CONCISE REPORT

CLABSI rates variation prior to and during the COVID-19 pandemic in two hospitals in Montreal, Canada

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ABSTRACT

We retrospectively analyzed central line-associated bloodstream infections (CLABSI) rates before and during the COVID-19 pandemic. While no significant increase in CLABSI rates was found, a rising trend was observed, particularly with gram-positive infections. Further research is needed to understand the relationship between health crises and CLABSI.

KEYWORDS

Catheter-related infections, COVID-19, healthcare-associated infections

INTRODUCTION

Central line-associated bloodstream infections (CLABSI) are preventable healthcare-associated infections (HAI) which contribute to increased mortality and incur additional costs estimated at nearly $50,000 per case (AHRQ, 2017).

In Quebec, from 2007 to 2018, the CLABSI incidence rate (per catheter-days) decreased from 1.10 to 0.76 in university adult intensive care units (ICUs), and from 3.5 to 2.18 in neonatal ICUs (CINQ, 2019). However, an increase was anticipated during the COVID-19 pandemic, due to the higher acuity and longer stays of hospitalized COVID-19 patients, with changes in nursing-related practices, and a decrease in low-risk central line days (McMullen *et al*, 2020).

In fact, during the pandemic, hospitals faced staffing and resource shortages, high turnover, a consistent surge of high-acuity patients, continuously changing recommendations, as well as "pandemic fatigue" (decreased motivation to follow recommended preventive practices) (Fakih *et al*, 2022; Krauss *et al*, 2022). Given these factors, we hypothesized that a higher rate of CLABSI events would occur during the COVID-19 pandemic. Sepcifically, we examined change in CLABSI rates and associated bacteria before and during the pandemic.

METHODS

Study setting and design

We retrospectively analyzed CLABSI rates and associated bacteria before the COVID-19 pandemic (March 2018 to February 2020) and during the COVID-19 pandemic (March 2020 to March 2021) in four units across two hospitals in Montreal, Quebec, Canada. CLABSI surveillance is an ongoing and prospective process performed by the Infection Prevention and Control (IPAC) team, using standardized published definitions

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from the province of Quebec, which are based on the Centers for Disease Control and Prevention's National Healthcare Safety Network definitions (Fontela *et al*, 2011).

Case identifications

Using the CLABSI line list from IPAC, we selected cases identified between March 2018 and March 2021 with admission to the adult (≥18 years) ICU in Hospital 1, or on the paediatric hematology-oncology (HO) unit, the paediatric intensive care unit (PICU) and neonatal intensive care unit (NICU) for children less than 18 years of age (Hospital 2) were selected. CLABSI events, associated organisms, and patient-days and catheter-days by 28-day periods were identified from the nosocomial surveillance system implemented at both hospitals. The pre-pandemic period was compared with the pandemic period. Data were deidentified and evaluated as aggregates.

Analysis

CLABSI rates and rate ratios (RRs) with 95% confidence intervals (CIs) from the period before and during the COVID-19 pandemic were estimated by Poisson regression models. The time period (pre-pandemic vs. during pandemic) was treated as an independent variable, with the number of CLABSI cases as the outcome, and the length of catheter days as the offset item. Stratified analyses by CLABSI-associated organisms and hospitals/units were further conducted. A p-value < .05 was considered statistically significant. All analyses were performed using R (version 4.0.5, R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

CLABSI rates

During the pandemic, the ratio of catheter-days to patient-days increased from 0.57 to 0.63, reflecting an increase in catheter use. Although a trend towards a higher overall CLABSI rate was observed during the pandemic period compared to the pre-pandemic period, this increased trend was not statistically significant (2.58 vs. 2.27 per 1,000 catheter-days, RR: 1.13, 95% CI: 0.85–1.50, $p = 0.37$).

Bacteria type associated with CLABSI

Gram-positive bacteria CLABSI rate per 1,000 catheter-days increased by 35% (1.62 vs. 1.02 per 1,000 catheter days, RR: 1.35, 95% CI: 0.92–1.99, $p = 0.12$), while the rate associated with Gram-negative bacteria slightly decreased (0.69 vs. 0.85 per 1,000 catheter days, RR: 0.69, 95% CI: 0.41–1.15, $p = 0.17$). *Candida sp.*-associated CLABSI rates were lower during the pandemic period (0.36 per 1,000 catheter days) compared to the pre-pandemic period (0.40 per 1,000 catheter days, RR: 0.55, 95%: 0.23-19, p=0.15).

Stratified analyses

In the stratified analyses, we found that CLABSI rates were lower in the adult ICU compared to the paediatric units.

Table 1: Central-Line-Associated Bloodstream Infection (CLASBI) rate before and during the COVID-19 pandemic

	Pre-COVID-19				Peri-COVID-19				Rate ratio (Ref. Pre-COVID-19)	
	Cases	Catheter days	Catheter/ Patient days	Rate per 1,000 catheter days	Cases	Catheter days	Catheter/ Patient days	Rate per 1,000 catheter days	In catheter days	*p*-value
CLABSI overall	125	55,123	0.57	2.27	78	30,258	0.63	2.58	1.13 (0.85, 1.50)	0.37
CLABSI associated with Gram+	56			1.02	49			1.62	1.35 (0.92, 1.99)	0.12
CLABSI associated with Gram-	47			0.85	21			0.69	0.69 (0.41, 1.15)	0.17
CLABSI associated with *Candida*	22			0.40	8			0.26	0.55 (0.23, 1.19)	0.15
CLABSI in adult ICU	46	21,207	0.92	2.17	21	12,094	0.91	1.74	0.80 (0.47, 1.32)	0.40
CLABSI in HO	33	14,591	0.89	2.26	26	7,270	0.93	3.58	1.58 (0.94, 2.64)	0.08
CLABSI in NICU	30	10,989	0.25	2.73	18	6,248	0.30	2.88	1.06 (0.58, 1.87)	0.86
CLABSI in PICU	16	8,336	0.61	1.92	13	4,646	0.73	2.80	1.46 (0.69, 3.03)	0.31

When comparing pre-pandemic and pandemic periods, the paediatric hematology-oncology unit appeared to show increased rates of CLABSI events, while not being significant (3.58 vs. 2.26 per 1,000 catheter days, RR: 1.58, 95% CI: 0.94–2.64, $p = 0.08$). The increased trend in paediatric hematology-oncology unit was exclusively observed in the Gram-positive bacteria CLABSI rate (2.06 vs. 1.17 per 1,000 catheter days, RR: 1.77, 95% CI: 0.87–3.55, $p = 0.11$). Similarly, a trend towards increased CLABSI rates was observed in the PICU (2.80 vs. 1.92 per 1,000 catheter days, RR: 1.46, 95% CI: 0.69–3.03, $p = 0.31$). However, CLABSI rates in the ICU and NICU during the pandemic were similar to those in the pre-pandemic period (Table 1).

DISCUSSION

This study examined changes in CLABSI rates and the associated pathogen before and during the pandemic. Unlike the findings in a recent systematic review (Satta *et al*, 2023), our study did not identify a statistically significant increase in CLABSI rates. The COVID-19 pandemic posed unique challenges for healthcare professionals, where a greater attention to IPAC practices was required in order to decrease the risk of COVID-19 transmission. For example, Wee *et al.* found an increased adherence to the CLABSI bundle during the pandemic (Wee *et al*, 2021). Moreover, some hospitals reported that having a robust quality improvement program in place prior to the pandemic helped to maintain focus on HAI prevention activities (Krauss *et al*, 2022). In Quebec, since 2014, new strategies have been developed to ensure compliance with CLABSI prevention bundles and assess their effectiveness (CINQ, 2019).

However, the trend towards a higher overall CLABSI rate observed during the pandemic was consistent with other data from Quebec (INSPQ, 2024). Notably, we found an increase in the rate of Gram-positive bacteria associated CLABSI, which aligns with findings from other studies (Satta *et al*, 2023). In fact, a systematic review highlighted that several studies reported a rise in enterococcal infections during the pandemic (Satta *et al*, 2023), with some authors even proposing a new pathogen-to-pathogen interaction between SARS-CoV-2 and *Enterococcus spp*. within the human microbiome (Toc *et al*, 2022).

In the stratified analyses, we found that CLABSI rates were lower in the adult ICU compared to the paediatric units during pandemic, consistent with other Quebec data (INSPQ, 2024). This may be explained by the fact that paediatric units were less impacted by the pandemic, as children generally developed less severe disease than older adults. Additionally, it is possible that children requiring admission had more underlying conditions, such as immunocompromised states, increasing their risk of CLABSI.

Our study has some limitations. First, no data on care bundle compliance were collected during the study, neither was data on the average time to CLABSI onset during the two periods, which could have helped confirm the impact of prolonged hospitalization during the pandemic. Additionally, this study was limited to two tertiary care hospitals, which may restrict generalizability. The pandemic context may have introduced variability in surveillance practices and reporting. Infection prevention and control practices also likely evolved over the course of the pandemic period. Finally, in an effort to preserve bed capacity for potential admissions, Quebec limited surgeries and overall hospital activities, which likely impacted the case load across units.

CONCLUSION

In conclusion, although our study did not find a significant increase in CLABSI rates, the results point to a rising trend during the pandemic. Maintaining adherence to CLABSI prevention strategies is crucial, especially in times of crisis. Healthcare facilities should strengthen quality improvement programs and monitor microbiological trends to adjust practices and prevent future CLABSI surges. Further research is needed to better understand the relationship between surges, crises, and CLABSI rates. Additionally, qualitative studies should investigate healthcare workers' perceptions of IPAC measures, and identify factors that could enable high-quality care.

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