are commonly used inappropriately. Azithromycin is a broad-spectrum antimicrobial commonly used inappropriately in clinical practice for nonspecific upper respiratory infections (URIs). In 2017, a medication use evaluation at Grady Health System (GHS) revealed that 81.4% of outpatient azithromycin prescriptions were inappropriate. In an attempt to optimize outpatient azithromycin prescribing at GHS, a tool was designed to direct the prescriber toward evidence-based therapy; it was implemented in the electronic medical record (EMR) in January 2019. **Objective:** We evaluated the effect of this tool on the rate of inappropriate azithromycin prescribing, with the goal of identifying where interventions to improve prescribing are most needed and to measure progress. **Methods:** This retrospective chart review of adult patients prescribed oral azithromycin was conducted in 9 primary care clinics at GHS between February 1, 2019, and April 30, 2019, to compare data with that already collected over a 6-month period in 2017 before implementation of the antibiotic prescribing guidance tool. The primary outcome of this study was the change in the rate of inappropriate azithromycin prescribing before and after guidance tool implementation. Appropriateness was based on GHS internal guidelines and national guidelines. Inappropriate prescriptions were classified as inappropriate indication, unnecessary prescription, excessive or insufficient treatment duration, and/or incorrect drug. **Results:** Of the 560 azithromycin prescriptions identified during the study period, 263 prescriptions were included in the analysis. Overall, 181 (68.8%) of azithromycin prescriptions were considered inappropriate, representing a 12.4% reduction in the primary composite outcome of inappropriate azithromycin prescriptions. Bronchitis and unspecified upper respiratory tract infections (URI) were the most common indications where azithromycin was considered inappropriate. Attending physicians prescribed more inappropriate azithromycin prescriptions (78.1%) than resident physicians (37.0%) or midlevel providers (37.0%). Also, 76% of azithromycin prescriptions from nonacademic clinics were considered inappropriate, compared with 46% from academic clinics. **Conclusions:** Implementation of a provider guidance tool in the EMR lead to a reduction in the percentage of inappropriate outpatient azithromycin prescriptions. Future targeted interventions and stewardship initiatives are needed to achieve the stewardship program's goal of reducing inappropriate outpatient azithromycin prescriptions by 20% by 1 year after implementation.

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Incidence and Risk Factors of Surgical Site Infection Following Pediatric Neurosurgery

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Background: Neurosurgeries are at high risk of surgical site infections (SSI), a complication associated with increased morbidity, mortality, and cost. Our aim was to measure SSI incidence and risk factors following pediatric neurosurgery at CHU Sainte-Justine, the provincial center for pediatric craniofacial surgery in Québec, Canada. **Methods:** Retrospective cohort study of all patients with elective neurosurgery performed at CHUSJ between October 2014 and October 2018. Medical records were reviewed to compare demographics, clinical presentations, and outcomes of patients. SSIs occurring within 30 days of a procedure without implant and up to 90 days with implant, were identified. SSI incidence was measured in patient years, and risk factors were assessed using univariate logistic regressions. **Results:** In total, 379 patients were included with an overall SSI incidence of 3.96 patient years. We found a higher SSI incidence in 2014–2015 compared to 2016–2018 (1.82 vs 4.83 patient years). The median age was 3.90 years, and cases seemed younger than controls (1.45 vs 4.15 years). No difference between groups was found for sex, body mass index, prematurity, and length of hospitalization. The proportion of deep SSIs was greater than superficial SSIs (53.3% vs 46.7%). Cases were more likely to present with a more severe ASA score, previous history of neurosurgery, neurological conditions, and pulmonary conditions than controls: OR, 3.90 (95% CI, 1.36–11.49); OR, 2.59 (95% CI, 0.88–7.40); OR, 2.77 (95% CI, 0.98–8.41), and OR, 3.21 (95% CI, 0.86–9.94), respectively. Among patients with history of neurosurgery, a higher proportion of cases experienced a cerebrospinal fluid leak (28.6% vs 2.2%). Most patients (85.8%) received preoperative prophylactic antibiotic. Of those, 49.3% were considered appropriate based on antibiotic and timing of administration. When antibiotic dosage was also considered, the number of patients who received an appropriate antibiotic therapy decreased radically. **Conclusions:** Patients with comorbidities, especially neurological and pulmonary conditions, are at higher risk of SSI after neurosurgery. We are currently working on a detailed analysis to explain the increase in SSI incidence after 2016. Finally, prophylactic antibiotic therapy needs to be improved and its impact on SSI rates needs to be monitored.

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Incidence of Mucosal Barrier Injury Bloodstream Infections Reported to the National Healthcare Safety Network

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Background: The NHSN collects data on mucosal barrier injury, laboratory-confirmed, bloodstream infections (MBI-LCBIs) as part of bloodstream infection (BSI) surveillance. Specialty care areas (SCAs), which include oncology patient care locations, tend to report the most MBI-LCBI events compared to other location types. During the update of the NSHN aggregate data and risk models in 2015, MBI-LCBI events were excluded from central-line–associated BSI (CLABSI) model calculations; separate models were generated for MBI-LCBIs, resulting in MBI-specific standardized infection ratios (SIRs). This is the first analysis to describe risk-adjusted incidence of MBI-LCBIs at the national level. **Methods:** Data were analyzed for MBI-LCBIs attributed to oncology locations conducting BSI surveillance from January 2015 through December 2018. We generated annual national MBI-LCBI SIRs using risk models developed from 2015 data and compared the annual SIRs to the baseline (2015) using a mid-P exact test. To

Table 1.

Year	Number of Locations	Central Line Days	Number of Events		SIR	p-value	95% CI for SIR	
			Observed (#MBIs)	Predicted			Lower	Upper
2015	2434	2,552,666	2,515	2381.535	1.056	0.0069	1.015	1.098
2016	2592	2,697,045	2,902	2550.229	1.138	0.000	1.097	1.18
2017	2714	2,749,553	3,584	2603.467	1.377	0.000	1.332	1.422
2018	2823	2,859,820	3,723	2730.778	1.363	0.000	1.32	1.408

account for the impact of an expansion in the MBI-LCBI organism list in 2017 from 489 organisms (32 genera) to 1,003 organisms (89 genera), we removed the MBI-LCBI events that met the newly added MBI organisms and generated additional MBI SIRs for 2017 and 2018. **Results:** The annual SIRs remained above 1 since 2015, indicating a greater number of MBI-LCBIs identified than were predicted based on the 2015 national data (Fig. 1). Each year's SIR was significantly different than the national baseline, and the highest SIR was observed in 2017 (SIR, 1.377). In 2017, 12% of MBI events were attributed to an organism that was added to the MBI organism list, and in 2018 it was 10%. After removal of MBIs attributed to the expanded organisms, the 2017 and 2018 SIRs remained higher than those of previous years (1.241 and 1.232, respectively). **Conclusions:** The distinction of MBI-LCBIs from all other CLABSIs provides an opportunity to assess the burden of this infection type within specific patient populations. Since 2015, the increase of these events in the oncology population highlights the need for greater attention on prevention strategies pertinent to MBI-LCBI in this vulnerable population.

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Incidence Rate and Risk Factors for Recurrent *Clostridium difficile* Infection in Pediatric At-Risk Groups

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Background: Recurrence rates and risk factors of *Clostridium difficile* infection (CDI) are well established in adults, though little is known about the rate of recurrent CDI (rCDI) within the pediatric population. The purpose of this study was to identify rates and risk factors of rCDI in pediatric at-risk groups to guide the optimization of targeted prevention efforts against disease recurrence. **Methods:** We report on the ongoing retrospective cohort study of pediatric patients at the CHU Sainte-Justine with a laboratory confirmed diagnosis of CDI between April 1, 2012, and March 31, 2017. Incidence rates of rCDI were obtained per 100 cases. Frequencies of rCDI were compared using the Fisher exact test. Univariate and multivariate logistic regression were used to identify risk factors for rCDI. Two-tailed $P < .05$ was considered significant. All statistical calculations were performed using R version 3.5.2 software. **Results:** Of 80 patients analyzed with CDI, 16 had rCDI, for a rCDI rate in this population of 20%. Most recurrences were observed in secondarily immunosuppressed patients including, but not limited to, oncology patients undergoing chemotherapy and/or radiotherapy (30.4%) and patients with inflammatory bowel disease (IBD, 29.2%). Patients that were administered vancomycin orally (PO) had recurrent infection less often than patients that administered metronidazole PO or IV (8.3% vs 23.4%, respectively). This trend was observed in all at-risk patient groups. Patients with secondary immunodeficiency had 7.4 times increased odds of recurrence compared to nonimmunodeficient patients (adjusted OR, 7.43,; 95% CI, 1.84–50.4; $P = .0126$). **Conclusions:** Initial vancomycin PO therapy seems to be associated with a lower risk of recurrence. Pediatric patients with IBD and with secondary immunodeficiency are at increased risk of rCDI. Given that these populations have an increased underlying risk of diarrhea, it would be worthwhile to determine whether toxin is actually produced (EIA testing) and to prioritize prevention efforts.

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Incidence Trends of Central-Line–Associated Bloodstream Infections in Acute-Care Hospitals, NHSN, 2009–2018

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Background: Central-line–associated bloodstream infections (CLABSIs) are an important cause of healthcare-associated morbidity and mortality in the United States. CLABSI surveillance in the CDC NHSN began in 2005 and has been propelled by state CLABSI reporting requirements, first introduced in 2005, and subsequently by the CMS requirements for intensive care units (ICUs) in 2011 and select ward locations in 2015. Although trend analyses were previously reported, no recent assessment of the NHSN CLABSI incidence rate changes has been performed. In this analysis, we evaluated trends in CLABSI rates in nonneonatal ICUs and all wards reported from acute-care hospitals. **Methods:** CLABSI rates, including blood stream infections attributed to mucosal barrier injury reported to the NHSN from 2009 to 2018, were analyzed. To evaluate trends in CLABSI incidence and to account for the potential impact of definitional changes in catheter-associated urinary tract infections (CAUTIs) that indirectly impacted CLABSI rates, as well as the CMS mandate for select wards, we conducted an interrupted time-series analysis using negative binomial random-effects modeling with an interruption in 2015. ICUs and ward locations were analyzed separately. Models were adjusted for patient care location type and hospital-level characteristics: hospital type, medical affiliation, teaching status, bed size, number of ICU beds, and average length of inpatient stay. Random intercept and slope models were used to account for differential baseline incidence and trends among reporting hospitals. **Results:** The overall crude incidence of CLABSI per 1,000 central-line days decreased from 1.6 infections in 2009 to 0.9 infections in 2018,

Table 1: Overall Crude and stratified CLABSI incidence rates/1,000 central line days from ACHs, non-neonatal ICUs and Wards, 2009-2018

	Overall				*ICU*				*Ward*			
Year	No. of hospitals	No. of events	No. of central line days	CLABSI RATE	No. of locations	No. of events	No. of central line days	CLABSI RATE	No. of locations	No. of events	No. of central line days	CLABSI RATE
2009	1,306	9,772	6,039,399	1.618	2,413	7,149	4,240,072	1.686	1,917	2,623	1,799,327	1.458
2010	2,059	11,746	9,403,184	1.249	3,581	7,147	5,496,411	1.300	4,071	4,599	3,906,773	1.177
2011	3,224	16,352	15,097,516	1.083	5,500	10,068	9,191,058	1.095	5,353	6,284	5,906,458	1.064
2012	3,235	16,508	15,773,453	1.047	5,546	9,867	9,167,675	1.076	6,310	6,641	6,605,778	1.005
2013	3,267	17,149	17,116,596	1.002	5,567	9,127	9,206,605	0.991	7,504	8,022	7,909,991	1.014
2014	3,289	17,365	18,983,677	0.915	5,505	8,220	9,196,847	0.894	9,693	9,145	9,786,830	0.934
2015	3,496	27,353	25,674,293	1.065	5,537	9,929	9,307,357	1.067	16,701	17,424	16,366,936	1.065
2016	3,494	25,713	25,512,882	1.008	5,525	9,341	9,177,308	1.018	17,098	16,372	16,335,574	1.002
2017	3,556	24,077	24,854,592	0.969	5,533	8,528	8,888,416	0.959	17,508	15,549	15,966,176	0.974
2018	3,527	22,373	24,471,423	0.914	5,474	7,487	8,606,746	0.870	17,879	14,886	15,864,677	0.938