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## Original article

# Late onset sepsis in newborn babies: epidemiology and effect of a bundle to prevent central line associated bloodstream infections in the neonatal intensive care unit



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## ABSTRACT

**Aim:** We assessed late onset sepsis (LOS) rates of neonates in a neonatal intensive care unit (NICU) before and after implementing an evidence-based bundle to prevent these infections in a country with poor resources.

**Methods:** We evaluate trends of LOS between October 2010 and August 2012 in a large tertiary hospital in Brazil. We designed a protocol based of CDC guidelines for insertion of maintenance of central venous catheter targeted to reduction of bloodstream infections. During this period two major events occurred: a great increase of LOS rates in January months and relocation of the unit to a provisory place. Additionally we evaluated the risk factors and etiology of these infections.

**Results:** A total of 112 (20.3%) cases defined as LOS were found. The overall incidence rate of LOS in the study was 16.1/1000 patient/days and 23.0/1000 CVC-days. Our monthly rates data of LOS/1000 patient-day reveal fluctuations over the studied period, with incidence rates of these infections in staff vacation period (January 2011 and 2012) significantly higher (59.6/1000 patients-days) than compared with the other months rates (16.6/1000 patients-days) (IRR = 3.59;  $p < 0.001$ ). As opposite, the incidence rates of LOS during relocation period was lower (10.3/1000 patients-days) when compared with baseline period 26.7/1000 patients-days (IRR = 2.59;  $p = 0.007$ ). After the intervention period, these rates decreased in the post intervention period, when compared with preintervention 14.7/1000 patients-days and 23.4/1000 patients-days, respectively (IRR = 1.59;  $p = 0.04$ ).

**Conclusion:** Through simple infection control measures, LOS can be successfully controlled especially in NICUs of limited resources countries such as ours.

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## Introduction

Late-onset neonatal sepsis (LOS) remains an important cause of death, morbidity and long-term complications among premature infants, which are associated with prolonged hospital stay and increased health-care costs.<sup>1</sup> It is of great interest to know the incidence and the strategies that are effective for preventing LOS in neonatal intensive care units (NICUs).<sup>2-4</sup>

The most common infections seen in neonates are central line-associated bloodstream infections (CA-BSIs), which substantially contribute to the burden and cost of neonatal care.<sup>5</sup> One proposed approach to achieve low CA-BSI rates is implementation of catheter care bundles.<sup>6</sup>

Besides the classic risk factors for LOS, neonates requiring intensive care in developing countries are at high risk due to structural factors such as overcrowding, shortages of nursing and medical staff, lack or improper use of basic supplies and equipment, excessive use of antibiotics, insufficient knowledge and difficulties in the implementation of infection control practices.<sup>7-9</sup>

The aim of this study was to evaluate the changes in LOS incidence rates in a reference NICU at a Brazilian hospital considering different time periods: staff vacation period, relocation of the unit to a temporary site, and the effect of implementation of an evidence based care bundle.

## Materials and methods

### Patients and setting

The tertiary NICU of Hospital das Clínicas of Uberlândia city, Minas Gerais receives both inborn patients from high-risk pregnancies and patients referred from a wide surrounding region. The permanent NICU has 15 beds, rated level III (10 beds) and level II (5 beds) and admits an average of 500 infants each year. We designed a prospective interventional cohort study in the NICU including all infants admitted from October 2010 to August 2012.

### Data collection

Blood cultures positive for any microorganism and/or with clinical symptoms of sepsis were actively and prospectively identified according to the National Healthcare Safety Network (NHSN) surveillance.<sup>10</sup> Patients were followed from their admission to the unit their discharge or death. Standard definitions for health care associated infections were used.<sup>10</sup> Laboratory information was required to identify all positive blood culture results. Medical records were reviewed to determine whether positive blood culture results met the criteria for LOS outlined by the National Healthcare Safety Network of the Centers for Disease Control (CDC),<sup>10</sup> with assistance of a neonatologist from the unit. For all study patients the following characteristics were abstracted from clinical records: place of birth; gestational age; birth weight; length of total hospital stay; antibiotics use; invasive procedures such as central venous catheter (CVC), mechanical ventilation, and parenteral nutrition; and the following clinical scores: the

Score of Neonatal Acute Physiology version II (SNAP II) and APGAR at five minutes of life. Data from patients with LOS were compared with those with no infection to compute risk factors associated with LOS.

### Intervention

The intervention was implemented in February 2012. Practices primarily addressed interventions relating to the evaluation and prevention of central line-associated bloodstream infections. Literature was assessed for methodological quality and applicability, and based primarily on categories IA and IB by CDC guidelines, and the staff for CVC insertion and maintenance drafted a new protocol. These included complying with diagnostic criteria and standard techniques for monitoring nosocomial infections; improving hand-hygiene compliance; preventing intravascular catheter-related infections by adopting stringent insertion practices and catheter maintenance routines, including maintaining closed vascular systems and reliable, antiseptic methods for line insertion and maintenance (dressing changes, administration of medication, daily chlorhexidine application to the umbilical cord stump, daily catheter hub scrub with 70% isopropyl alcohol), dressing changes only when soiled, instead of routine weekly changes, using full-barrier precautions during insertion of central venous catheters, cleaning the skin with chlorhexidine 0.2%, avoiding the femoral site if possible, and removing unnecessary catheters besides better knowledge about prevention of CA-BSI in neonates. The intervention focused on group sessions and feedback on pathogenesis and data of CA-BSI per 1000 CVC days in the unit before intervention. All staff was invited to attend the meetings in order to review the infection rates and device use and care. A catheter checklist was created to ensure adherence to CA-BSI prevention practices at the time of CVC insertion. CVC insertion was observed by a nurse to ensure that aseptic technique was maintained. Otherwise, visual displays with A3-size color posters that emphasized care with CVC were distributed at strategic points of the unit.

### Comparison rates

We accessed the incidence of LOS in the NICU in different periods during the study: (1) January 2011 and 2012, staff vacation period; (2) April–October 2011, relocation of the unit to a temporary nursery for repairing the air conditioner system; and (3) February 2012, the intervention period designed to reduce bloodstream infection (intervention bundle). Rates during staff vacation were compared to rates of other months during the study (October 2010–December 2010; February 2011–March 2011; November 2011–December 2011), excluding relocation and post-intervention periods. Rates of LOS during the relocation period (from April 2011 to October 2011) were compared rates observed in the period before unit relocation (from October 2010 to March 2011, excluding January 2011). To evaluate the impact of the intervention bundle, the incidence rates of LOS during pre-intervention period (October 2010–December 2011, excluding January 2011 and relocation period) were compared to rates during the post-intervention period (February 2012–August 2012). A graph

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