Methods

Design/Ethical Issues

This was a retrospective, observational study of critically ill children and babies in the PICU before and after QI efforts to reduce CLABSI. No experimental practices or equipment were involved.

Study Population/Setting

The study population included all patients admitted to the Pediatric Intensive Care Units (PICUs) Children's Hospitals and Clinics of Minnesota (CHC-M) from 1 January 2005 to 30 June 2011. A general PICU is present on both the St. Paul and Minneapolis campuses of CHC-M. The Minneapolis campus also has a Cardiovascular PICU.

Year	CLABSI	CLDs	Rate/1000 CLDs	Rate ratio (95% CI)	p-value (Poisson)
2005	14	5022	2.8		
2006	20	4595	4.4	1.56 (0.75, 3.34)	0.23
2007	12	4954	2.4	0.56 (0.25, 1.20)	0.11
2008	4	5587	0.7	0.29 (0.07, 0.97)	**0.04**
2009	5	6387	0.8	1.09 (0.24, 5.51)	1
2010	5	7206	0.7	0.89 (0.20, 3.85)	1

	CLABSI	Other patients	p-value*
Age at admission (month)	25.0 (0, 220)	27.0 (0, 607)	0.04
Gender, male, n (%)	24 (50%)	2925 (54.2%)	0.557
PIM2ROM, median (range)	3.18 (0.28, 26.9)	1.17 (0, 99.1)	<0.001
PRISM3, median (range)	4.2 (0.11, 60.2)	0.91 (0.03, 98.33)	0.009
Number of CLs, n (%) >1	18 (40.9%)	485 (11.5%)	<0.001

There are separate nursing staffs for each of the PICUs, but the medical staff works at all three units. All PICUs are staffed 24/7 by board-certified/eligible intensivists. The same infection preventionist works with all three units. This study was approved (#0401-010) by the CHC-M Institutional Review Board.

Planning the Intervention

We assumed that most cases of hospital-acquired infections were associated with centrally-placed intravascular lines (IVs). To prevent central line associated bloodstream infections (CLABSIs) we sought to increase compliance with established infection prevention principles: hand hygiene,[5,26] central line insertion and maintenance bundles of care,[27,28] use of 2-3% chlorhexidine for skin and IV hub cleansing,[29,30] changing staff perceptions of infection prevention,[31,32] increasing family engagement,[33] and reducing the duration of central IVs and parenteral nutrition.

Interventions

In 2005, CHC-M participated in a CHCA lead collaborative QI effort to reduce CLABSIs.. As part of the collaborative, we have shared treatment process and outcome data, implemented numerous interventions to prevent CLABSIs and participated in routine conference calls and face-to-face meetings. Specific interventions and the year of their introduction are listed in Table 1.

Planning the Study of the Intervention

Our primary outcome measure was CLABSI, using the Centers for Disease Control/National Healthcare Safety Network's (NHSN) Surveillance definitions.[36,37] The NHSN definition of CLABSI changed in 2008,[37] and we retrospectively adjusted our rates based on the new definition. Secondary outcomes were length of stay, catheter days per patient, and overall mortality. We monitored hand hygiene, compliance with central line insertion and maintenance bundles, days of central line and parenteral nutrition use, and the percentage of patients receiving central IV lines.

Methods of Evaluation

We used data from two sources. CHC-M participates in the Virtual Pediatric Intensive Care Unit Performance System. Clinical and administrative data are abstracted from the medical record at discharge by a specially trained database manager using standardized definitions. Data was then entered into the VPS database. CHC-M's own data was then downloaded for this study. The second source of information was CHC-M's records of CLABSIs, and reports of compliance with best practices, such as use of line insertion and maintenance bundles of line care. After matching records from the two data sources, we de-identified the data.

Statistical Analysis

We used 2005 as the baseline year, since that was the year that we began to participate in the collaborative. Interventions began in 2006 We compared outcomes in

2005 with those from 2006-2011 using Chi-square tests for dichotomous or categorical variables and rank sum tests for continuous variables, which were positively skewed. To adjust for covariates, we used multiple logistic regression. Potential covariates included the demographic variables presented in Table 2. Significance required a two-sided P-value <0.05. This study had 91% power to detect a 20% difference in nosocomial infections rates in the two eras at alpha = 0.05. Statistical analyses were performed using Stata version 11.1 (College Station, TX).

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