*Research article*

# An audit on the technique of collection of blood for culture at the National Hospital of Sri Lanka

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*Sri Lankan Journal of Infectious Diseases 2011 Vol.1 (1); 18-23*

DOI: http://dx.doi.org/10.4038/sljid.v1i1.3184

Keywords : Blood culture, Quality

## Abstract

The accuracy of blood culture results is highly dependent on proper technique. This audit sought to determine whether health care personnel are adhering to standard techniques for collection of blood for culture. Fifty episodes of blood culture collection were observed at the National Hospital of Sri Lanka between August and December 2008 using an observational check list to determine accuracy of technique. 44/50 of the cultures were drawn after commencement of antibiotics. 45/50 did not wash their hands prior to collection. Of the five who washed their hands only two used antiseptic soap. 37/50 wore sterile gloves. 16/50 used two antiseptics and 32/50 used one to disinfect the venepuncture site. Two did not disinfect the entry site. Only 2 swabbed the site in a concentric manner. 11 touched the site after disinfection. Only 39 were able to collect blood with a single puncture. Almost all the participants (49/50) did not disinfect the lid of the culture bottle. Only 21/50 drew adequate blood for blood culture. Only two drew a second blood culture. Syringes used to collect blood should be discarded into a sharp bin without recapping. In our study 40 /50 participants recapped the syringe before disposal. However 45/50 of the participants correctly disposed the sharps and gloves into the sharp bin and yellow bag respectively. Although written instructions have been given regarding collection of blood for culture, a high percentage of health care workers do not adhere to these guidelines. This is an important quality assurance issue that needs to be addressed.

## Introduction

Blood stream infections are an important cause of morbidity and mortality. Blood cultures should be routinely obtained in patients with suspected bacteraemia and serve as a reference for diagnostic, therapeutic and prognostic decisions. Hospitalized patients may have antibiotic treatment discontinued, changed, or de-escalated on the basis of the results of cultures.

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Proper collection of blood cultures is fundamental in the diagnosis and treatment of sepsis[1]. Blood culture is also useful in the diagnosis of deep seated infections such as meningitis, pneumonia, pyelonephritis and osteomyelitis. It is the laboratory test of choice in the diagnosis of enteric fever and endocarditis.

Blood culture, as a diagnostic test is influenced by many factors, including timing of the culture, volume and source of the blood, the number of cultures, and the type of underlying infection[2]. Errors in the timing, number and volume of specimens may lead to a less than optimal yield of positive cultures i.e. false negatives. For example, obtaining blood culture prior to antibiotics is vital and is considered a key indicator of quality control in blood culture technique. In contrast, timing in relation to peak of fever has not been found to be important[3]. Therefore the emphasis is on obtaining suitable numbers of blood culture of adequate volume.

The accuracy of blood culture results is highly dependent on proper technique. Blood cultures should be taken aseptically with minimal contamination from skin flora to prevent false positives. Studies have shown that false positive blood cultures may constitute more than half of the positive blood cultures leading to confusion[4]. To help avoid erroneous judgments about the clinical significance of positive blood cultures a standard technique that minimizes the risk of contamination and maximizes the probability of isolating pathogens should be used. Collection procedures that emphasize that culture must be obtained prior to antibiotics and stipulate thorough disinfection of the skin, aseptic technique and adequate number and volume of cultures help achieve both of these goals.

Standard protocols should be followed from the time of writing the request, to interpreting the blood culture results. Blood culture protocols vary among hospitals. Investigators also differ in their recommendations of best practices. For example, some no longer recommend routine collection of anaerobic blood culture specimens because the incidence of anaerobic bacteremia has declined in the last 15 years[2]. Each hospital should consider all relevant factors - patient population, recent literature, financial resources, anticipated volume, and technical expertise - and develop protocols that best meet the needs of its patients. The National Hospital of Sri Lanka (NHSL) has a written protocol for blood culture collection.

*Request*

The question of whether an organism is a pathogen or a contaminant is often complex and the answer cannot be based solely on blood culture results. Rather, this judgment must include a consideration of the patient's history and clinical signs. Thus providing information regarding the patient's history including the treatment he/she is on, in the request form will greatly help the microbiologist to arrive at a correct decision. The request form must state the clinical diagnosis, time of collection, anatomic site from which blood is drawn and list current antibiotic therapy and any special organisms to be isolated.

*Consent*
The patient should be informed of the investigation and consent obtained.

*Timing, number and volume of blood*
Timing, volume of blood and number of cultures are important determinants of the sensitivity of the blood culture. Of these factors, specimen volume is more important. Studies have shown a direct relationship between the volume of blood cultured and the yield of positive results [5]. Mermel and Maki found an increased yield of approximately 3.2% per milliliter of blood collected[6]. Guidelines usually suggest a volume of 10ml per culture distributed equally into one aerobic and one anaerobic culture bottle. As only aerobic cultures are done in Sri Lanka we considered 5ml per venepuncture as adequate.
Proper timing of blood cultures depends on the episodic nature of the suspected bacteremia. Blood for culture should be collected before the commencement of antibiotics. Drawing two blood samples from two separate venepuncture sites, 10 minutes apart, would be a practical and logical strategy in most cases.

*Method of collection*
A suitable venepuncture site should be located before beginning the procedure. Blood cultures should not be drawn from indwelling vascular catheters[7]. The culture medium in the blood culture bottle should be checked for evidence of contamination. A tourniquet may be placed above the venepuncture site.
Aseptic precautions including thorough disinfection of the venepuncture site with 70% alcohol and 10% povidone iodine by swabbing the skin concentrically from the centre of the venepuncture site outwards and allowing the antiseptic to evaporate to provide maximal activity, handwashing with antiseptic soap using a standard technique, drying on a sterile towel, use of sterile gloves and sterile syringes and needles should be scrupulously adhered to. The vein should not be re-palpated after disinfection. The venepuncture should be performed with a single prick[8].
If withdrawing with conventional disposable syringes, 5-6 ml of whole blood from adults, 2-3 ml from children and 1 ml for infants should be drawn[9]. If withdrawing using vacuum systems, the desired amount of blood should be withdrawn directly into each transport tube and culture bottle. In other cases, the lid of the blood culture bottle should be disinfected using 70% alcohol and the specimen injected into the culture bottle/s and gently mixed with medium.

*Universal precautions*
Used sharps should not be recapped but discarded directly into the sharps disposal container. Gloves should be disposed into the yellow “clinical waste” bag.

*Problems*
Many studies have identified widespread problems with the quality of the blood cultures sent to laboratories[6]. Donnino and colleagues noted that a high percentage of health care personnel qualified to collect blood cultures were unaware of the appropriate blood volume required for blood culture[10]. Therefore we performed an audit to determine if health care personnel at the NHSL are adhering to standard techniques of collection of blood for culture.

## Materials and Methods

The study was carried out in the general medical wards, intensive care units and the recovery unit of the National Hospital of Sri Lanka from August to December 2008. Fifty separate episodes of blood culture collection by different individuals were observed. The blood culture technique was observed and an observational check list, prepared according to standard guidelines, was used to determine accuracy. The person who was drawing blood was unaware that the technique was being inspected, to prevent deliberate alteration of their routine practice. Ethics clearance for this methodology was obtained from the ERC, Faculty of Medicine, Colombo. Additional information such as clinical diagnosis and indication for the test were recorded and the results of the blood culture were obtained from the Microbiology Laboratory of the hospital. Descriptive statistics were used to analyze the data.

## Results and Discussion

The 50 episodes of collection of blood for blood culture included 24, 18 and 8 episodes from medical wards, ICUs and the recovery unit respectively. The cultures were collected by doctors (n=36) and nurses (n=14.) The doctors included 3 registrars, 25 medical officers and 8 house officers. Most of the cultures were drawn from the cubital fossa (n=42) with 5 cultures drawn by femoral puncture and 2 from the dorsal aspect of the hand. One of the cultures was drawn from an indwelling line which is an incorrect procedure. The vast majority (n=44) of the cultures were drawn after commencement of antibiotic treatment. Completeness of the request form is necessary for the results of investigations to be conveyed promptly to the requesting physician. This is particularly important in the case of blood cultures where early results should be telephoned directly to the physician. While all the requests forms had noted the patient registration number, none contained the contact details of the doctor and 11 (22%) omitted the unit where the blood was collected. These omissions may have led to confusion and delay when forwarding the results.

None of the request forms included the time of collection of the specimen and 6 (12%) and 12 (24%) respectively had omitted to mention the indication for blood culture and the current treatment. As these details are required to determine time to positivity, significance of isolates and choice of antibiotics for sensitivity testing, such omissions may lead to suboptimal use of the laboratory. The majority of the doctors and nurses 47 (94%) did not obtain informed consent from the patient when drawing blood either in verbal or written form. None of the nurses obtained consent and only 3 doctors (1 House officer and 2 Medical Officers) obtained verbal consent. Only five of the doctors explained the nature of the procedure to the patient prior to obtaining the culture.

During an aseptic procedure such as taking a blood culture it is important to prepare the patient and the equipment in order to prevent delay as well as avoid contamination. Overall there was good preparation for the procedure. This may be mostly due to having a pre-prepared kit for blood culture in most units. The most frequently forgotten items were a towel and the label for the bottle.

| MATERIAL | READY (%) | NOT READY (%) |
|---|---|---|
| Skin disinfectants:<br>70% alcohol (isopropyl alcohol) or 10% povidone iodine | 46 (92) | 4 (8) |
| Swabs, gauze, band aid | 48 (96) | 2 (4) |
| Sterile towel | 26 (52) | 24 (48) |
| Sterile disposable latex or vinyl gloves | 48 (96) | 2 (4) |
| Tourniquet | 47 (94) | 3 (6) |
| Disposable syringes and needles | 50 (100) | 0 (0) |
| Blood culture bottles (50ml for adults, 25ml for children) with appropriate media | 47 (94) | 3 (6) |
| Labels and indelible marker pen | 27 (54) | 23 (46) |

**Table 1 - Summary of state of preparation for blood collection**

Blood culture is obtained by penetration through the skin which has a resident normal flora. To obtain accurate results blood cultures should be collected with minimum skin contamination. However 29 out of 50 had not identified a suitable vein prior to venepuncture and a staggering 45 did not wash their hands prior to collection. Of the 5 who washed their hands only 2 used an antiseptic soap. 37 of the participants wore sterile gloves. Thirty three and 31 participants used 70% alcohol and povidone iodine respectively to disinfect the venepuncture site but only 16 used both antiseptics as recommended and two did not disinfect the site. Only two collectors (one nurse and one doctor) swabbed the site from inside outwards in a concentric manner. The rest swabbed unidirectionally. Eleven participants touched the site after disinfection. Only 39/50 were able to collect blood with a single puncture as recommended. The highest number of punctures was 8 but that was recorded only once. Almost all the participants (49/50) did not disinfect the lid of the culture bottle before inoculating the blood.

The volume of blood collected for culture is the single most important factor that determines yield of organisms[5]. Although most guidelines recommend at least 10ml per blood culture bottle we considered a volume of greater than or equal to 5 ml as adequate. Only 21/50 (42%) participants drew adequate blood for blood culture. A minimum of two blood cultures from two different sites should be collected from each patient to maximize recovery of the pathogen and to distinguish true positives from skin contamination. However, only two of the participants drew a second blood culture.

Standard precautions taken by health care workers to prevent blood borne infections include proper handling of sharps. Syringes used to collect blood should be discarded into a sharp bin without recapping. Recapping is probably the most important risk factor for needle prick injury. In our study 40 /50 (80%) participants recapped the syringe before disposal. All the registars and nurses recapped and 17/25 Medical Officers and 6/8 House officers recapped the syringe after the procedure. However 45/50 of the participants properly disposed the sharps and gloves into the sharp bin and yellow bag respectively.

Out of the 50 cultures collected, 44 recorded no growth after 7 days of incubation while 6 grew pure and mixed growths of various Gram positive and negative bacteria. The

number was too low to determine the significance of prior antibiotics and number of cultures taken on the culture positivity rate. The low rate of positivity can be attributed to the fact that most patients were already on antibiotic treatment when the cultures were taken.

## Conclusion

A high percentage of health care workers do not know or do not adhere to standard guidelines in the collection of blood for blood culture. This is an important quality assurance issue that needs to be addressed. Trained phlebotomists or blood culture teams are one option to improve the quality of blood cultures. Educational initiatives in both undergraduate and postgraduate courses and ongoing quality assurance programmes in hospitals are needed to address this issue.

## References


1. O'Grady NP, Barie PS, Bartlett JG et al. Practice guidelines for evaluating new fever in critically ill adult patients. *Clinical Infectious Diseases* 1998; 26: 1042–59.
2. Mylotte JM Tayara A. Blood cultures: clinical aspects and controversies. *European Journal of Clinical Microbiology and Infectious Disease* 2000; (19):157-163.
3. Riedel S, Bourbeau P, Swartz B, Brecher S et al. Timing of specimen collection for blood cultures from febrile patients with bacteremia.*Journal of Clinical Microbiology* 2008; 46(4): 1381-1385.
4. Weinstein MP. Blood culture contamination: persisting problems and partial progress. *Journal of Clinical Microbiology* 2003; 41(6): 2275- 2278.
5. Arpi M, Bentzon MW, Jensen J, Frederiksen W. Importance of blood volume cultured in the detection of bacteremia.European *Journal of Clinical Microbiology and Infectious Disease*s 1989; 8(9): 838-842.
6. Mermel LA, Maki DG. Detection of Bacteraemia in Adults: Consequences of culturing an inadequate volume of blood. *Annals of Internal Medicine* 1993; 119 (4): 270-272.
7. Everts RJ, Vinson EN, AdhollaPO, Barth Reller L. Contamination of Catheter-Drawn Blood Cultures: *Journal of Clinical Microbiology* 2001;39(9): 3393-3394.
8. Hospital Infection Control Manual. Sri Lanka College of Microbiologists (2005) eds. Karunaratne K, Corea EM.