate of infection during the outbreak period was compared with the historical incidence rate of the previous period, and the relative risk (RR) was calculated. A control case was used to assess the associated costs. The affected patients were hospitalized in general wards, ranging in age from 20 to 91 years. During the outbreak, some patients required more than one readmission due to episodes of diarrhea, while others sought care in outpatient clinics. Additionally, two patients underwent surgical procedures and three received ultrasound services during the outbreak.

Case definition

Clostridium difficile infection was defined as any patient hospitalized during the study period with diarrhea and a positive result for *C. difficile* toxin in fecal matter, in the general inpatient service.

Data Collection

During the outbreak period, active surveillance of patients with diarrhea was implemented through clinical evaluation and microbiological studies. A survey of the service's care and environmental conditions was also conducted. Systematic *C. difficile* toxin was requested testing of all patients admitted or who develop diarrhea during hospitalization. Outbreak intervention measures were implemented immediately. A table was created to collect clinical, epidemiological, and administrative data: place, time, age, inpatient service, sample results, procedures performed, clinical evolution, readmissions.

Epidemiological research and implemented interventions

During the epidemiological investigation of the outbreak, a service assessment was conducted to identify factors that may have facilitated the transmission of *Clostridium difficile*. The following risk factors were identified:

- Reduction in the number of cleaning staff. High turnover of outsourced cleaning staff. Staff absences due to illness, leave, days off, and vacations.
- Reduced cleaning coverage during weekends (SADOFE).
- Incomplete coverage of training in hospital hygiene, hand hygiene and isolation measures, attributable to high staff turnover.

- Lack of essential supplies, such as hand sanitizer and soap dispensers, and deterioration of some items used in hospitals, including pillows.

These conditions were considered potential contributing factors to the intrahospital transmission of the microorganism.

Following confirmation of the outbreak, a package of prevention and control measures was implemented to interrupt the chain of transmission, which included:

- *C. difficile* toxin detection in patients with diarrhea upon admission or during hospitalization.
- Immediate implementation of contact precautions until microbiological results are available.
- Clinical and epidemiological monitoring of confirmed cases.
- Increased frequency of environmental cleaning and disinfection through the use of chlorinated solutions with sporicidal activity.
- Reinforcement of the proper use of personal protective equipment (gown and gloves).
- Intensified cleaning and disinfection of shared equipment, including infusion pumps, stethoscopes and electrodes.
- Reinforcement of hand hygiene, prioritizing washing with soap and water after caring for patients with suspected or confirmed *C. difficile* infection.
- Immediate communication of the outbreak to institutional authorities and healthcare staff through different information channels.
- Allocation of exclusive equipment for affected patients (stethoscope, thermometer and other frequently used devices).
- Immediate replenishment of alcohol and soap dispensers for hand hygiene and pillowcases.

Cost Analysis

A descriptive analysis of direct and indirect costs was performed based on a case that presented with *C. difficile* infection acquired during hospitalization, with two associated readmissions. **This case was used for cost analysis, comparing the expenses associated with the initial surgical procedure with the readmissions resulting from the infection associated with the *C. difficile* outbreak.** Costs included hospitalization, treatment, diagnostic studies, and supplies used during the case's care.

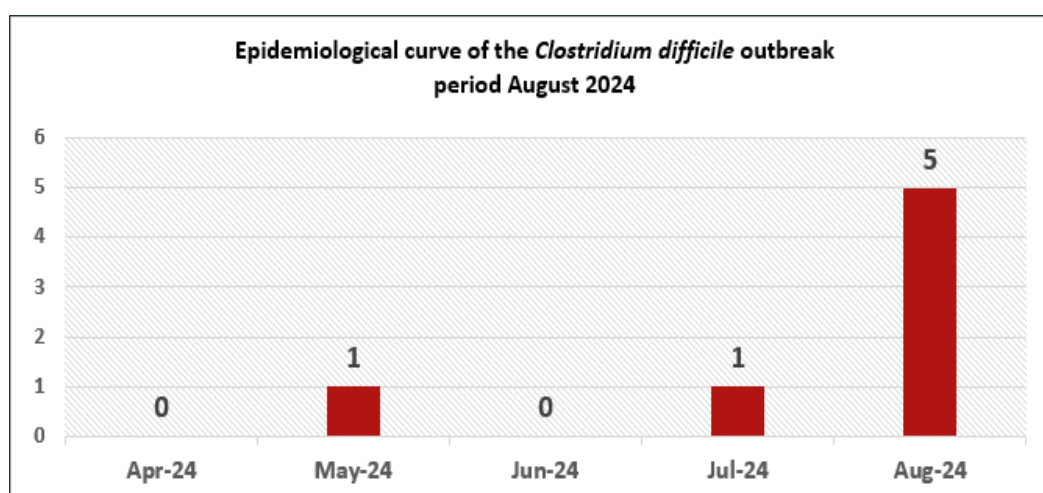
Results

Clostridioides difficile infection were identified during the outbreak period (between July 31 and August 23, 2024). The historical incidence rate of *C. difficile* is $1/2279 = 0.000439$, and the rate during the outbreak period is $5/591 = 0.00846$; $RR = 0.00846/0.000439 = 19.27$ (95% CI: 2.26–164.73; $p = 0.0018$).

The *C. difficile* outbreak was registered on August 9, 2024. Subsequently, active surveillance of patients with diarrhea was maintained through microbiological studies, with no new cases detected during the following two weeks, and the outbreak was considered controlled on August 23, 2024. **Figure 1. Epidemic curve of the *Clostridium difficile* outbreak, August 2024.**

- The implementation of isolation measures, reinforcement of hand hygiene, improvement in environmental cleaning and immediate replacement of alcohol and soap dispensers for hand hygiene and pillowcases allowed the outbreak to be controlled with no new subsequent cases.

Figure 1: Epidemic curve of the *Clostridium difficile* outbreak , August 2024.



Clinical and Economic Impact

Cost analysis of one case showed that *C. difficile* infection generated expenses approximately four times higher than the initial surgical procedure. We see a significant increase between the first surgical hospitalization compared to the re-hospitalization for CD-associated infection (ARS1,034.810 vs. ARS5,047.006).

Case description (Pat. X)

- First surgical hospitalization August 3, 2024(appendicitis surgery, 1 day): **ARS 1,034,810**
- Second re-admission August 6, 2024 (*C. difficile* infection, 8 days): **ARS 3,241,399**
- Third re-admission August 20, 2024 bloody diarrhea (recurrence, 3 days): **ARS 1,805,607**

The patient, upon readmission, was treated with Vancomycin and kept in contact isolation (continuous use of gloves and gowns, etc.). This case demonstrated the increased costs associated with *C. difficile* infection, resulting in ARS 5,047.006 and prolonging hospitalization for an additional 11 days. The patient died from *C. difficile* infection. During hospitalization, the infection developed, highlighting its potential severity in patients with comorbidities. Following the outbreak, epidemiological surveillance was maintained, and no new cases were recorded in the service until December 2024.

Figure 2. Graph comparing direct costs between surgery and readmissions associated with *Clostridioides difficile* infection . **Figure 3.** Evolution of the *Clostridium difficile* outbreak and control of the event, July–December 2024.

Indirect Costs

Unquantified indirect costs were identified, including loss of productivity, absenteeism, emotional costs (stress, anxiety, depression) and the need for care from family members or caregivers.

Figure 2: Graph comparing direct costs between initial surgical procedure and *Clostridium difficile* infection associated with outbreak.

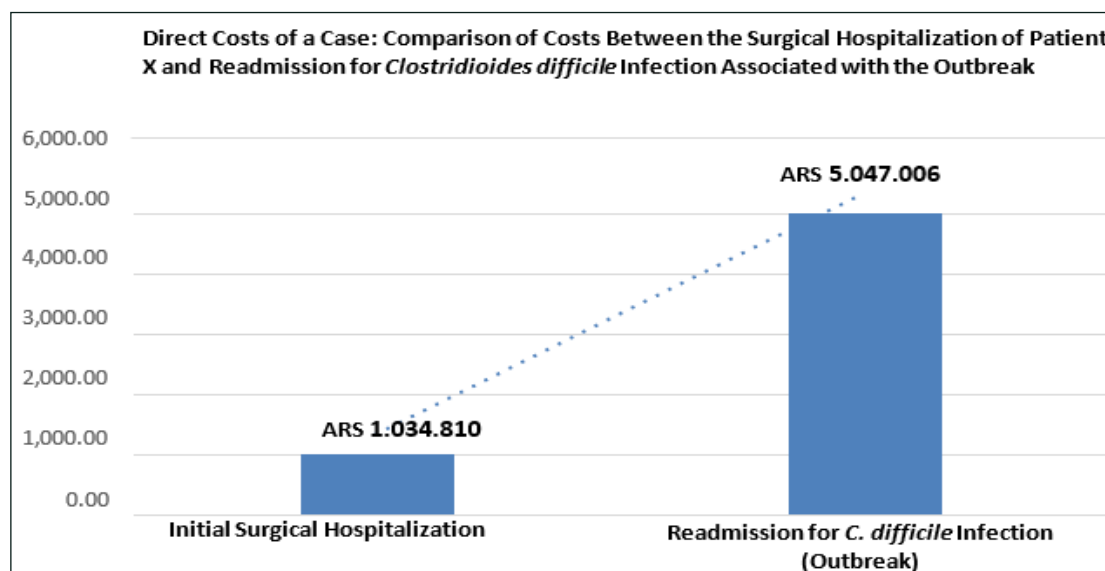
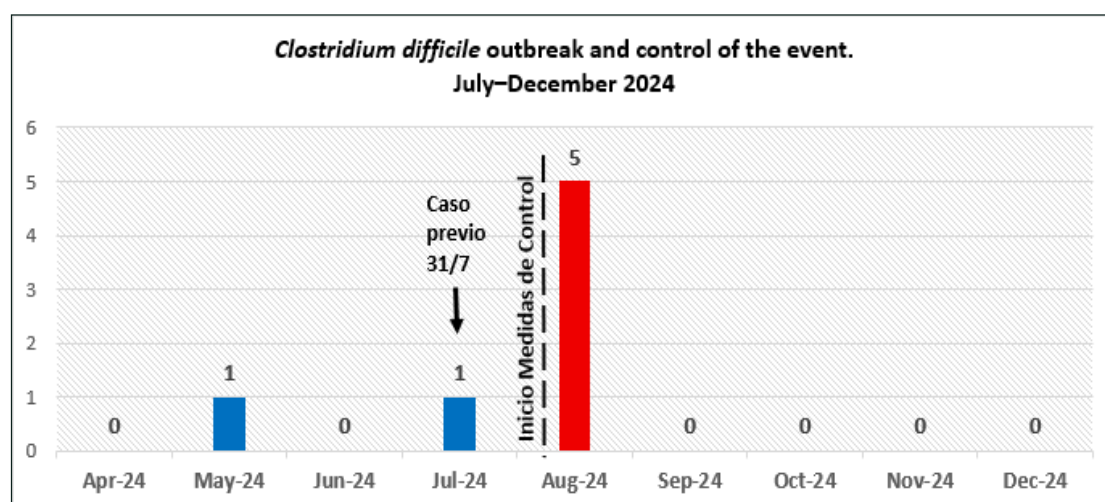


Figure 3: Evolution of the *Clostridium difficile* outbreak and control of the event, July–December 2024.



Discussion

The outbreak described highlights the central role of the hospital environment and infection control practices in the transmission of *Clostridium difficile*. The high relative risk (RR) observed during the outbreak period confirms a significant increase in the risk of infection associated with hospital-acquired exposure. Scientific literature supports the idea that poor environmental cleaning, insufficient staffing, high turnover of cleaning staff, and a lack of adequate supplies are risk factors for the transmission of *C. difficile* and other multidrug-resistant pathogens [7, 8]. In this context, active surveillance made it possible to detect the outbreak early and apply control measures that limited its spread. Economic analysis of a case demonstrates that healthcare-associated infections generate significantly higher costs than initial care, reinforcing the concept that IPC Programs should not be considered an expense, but a cost-effective investment [9-13].

Conclusion

This study showed that an outbreak of *C. difficile* had a significant impact on both the clinical course of patients and the use of healthcare resources. In the case analyzed, the infection resulted in an increase in healthcare costs of ARS 5,047,006 and an 11-day extension of hospitalization. Furthermore, patients exposed during the outbreak period had a 19-fold increased risk of infection. Epidemiological surveillance enabled the early detection of the outbreak, the timely implementation of control measures, and the limitation of its clinical and economic impact. These results highlight the strategic value of Infection Prevention and Control Programs as an essential tool for patient safety and the efficiency of the healthcare system. The findings reinforce the need to maintain active epidemiological surveillance, accompanied by continuous staff training, systematic audits of preventive practices, and the availability of resources to ensure the correct implementation of contact isolation measures. It is also a priority to strengthen antimicrobial stewardship programs (ASPs), along with hand hygiene and environmental cleaning and disinfection strategies. Integrating these interventions is fundamental to preventing new outbreaks, reducing *C. difficile* transmission, and lessening the clinical and economic burden associated with this infection.

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