



**Fig. 1.** Analysis of blood culture contaminated and positive rates for the pre-study period compared with the study period. A. Blood culture contaminated rates comparing monthly for the study period compared with the pre-study period. B. Proportions of blood culture contaminated and positive rates before and after implementing a quality control circle.

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# Surgical site infections and temperature in the operating theater—Challenges for infection control in developing countries

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*To the Editor*—Healthcare-associated infections (HAIs), and surgical site infections (SSIs) in particular, are more frequent in developing countries compared to Europe and the United States.<sup>1,2</sup> Poor staff adherence to infection control guidelines in the operating theater has been blamed,<sup>3</sup> but environmental factors may also be involved in high SSI rates.<sup>4</sup>

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In a study conducted from 2011 through 2016, we identified an association of external environmental temperature and the individual risk of SSI in a teaching hospital in inner Brazil.<sup>5</sup> That association was especially strong for higher temperatures (ie, above the 75th or 90th percentile of daily temperatures). Since previous studies reported “summer peaks” of SSI in the United States,<sup>6</sup> we hypothesized that ecological changes in the patients’ microbiota could account for our findings.

This study complements our previous research; this time we collected temperatures *inside* the operating theater. It was conducted in the teaching hospital of Botucatu Medical School, a 450-bed facility that provides tertiary care for an area comprising 500,000 inhabitants. The hospital is located in a tropical area (22°

**Table 1.** Effect of 3-Day Average Temperature and Other Parameters on the Risk of Surgical Site Infections—Multivariable Logistic Regression Model<sup>a</sup>

Factor	OR (95% CI)	P <sup>b</sup>
<b>Temperature (°C)</b>	<b>1.07 (1.01–1.14)</b>	<b>.04</b>
Time from admission to surgery, d	1.00 (1.00–1.00)	.85
Male gender	1.04 (0.85–1.27)	.68
<b>Age (by decade)</b>	<b>1.09 (1.04–1.13)</b>	<b>&lt; .001</b>

Note. OR, odds ratio; CI, confidence interval.

<sup>a</sup>The model was also adjusted for surgical specialty.

<sup>b</sup>Significant ( $P < .05$ ) associations are presented in bold.

53°21′S, 48°29′40″W), and ~7,000 surgical procedures are performed there annually. The operating theater is air-conditioned.

We collected the average temperatures for the 3 days preceding each surgical procedure from July 2017 through June 2018. All patients undergoing surgeries during that period were surveilled for SSI during admission and postdischarge for 30 days. Multivariable logistic regression models were used to assess the association of temperature and the risk of SSI. Models were adjusted for surgical specialty, time of admission prior to the surgery, and patient demographic data. Analyses were performed using SPSS version 20 software (IBM, Armonk, NY, USA).

A total of 6,752 patients underwent surgery in the study period. The overall SSI rate was 8.2%. Average temperatures for surgical procedures that resulted in an SSI (23.8°C) were slightly but significantly higher than for other procedures (23.6°C;  $P = .04$ ). The results of the logistic regressions are presented in Table 1. Briefly, temperature was associated with higher risk of SSI in adjusted models.

We identified relevant variation in the operating theater temperature during the study period. The 3-day average ranged from 19.5°C to 27.3°C (median, 23.8°C), and daily thermal amplitude reached 8°C. This amplitude is considered high for a tropical climate.

Current guidelines recommend that operating-theater temperature must not be too cold, in order to prevent patient hypothermia.<sup>7,8</sup> Therefore, evidence of SSI seasonality and association with high temperatures seems paradoxical.<sup>5,6</sup> It has been hypothesized that heat causes surgeon discomfort and may impact negatively on their performance.<sup>9</sup> Those apparently conflicting findings imply that further research is required to identify optimal temperatures for the operating theaters. Maintaining such an optimal temperature also poses a special challenge for developing countries, where climate control in hospitals is often not feasible.<sup>4</sup>

Obviously, difficulties in temperature control in operating theaters are not the only drivers of SSI in developing countries. A countrywide survey in Brazil found relevant deficits in the overall

structure for infection control, including infection control committees, sterilization services, and microbiology laboratory resources.<sup>10</sup> Not surprisingly, high SSI rates occur even in very small hospitals that perform low-complexity surgical procedures.<sup>2</sup>

SSIs affect thousands of patients in developing countries every year.<sup>1,2</sup> They meet all the requirements to be considered a public health threat. Although low- to middle-income countries face challenges in providing medical and surgical care for their inhabitants, patient safety should not be a lesser priority in the healthcare agenda. Measures directed at achieving adequate environmental patterns for operating theaters, including temperature control, may prevent morbidity, mortality, and additional costs of treating SSI.

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