Editorial

Gram-Negative Bacillary Bacteremia and Intravenous Therapy Practices

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Several important studies in this issue of *Infection Control and Hospital Epidemiology* found associations between gram-negative bacteremia and intravenous infusion therapy in hospitals in developing countries.[1-3] Although most vascular catheter–related bloodstream infections are caused by staphylococci (ie, coagulase-negative staphylococci and *Staphylococcus aureus*), gram-negative bacilli have also been important causes of catheter-related bloodstream infections in the United States and other developed countries.[4-13] For example, several studies of short-term nontunneled central venous catheters found gram-negative bacilli to cause 22% to 54% of associated bloodstream infections.[4-8] Others demonstrated that gram-negative bacilli caused 26% to 55% of long-term catheter-related bloodstream infections, with *Enterobacter* and *Klebsiella* species being leading organisms.[9-13]

Contaminated infusate has been an important source of gram-negative bacillary bacteremias, because once introduced, these microbes can thrive in such fluids.[14-18] Richards et al. report an outbreak of *Klebsiella pneumoniae* bacteremia among neonates in a high-risk nursery in Cali, Colombia.[1] Multivariate analysis in this retrospective cohort study showed that the *K. pneumoniae* bacteremia was independently associated with blood transfusions and intravenous injections. Furthermore, surveillance cultures of the high-risk neonates showed that 61% had rectal colonization with *K. pneumoniae*. Colonized neonates were cohorted in a specific area and infection control aseptic practices were enforced. These measures led to the control of the *K. pneumoniae* outbreak. Molecular typing methods were not performed in the study to determine the source of the *K. pneumoniae* bloodstream infections. Therefore, it would be difficult to determine whether gastrointestinal colonization versus other sources (such as contaminated infusate) was the exact source of the outbreak. However, the authors reasonably postulate that the source of the *K. pneumoniae* outbreak was most likely a high rate of patient-to-patient *K. pneumoniae* transmission coupled with suboptimal infection control practices related to intravenous catheters.

This conclusion was based on the fact that simultaneously cohorting colonized neonates and recommending improved aseptic techniques resulted in prompt resolution of the outbreak and a much lower prevalence of *K. pneumoniae* intestinal colonization (12%). The authors concluded that, most likely, *K. pneumoniae* colonizing the infants' gastrointestinal tracts was transferred through the contaminated hands of medical personnel to the intravenous catheter insertion site or administration set. The authors acknowledged the study's limitation related to the absence of genotypic testing. However, the study has merit in showing how lapses in infection control practices including suboptimal hand hygiene might lead to epidemic infusion therapy–related bloodstream infections by spreading Enterobacteriaceae among high-risk patients in general and to their indwelling catheters in particular.

A study by Macías et al.[2] complements the study by Richards et al. by providing molecular typing methods to demonstrate that the injection port of the intravenous administration set could be the potential source for infections caused by Enterobacteriaceae. They found that 70% of 251 injection ports were contaminated with microbes. Contamination with gram-negative bacilli occurred in 13.9% (with *Klebsiella* species accounting for 69% of the ports contaminated with gram-negative bacilli). With the use of pulsed-field gel electrophoresis, the strain of *Enterobacter cloacae* isolated from the infusion ports of eight patients was indistinguishable from blood culture isolates of one

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bacteremic patient, and from that patient's total parenteral nutrition fluid and intravenous fluid.

Macías et al. postulated that infusate-related bloodstream infections in their setting could be related to contamination of the injection ports of the intravenous administration sets rather than intrinsic contamination of the infusate. The authors suggested that contaminated hands of healthcare workers were likely the ultimate source of injection port contamination related to poor hand hygiene, possible contamination from inadequately chlorinated water, or both. This study supports the premise of Richards et al. that contamination of the infusion administration set could be secondary to the external transfer of gram-negative bacilli through the hands of healthcare workers from multiple contaminated sources, such as colonized high-risk patients or contaminated tap water.

The study by Nasser et al.[3] is a vivid example of the seriousness of nosocomial gram-negative bacillary bacteremias and the importance of high-quality infection control investigations for interrupting outbreaks related to such infections. The authors report one of the largest nosocomial bacteremia outbreaks caused by *Burkholderia cepacia* and trace it to tap water contamination of alcohol dispensers used throughout the hospital for a variety of purposes including application to skin before catheter insertion. The authors are to be commended for this high-quality study, which combines sound clinical and epidemiologic investigation with molecular typing of organisms obtained from patients and environmental sources.

Nasser et al. described 411 episodes of *B. cepacia* bacteremia occurring in 361 patients during a 7-year period. Most (98%) of the patients had fever at the time of the positive blood cultures, and 44% had catheter-site phlebitis. *B. cepacia* has been associated with outbreaks or pseudo-outbreaks related to contaminated distilled water,[19,20] tap water,[21] saline,[22,23] and antiseptics or disinfectants.[24-32] On the basis of this knowledge from the literature, the authors were able to trace these bacteremias to a contaminated tap water source, which was used to dilute a 90% ethanol solution for skin antisepsis before catheter insertion. The results of molecular typing of the organisms cultured from the tap water as well as the contaminated alcohol solution and patients' blood were found to be identical. This study is another illustration of how antiseptics used to prevent infection can become the source of a serious nosocomial gram-negative bacillary bacteremic outbreak. *B. cepacia* has been postulated to have the potential of surviving 70% alcohol because of its ability to hydrolyze alcohol through a lipase enzyme produced by this organism.

The three studies on nosocomial catheter-related gram-negative bacillary bacteremias published in this issue of *Infection Control and Hospital Epidemiology* provide the hospital epidemiologist with new insight.[1-3] When approaching a cluster of gram-negative bacteremias, the hospital epidemiologist should consider multiple sources. Suboptimal intravenous therapy practices in high-risk colonized patients could be the driving force for the contamination of the intravenous administration sets, as demonstrated by the studies by Richards et al. and Macías et al. Furthermore, contaminated tap water, antiseptics, or both could be a source for gram-negative bacillary bacteremic outbreaks caused by water organisms such as *B. cepacia* and should prompt appropriate investigation when seen. Whereas catheter-related bacteremias caused by staphylococci reflect the natural history of devices penetrating skin colonized with these organisms, a cluster of gram-negative catheter-related bacteremias occurring in non-neutropenic patients should be thoroughly investigated, with special attention to intravenous therapy practices.

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Letter to the Editor

Use of an Alcohol-Based Handrub and Quality Improvement Interventions to Improve Hand Hygiene in a Russian Neonatal Intensive Care Unit

To the Editor:

We would like to acknowledge the professional, non-salary support of Drs. Lubimova, Khrustalyeva, Tekhova, and Zueva from grant monies provided by the Swedish International Development Agency (grant no. EEC H 142) for our study recently published in *Infection Control and Hospital Epidemiology*.[1] We would also like to acknowledge the collegial support of our project from Drs. Lars G. Burman, Anna Hambraeus, and Ingegerd Kallings and Ms. Kerstin Mannerquist. They have been a great support to infection control in Russia. Our failure to acknowledge them previously was an accidental omission that we sincerely regret.

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