BLOOD CULTURE CONTAMINATION RATES AT A TERTIARY CARE HOSPITAL; IMPACT OF CONTINUING MEDICAL EDUCATION AND FEEDBACK

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ABSTRACT

Objective: To determine the impact of directed feedback and training sessions for phlebotomists and nursing staff on blood culture contamination rates at a tertiary care hospital.

Material and Methods: Blood culture contamination rates were evaluated for a period of four years by data entry in Excel 2010. A feedback mechanism was instituted in January 2012 and blood culture specimen collection trainings were conducted as a part of continuing medical education (CME) for nursing staff and phlebotomists. The definition of blood culture contamination was based on isolation of typical skin organisms from a single blood sample from a series of two samples.

Results: The blood culture contamination rates declined from 5% in 2011 to 1.5% in 2014 with no contaminants isolated in the outpatient setting in 2013 and 2014.

Conclusion: Blood culture contamination rates can be significantly reduced through regular and directed feedback to phlebotomy and nursing staff and by including training on blood culture specimen collection as a key component of continuing medical education for these healthcare personnel.

Keywords: Blood culture, Contamination, Continuing medical education, Feedback.

INTRODUCTION

Sepsis is diagnosed with the help of blood cultures, yet blood culture positivity may be difficult to interpret for clinical decision making due to the isolation of skin contaminants. Blood culture contamination can occur when inadequate antiseptic techniques for collection are used. Contamination rates of less than 3 percent are warranted. Contamination with normal skin flora during venipuncture can be prevented by proper skin antisepsis but in some clinical scenarios skin flora can be implicated in diseases like infective endocarditis, making it difficult to differentiate false positive results and true bacteremia. High blood culture contamination rates are associated with poor patient outcomes due to injudicious use of antibiotics thus giving rise to bacterial resistance, increased costs, increased length of hospital stay and mortality. Organisms implicated in contamination include Bacillus, Coagulase-negative Staphylococci, Propionibacterium species and Corynebacterium species, Streptococcus pneumoniae, Haemophilus influenzae, Group A Streptococci, Pseudomonas aeruginosa, Enterobacteriaceae, Staphylococcus aureus, and Candida species are usually clinical pathogens. The present study was carried out to determine the annual blood culture contamination rates and study the impact of a timely feedback intervention and continuing medical education on blood culture collection technique.

MATERIAL AND METHODS

The cumulative annual blood culture contamination rates inclusive of both outpatient and inpatient blood culture orders processed were calculated for all four years, 2011 to 2014 retrospectively from Pathology lab records, expressed as percentages using Excel 2010 at a 250 bedded tertiary cardiac care center. Critical wards included the and adult Intensive Care Units, two Coronary care units and a surgical High dependency care unit. Blood cultures had been processed by a manual method.

Operational Definitions

Blood culture Contamination

A blood culture was considered to be contaminated if one of the following organisms was identified in only one of a series of blood culture specimens: bacillus species, coagulase-negative Staphylococcus species, viridans streptococci, Corynebacterium species,
Propionibacterium species or micrococcus species.

Blood culture contamination rates

Contamination rates were defined as the number of contaminated cultures during a year divided by the total number of cultures performed during that year.

We formed a quality improvement team consisting of Pathologist, microbiology laboratory personnel and phlebotomists in Jan 2012. A quality improvement initiative to improve blood culture specimen collection via sterile aseptic technique was instituted and a standard operating procedure (SOP) was developed inclusive of standardizing sterilization of skin preferably with chlorhexidine or tincture iodine, using standardized kits that have all supplies ready for the nurses; this consisted of all the equipment necessary to collect a culture using sterile technique, including a tincture iodine or chlorhexidine, Isopropyl alcohol swabs used for disinfecting the tops of culture bottles and sterile supplies, avoidance of contamination of sterilized site prior to venepuncture, avoiding use of peripheral IV lines for blood culture draws, and timely directed feedback to nurses regarding their contaminated blood cultures. The feedback mechanism consisted of directed feedback and training by a team of two lab phlebotomists trained in aseptic blood culture specimen collection to the particular clinical area nursing personnel from which blood culture contaminants were isolated.

### RESULTS

Year wise blood cultures processed are shown in Fig-1 with majority of the blood cultures collected from inpatients on an annual basis from 2011 to 2014. The blood culture contamination rate was fairly high at 5% (n=52) during 2011 as shown in Table-1 with the contaminated cultures mostly from critical wards and other adult-care wards. After our quality improvement initiative there was a decline in the annual blood contamination rate in 2012 to 2.2% (n=16) with only four contaminants from critical care wards (Table-1). No blood culture contaminants were isolated in 2013 and 2014 respectively from outpatient samples collected by trained pathology lab phlebotomists. Majority of the contaminated

### Table-1: Year wise blood culture contaminations according to outpatient and inpatient sampling.

<table>
<thead>
<tr>
<th>Year</th>
<th>Blood culture contaminants (n)</th>
<th>Critical wards (n)</th>
<th>Non critical adult wards (n)</th>
<th>Paediatric wards (n)</th>
<th>Total contaminant (n)</th>
<th>Annual blood culture contamination rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>03</td>
<td>20</td>
<td>25</td>
<td>04</td>
<td>52</td>
<td>5</td>
</tr>
<tr>
<td>2012</td>
<td>01</td>
<td>04</td>
<td>10</td>
<td>01</td>
<td>16</td>
<td>2.2</td>
</tr>
<tr>
<td>2013</td>
<td>0</td>
<td>02</td>
<td>01</td>
<td>01</td>
<td>04</td>
<td>1</td>
</tr>
<tr>
<td>2014</td>
<td>0</td>
<td>01</td>
<td>09</td>
<td>0</td>
<td>10</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Figure-1: Frequency of blood cultures processed year wise.
isolates constitute Bacillus species; an environmental contaminant as shown in Fig-2.

The blood culture contamination rates remained below 2% during the years 2013 and 2014 as shown in Fig-3.

**DISCUSSION**

It is prudent to identify blood culture contaminants which if isolated from a single blood culture warrant clinical correlation; otherwise unnecessary antibiotic treatment may be given. Prior to our quality improvement initiative to decrease blood culture contamination rates in 2011, a significant number of blood culture contaminants were isolated from specimens collected in critical wards and pediatric ward where there is a likelihood of sample collection from intravenous catheters consistent with the findings of Norberg et al who reported the blood culture contamination rate as high as 9.1% versus 2.8% from Intravenous catheters and peripheral venepuncture respectively. Our Nursing staff and phlebotomists were taught to avoid taking blood for cultures through an intravascular catheter, because of colonization of catheter ports with skin commensals. We also emphasized the need for collecting blood culture sets and not single bottles to distinguish contaminants adequately because Coagulase negative staphylococci and Corynebacteria may be implicated as true pathogens in certain clinical scenarios. We initiated a hospital staff educational program by training the trainers i.e our centralized lab phlebotomy team thus resulting in reducing the OPD blood culture contaminants to nil and maintaining blood culture contamination rates below the 3% benchmark as per American society of Microbiology (ASM) standards. Alahmadi et al have reported significant annual cost savings through a similar approach using an educational intervention directed towards emergency nursing staff. Hernández et al have reported a very high blood culture contamination rate of 82% in the emergency pediatric setting.

A retrospective study conducted in a clinical laboratory of a tertiary hospital in Nigeria showed that the contamination rate was as high as 10.4% with the common contaminants being Bacillus species coagulase negative Staphylococci, and Diphtheroids similar to our findings.

![Figure-2: Frequency of blood culture contaminants isolated year wise.](image)

![Figure-3: Blood culture contamination annual trends.](image)

Implementation of aseptic technique for blood culture collection is the key component in reducing contamination rates as reported by Self et al resulting in reductions in blood culture contamination across two community hospitals. We prepared a standard operating procedure available in all clinical areas for blood culture specimen collection. A similar application of bundles on blood cultures had a drastic decrease in contamination rates by more than 50% as reported by Murphy et al.

In a tertiary care teaching hospital, Canada, a continual feedback mechanism of blood culture contamination rates resulted in
reduction of contamination rates from 2.6% in the pre-feedback year to 1.4% during the post-feedback year. This is consistent with our findings.

CONCLUSION

Blood culture contamination rates can be significantly reduced through regular and directed feedback to phlebotomy and nursing staff and by including training on blood culture specimen collection as a key component of continuing medical education for these healthcare personnel.

Acknowledgement

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Conflict of Interest

This study has no conflict of interest to declare by any author.

REFERENCES