BLOOD CULTURE CONTAMINATION

An audit at Furness General Hospital

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BACKGROUND

Every year most hospital laboratories in the United Kingdom (UK) witness a rise in requests for tests[1] and there is evidence that between 25% and 40% of those tests are unnecessary.[2,3] Moreover, often samples are not collected appropriately,[4] leading to inaccurate results, defeating the whole purpose of the request.

It is widely agreed by physicians and microbiologists that blood cultures are among the most important laboratory tests performed in the diagnosis of serious infections.[5] However, the well-known high contamination rates[4,6,7,8] are costly[6,7,9] and often confuse clinicians.[6,7,10,11]

The American Society of Microbiology recommends that the rate of blood culture contamination should not exceed 3%.[12] However, reports from NHS trusts and equipment suppliers suggest that the contamination rate in the UK could be as high as 10%.[13]

Several studies have provided guidelines to help distinguish between contaminants and true bacteraemia.[4,10,14] However, an individual result must always be interpreted in the clinical context.

Table 1 divides some of the more frequently-identified micro organisms into two categories according to their likelihood of representing true bacteraemia/fungemia or contamination.[4,14]

True bacteraemia/fungaemia	Contaminants *
Staphylococcus aureus *Streptococcus pneumoniae* *Escherichia coli* Enterobacteriacae *Pseudomonas aeruginosa* β–Haemolytic streptococci *Listeria monocytogenes* *Neisseria meningitides* *Haemophilus influenzae* *Bacteroides sp.* *Candida sp.*	*Corynebacterium sp.* *Bacillus sp.* Coagulase negative staphylococci (CoNS)

Table 1 Micro organisms according to their likelihood of being contaminants or representing true bacteraemia

**Exceptions exist as CoNS/*corynebacteria *may be significant in the presence of a foreign body, such as a central line, temporary pacing wire, etc.*

AIM

This audit aims to determine the contamination rates in blood culture samples collected in Furness General Hospital (FGH). (Suggestions will be made towards guidelines to help tackle this problem.)

METHODS

Concurrent analysis of all blood culture requests in March 2007 in FGH. Outcome measures:

- number of positive blood cultures
- type of micro organisms grown
- requesting speciality

The results were discussed with the consultant microbiologist in FGH, where data regarding the clinical context of each individual request was considered retrospectively.

RESULTS

A total of 288 sets of blood cultures were requested, the majority being from female patients (67%), as there were more females than males admitted to FGH during the month in question. The age of the patients ranged between two days and 98 years (median 68 years; mean 62 years).

Most samples were requested by medical (59.3%) and accident and emergency (A&E) staff (14.7%). The others originated from surgical (8.8%), intensive care (8.8%), paediatric (2.8%), obstetrics and gynaecology (2.8%) and oncology (2.8%) wards.

Of the cultures, 12.2% were positive and grew a variety of organisms, as represented by table 2.

Organisms isolated	n
Coagulase negative staphylococcus (CoNS)	18
Methicillin resistant *Staphyloccus aureus* (MRSA)	3
Corynebacterium sp.	3
Escherichia coli	3
Enterobacter sp.	2
Candida albicans	1
Rothria dentaccisosia	1
Streptococcus mitis	1
Bacillus sp.	1
Methicillin sensitive *Staphylococcus aureus*	1
Enterobacter faecalis	1
Total	**35**

Table 2 Breakdown of all the micro organisms grown in the requested samples

The decision as to whether an isolate was significant or a contaminant was based on a retrospective review of laboratory data. Accordingly, a consensus was reached between the microbiologist and the physician that the cultures that grew coagulase negative staphylococcus (CoNS), *Candida albicans, Rothria dentaccisosia*, *Streptococcus mitis*, *Corynebacterium species* and *Bacillus species* were

contaminants. Similarly, the cultures that grew methicillin resistant *Staphylococcus aureus* (MRSA), *Enterobacter species, Staph. aureus, E. Coli* and *Enterococcus faecalis* represented true bacteraemia.

Thus, the contamination rate was 8.7%.

Most of the contaminated requests were collected in surgical (28%) and medical wards (24%), as well as in the A&E department (20%).

DISCUSSION

Even though the contamination rate in this hospital lies within those of the rest of the UK, it exceeds the United States' recommended figures by over 5%.

Contamination can come from a number of sources:

- the patient's skin
- the equipment used to take the sample and for inoculation
- the hands and technique of the person taking the blood sample
- the general environment

In this hospital, the usual method for disinfecting the patient's skin is with 70% isopropyl alcohol impregnated swabs. Some studies suggest that, to achieve better bactericidal results, one should use other antiseptic agents, such as chlorine peroxide, providone iodine, or tincture of iodine.[6]. However, the use of these antiseptics may not always be practical.

Regarding the number of needles used to collect the blood and inoculate the vials there are two schools of thought. One is that, in order to avoid needle-stick injuries, the same needle used to puncture the skin and collect the blood should be the same used to inoculate the vials. However, some studies suggest that using one needle to collect the blood and a different one to inoculate the vial reduces contamination rates.[1] Nowadays, with the introduction of the vacutainer system, it should be standard practice that the vacutainer extension kits should be used for blood culture collection. This will result in only one needle being used, (therefore lower risk of needle-stick injuries) and the same rate of contamination as with the two-needle technique.

Interestingly, junior medical staff (who collect the majority of blood cultures in FGH) are reported to have contamination rates as much as 8% higher than phlebotomists or blood culture teams, in various hospitals.[4,15,16] One possible reason is that junior doctors often collect the samples in a hurry, not performing an adequate sterile technique, not allowing enough time for the antiseptic agent on the skin to dry and inoculating non-sterile tubes at the same time as the blood cultures.

These high contamination rates will inevitably lead to undesirable consequences both in the hospital in question and in the NHS. False positive results can lead to unnecessary treatment of patients with antibiotics. It also raises the apparent incidence of, for example, MRSA infection, as the MRSA bacteraemia surveillance system does not distinguish between genuine bacteraemias and contaminants. This has implications for our attempts to meet our MRSA target, imposed centrally.

The most common contaminant is CoNS[17,18,19] (also observed in this audit). As it is not always easy to distinguish between true bacteraemia and contamination, physicians tend to use antibiotics inappropriately in the lights of defensive medicine. One American study reports misuse rates of vancomycin (often used for treatment of CoNS) as high as 34%, and even though significant adverse events or prolonged hospital stays were not observed, there obviously were the additional costs of treating such cases.[20]

To complicate matters even further, CoNS are the most common pathogens growing in infected foreign bodies, such as: central venous catheters, prosthetic joints,[21] pacemakers[22] and cardioverter-defibrillator devices.[23] In the majority of cases the correct antibiotics can treat the infection, but in severe bacteraemia removal of the foreign body may be necessary.[23] This poses a real difficulty for the physician looking after a patient with a foreign body *in situ* and a positive blood culture for CoNS, in interpreting the result.

Another consequence of the use of antibiotics is the development of *Clostridium difficile* associated diarrhoea, which is potentially fatal. It carries a mortality of 25% in frail elderly people.[24] Sadly, *C. difficile* cases continue to rise in UK hospitals. Data published by the Health Protection Agency indicate a rise by 5.5% in 2006 compared with 2005.[25]

Finally, most of blood culture samples were requested by medical and surgical staff. Nevertheless, a significant number originated in the A&E department. This is a place where strict aseptic technique may not always be possible, accounting for its high contamination rates. Moreover, there is evidence to suggest that less than 2% of blood culture results performed in A&E departments will actually alter management.[26,27]

CONCLUSION AND RECOMMENDATIONS

Blood cultures taken in FGH have a high contamination rate, although similar to other hospitals in the UK. This can be explained by poor aseptic technique and inappropriate collection methods.

This audit has a small limitation, in that clinical information was not obtained regarding the indications for each blood culture request and patient's medical background. Therefore, the micro organisms grown in each sample were labelled as 'contaminant' or 'true bacteraemia' according to their statistical likelihood of falling in each category, together with other laboratory test results such as C-reactive protein, white blood cells and the results of other blood. This might have resulted in misidentification of some genuine cultures as contaminants.

Nevertheless, we believe that a local policy on blood culture collection regarding indications, technique and interpretation of results would be of value in reducing contamination rates, as well as the number of unnecessary requests.

The Department of Health has recently produced such guidelines[13] and below is a summary of the main recommendations:

Indications

- blood cultures should be taken after identification of possible bacteraemia or sepsis and before administration of antibiotics

- if a patient is on antibiotics, blood cultures should ideally be taken immediately before the next dose, with the exception of paediatric patients

Method

- wash your hands with soap and water, then dry
- clean any visibly soiled skin on the patient with soap and water, then dry
- apply a disposable tourniquet and palpate to identify vein
- clean skin with a 5% chlorhexidine in 70% isopropyl alcohol impregnated swab and allow to dry
- if a culture is being collected from a central venous catheter, disinfect the access port with a 70% isopropyl alcohol impregnated swab
- apply clean examination gloves (sterile gloves are not necessary)
- do not palpate again after cleaning skin
- insert needle
- collect sample and release tourniquet
- cover the puncture site with appropriate dressing
- inoculate blood into culture bottles, starting with anaerobic culture
- discard needle and syringe in a sharps container
- wash hands after removing gloves
- record the procedure with indication for culture, time, site of venepuncture and any complications in the patient's record
- blood cultures should only be collected by members of staff who have been trained in the collection procedure and whose competence in blood culture collection has been assessed
- in patients with suspected bacteraemia, two sets of cultures should be taken at separate times from separate sites
- do not use existing peripheral lines or sites immediately above them

We intend to develop a local policy based on the above for use in University Hospitals of Morecambe Bay hospitals.

After the introduction of such a policy, regular audits could be performed to ensure that the policy is being followed and the rates of contamination are falling. Also, efforts should be made towards the education of clinicians on the interpretation of results.

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Members of the gynaecology department model the new dress code after abandoning traditional long-sleeved white coats and ties which are believed to carry infection