Developing and Sustaining a Practice Based Strategy for Reducing Healthcare Associated Infections: Preventing Methicillin-Resistant *Staphylococcus Aureus* Bacteraemia by reducing Contamination of Blood Culture Sampling in an Emergency Department

**Keywords:** contamination, reducing, strategy, healthcare acquired infections

**Duration of project:**
June 2009 – October 2010
Report received for publication: February 2011

**Project team:**
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Rachel Ben Salem, Senior Infection Control Nurse
Robin Khariuk, Practice Development Nurse

**Summary of project**
The project aimed to reduce healthcare associated infections (HCAI) by reducing the risk of inoculation of patients with pathogens present on their skin. This was achieved by the reduction of contaminated blood cultures in a busy East London Emergency Department. To achieve the project aim, the project team and staff undertook an audit of why and how blood cultures were taken; reviewed the current infection control practices; and engaged with staff to gain their views and perspectives on infection control. The outcomes were the development and implementation of a training programme for the team, that supported best practice for taking blood cultures; as well as the integration of the strategy and polices outlined by the Department of Health (DOH) to reduce HCAI in the NHS.

**Introduction**
Cleanliness and infection control are at the forefront of media and public interest in the NHS. In Newham, there is a dedicated Infection Control Team who oversee this important area of work and give leadership to the nursing teams that care for patients on a daily basis. Sustainable reductions in healthcare associated infections (HCAIs) like MRSA and *Clostridium difficile* require the proactive involvement of every member of staff across all healthcare settings. All staff have a role to play in reducing HCAI and making that contribution crucial. (Department of Health, 2007)

Although HCAIs have been a high profile area in the NHS for several years, continued efforts are required to ensure that progress towards reducing HCAI and maintaining improved cleanliness (Department of Health, 2007). Provision of education and training on infection control is a fundamental cornerstone of the infection control strategy within the Trust. During April 2009 - April 2010 more than 150 infection control training sessions were held by the Infection Control Team with the attendance amounting to approximately 1,800 staff and visitors. This included public events such as the Annual Public Meeting and National Infection Control Week.
The Trust had continuously improved prevention of infections in hospital, and wanted to improve further through implementing the Saving Lives audit. The National Audit Office (2000) identified that at any one time, around 9% of hospital in-patients had an infection which had been acquired whilst in hospital and states that the annual cost of dealing with these 100,000 incidents a year amounted to £1 billion.

The Trust made an application to the Foundation of Nursing Studies (FoNS) after completion of a number of root cause analyses showed a high number of positive blood culture samples. The analyses showed that many of the positive blood culture samples were due to contaminants (a false positive result) as a consequence of poor aseptic collection technique. This was proven when the cultures were repeated. Blood culture contamination leads to the administration of unnecessary antibiotics and according to Hall and Lyman (2006), represents an on-going source of frustration for clinicians and microbiologists.

The Trust recognised that blood culture samples were an important tool for all healthcare providers in terms of identifying and managing bacteraemia. Furthermore, they appreciated that, to effectively audit practice and develop an appropriate training programme, professional and monetary support from FoNS was required.

**Project site**
The Emergency Department was chosen for this project as this is often the first point of contact with the patient. It is vital that good infection control measures begin at the start of the patients’ journey and it was hoped that the Emergency Department Team would take responsibility for promoting best practice by adhering to the standards and policies and encouraging excellence throughout the Trust. The key project team were the Matron for the department, the Infection Control Nurse and the Practice Development Nurse.

The Emergency Department involved sees 180-200 patients per day; this equates to a total of 70,000 attendances per year, with an additional 45,000 patients being seen in the Urgent Care Centre. The department consists of 15 single-occupancy cubicles for patients with a serious illness or injury (majors), three minor injuries trolley spaces, a four-bedded resuscitation room, a four-bedded paediatric area, and a purpose built Urgent Care Centre. Adjacent to the department is a 21-bedded specialty assessment area, where patients are managed for up to 12 hours, and a five-bedded Clinical Decisions Unit. The nursing team consists of 107 nurses and is led by a Matron. Additional support is provided by a Nurse Consultant, Business Manager, and Professional Development Nurse.

**Aims and objectives of the project**
The aim of the project was to reduce the risk of inoculation of patients with pathogens present on their skin, such as methicillin-resistant Staphylococcus aureus (MRSA) and to reduce contamination of blood cultures in a busy East London Emergency Department.

The following objectives were initially identified:
- Undertake an audit of blood cultures
• Review current infection control practices to identify areas of good practice and areas requiring development/improvement
• Engage with staff to gain their views and perspectives on infection control
• Develop and implement a training programme that would facilitate the gaps in knowledge with the nurses in the Emergency Department

A number of approaches were used to achieve the above objectives and these will be outlined below.

Audit of blood cultures
The Department of Health’s Saving Lives document states that reports from NHS Trusts and equipment suppliers suggest that contamination rates of blood cultures could be as high as 10%; our organisation demonstrated higher rates. The microbiologist at Newham University Hospital NHS Trust (NUHT) was concerned that a considerable number of the blood cultures collected were being reported as contaminants. An audit of blood cultures from April 2008 to March 2009 was undertaken and 15 MRSA bacteraemia were identified against a ceiling of 12, which is the number the Department of Health will allow any one Trust to have at a given time. Five of the positive samples were taken in the Emergency Department; however three of the patients were readmissions from the community and therefore these infections may not have been acquired from a hospital environment. Consequently, the Trust could report these positive results against the PCT.

Analysis of all cases was carried out by the project team using the Department of Health Root Cause Analysis (RCA) tool (2008). An RCA should be undertaken if a patient has a confirmed HCAIs such as methicillin-resistant Staphylococcus Aureus or Clostridium difficile infection (CDI). An RCA is important as it allows the Trust to understand areas requiring improvement in the patient pathway and to effectively minimise the chance of recurrence, thereby maintaining customer satisfaction and reducing costs significantly (National Patient Safety Agency, 2009).

The key themes identified from the audit and RCA process were:
1. Poor aseptic technique
2. Use of intravenous cannulae to collect samples
3. Lack of adequate documentation pertaining to sample collection. In many cases, the lack of documentation meant that it was unclear whether an aseptic technique was used on every occasion

There can be considerable consequences for those patients that have a false-positive result, with the dilemma of whether to commence antibiotic therapy or to wait for a repeat result. This can lead to a treatment delay for the patient. According to the American Association of Clinical Chemistry (2011), sepsis can be life-threatening especially in immune-compromised patients.
Using the results

The results of the audit and subsequent Root Cause Analysis were used by the RCA members chair to make a number of recommendations for changes in practice, which led to the following actions being taken by the project team:

- Chlorhexidine 2% skin wipes were introduced to clean the patients skin before taking blood cultures. This practice is supported by Stokowski updated (2011) that chlorhexidine has emerged as the best broad spectrum antiseptic which comes as a sponge applicator and a swab to clean the skin
- Wound care packs for sample collection were introduced
- Disposable tourniquets were introduced for taking all blood samples
- Blood culture collection stickers were produced to aid documentation
- A competency pack was completed by the project team in order to promote best practice.
- It was decided that medical doctors would not be included in blood sampling training as they were most likely to change jobs after 3-6 months

Review of current infection control practices

The infection control team and project team reviewed current infection control practice within the Trust to identify areas of good practices but also areas that needed improvement to aid in reducing the current level of MRSA in the unit. The team identified that a number of policies and good practices were in place. These included:

- The Primary Care Trust worked closely with NUHT in terms of monitoring MRSA bacteraemia and could confirm that NUHT have implemented the use of MRSA care bundles from the Department of Health High Impact Intervention. These bundles are a collection of interventions that can be applied to the management of a condition. The interventions in a care bundle were based on evidence based practice (Adair and Kernohan, 2008)
- Hand washing compliance audits were undertaken throughout the year and the importance of hand hygiene was re-iterated by the Matrons and the Director of Nursing. This was done in monthly matron and ward level meetings
- Staff were administering the MRSA protocol after the patient has been swabbed according to Trust policy, and an audit was planned across the organisation within 2 months to monitor the compliance. A new antibiotic prescribing policy was launched in December 2008

The review also identified a number of areas for development. These included:

- Root cause analysis (RCA) of all new MRSA bacteraemias should take place in conjunction with the clinical team involved so that learning is shared better and actions are implemented promptly
- All bacteraemias occurring within 48 hours of admission were to have a further RCA undertaken by the Community Infection Control Team, hopefully improving understanding, and therefore possible prevention of a large number of the bacteraemias beginning outside the acute Trust
- Octenisan body and hair wash was to be introduced to replace hydrex wash that can be drying to the skin
• Chlorhexidine 2% in alcohol skin antiseptic was to be used for all central and peripheral line procedures
• Hand hygiene compliance audits to commence weekly
• The formation of a Joint Infection Control Committee with NUHT and PCT to continue to promote best practice across both the community and the Trust
• An infection alert flag for MRSA to be added on electronic patient record (EPR) and retrospective data to be inputted
• Tristel sporicidal cleaning product to be introduced across the Trust

Engaging with staff: exploring staff beliefs and values
When working in a team, identifying values and beliefs can form the foundation of the team’s direction, as well as their aims and objectives. (Manley, 1997) states “a values tool is useful when starting a journey of cultural change, or as a way of developing a common vision.” The project team involved 15 staff on the Medical Assessment Unit and the Emergency Department in a process to understand the values and belief that the Emergency Department held about their role in infection control.

When the project team started this process, it became clear that the nursing team believed that taking blood cultures was associated with the Health Care Assistant (HCA) as part of their role when they were taking routine bloods. They did not see the role as an advanced part of nursing. The team also expressed they did not believe that they played a valuable role in changing the way their colleagues viewed infection control and it was not ‘everyone’s business’. This surprised the project team as they thought the team would see they had a valuable role in infection control practice. The project team realised that there were barriers that needed to be erased within the multidisciplinary team to encourage best practice.

Observing practice
One way in which these barriers could be erased was through the staff looking more closely at their practice. The project team carried out approximately 6 observations of practice with the nurses and doctors over a 2 month period to observe how the team was interacting with each other, whether there were challenges from the team when they observed poor practice or felt that the patient did not need any cultures or other invasive investigations completed. This was later followed with a critical discussion on what they saw and experienced to establish the gaps between spoken values and those experienced. Most of the team spoke about challenging others in the beliefs and values exercise, and the importance of this, reminding colleagues about the bare below elbow policy to prevent the increase of infection control. However, it was observed that the nursing team approached their nursing colleagues but the medical team did not challenge each other. Most of the medical team was happy not to have the extra task of taking blood cultures and saw the value in leaving this to the Health Care Assistant.

Following the observations of practice, the project team meet with the band 7 and 6 nurses that currently managed the department on a daily basis to discuss developing an atmosphere of good practice in the Trust which would help reduce the spread of MRSA.
The nurses felt excited about this idea but felt intimidated to approach senior colleagues about their practice. They expressed that they:

- Did not feel that they were equipped with the knowledge to challenge others.
- Felt that they required more information from the project and infection control team to challenge poor practice
- Felt that blood cultures were ordered for patients that did not need these invasive investigation but were taken at the time by the junior doctor/nursing team

It was evident to the project team that developing a training programme would be of excellent value as the team needed to challenge poor practice otherwise they would be unable to eradicate poor practice and HCAIs.

After reviewing the information from the values and belief exercise, the project team identified that in order for there to be any success with reducing infection a number of actions needed to be taken; these actions will be outlined below.

**Developing and implementing a training programme**

The information from the values and belief exercise showed that there was a need to implement a training programme and to support the team to reassess their values and beliefs, in order to implement quality care to patients. This training focused on the advanced skills and knowledge needed to take blood cultures. The team also looked at how to challenge poor practice and the importance of doing so. A policy was developed to support key staff in the task of taking blood cultures. The team included senior nurses, site practitioners and clinical technicians that had been trained to complete this task. This policy was launched with the support of the Director of Nursing and Medical Director to encourage compliance and co-operation by staff across the unit.

A comprehensive training package on how to take blood cultures aseptically was then put together by the Professional Development Nurse, Nurse Consultant, and Emergency Department Matron. After training had been undertaken by the nurses in charge of the Emergency Department (Band 6 and 7) and also the Clinical Site Managers, these practitioners were observed taking blood cultures in practice by the project team, using the competency for collection of blood culture assessment form (see Appendix A), to ensure that no theory-practice gap existed. The project team reminded the team about sticking to the Sepsis guideline that was on the Trust intranet before taking blood cultures (see Appendix B). The project team implemented blood cultures stickers to place in all notes when this investigation was completed and to be signed by the practitioner (See Appendix C) with an alert label for patients with known infections to alert the practitioner.

**Hand hygiene audits**

Hand hygiene audits were introduced and completed weekly in accordance with the infection control audit tool and the results recorded and discussed in the Nursing Quality and Accountability System (NQAS). It was an observation audit done by the ward managers or Infection Control Link Nurses in all ward areas. In the Emergency Department, the team took it more seriously after awareness was created about the MRSA
rate. The initial compliance rate was 71% and the team took the following steps to make improvements:

1. The number of staff who could take blood was reduced
2. Education sessions to train staff in blood culture taking were introduced
3. Staff were encouraged through the training session to challenge poor infection control practices
4. Observation audits were introduced which included whether hands were washed before and after a procedure; and after being with being patients; and whether staff were bare below the elbow while in the department

These measures were effective. The hand hygiene audit results in Figure 1 below show an improvement at the end of the year. Figure 1 shows that the initial compliance was 71% in January 2009. However, by December 2009, following the introduction of the measures outlined above, the compliance rate had gradually increased (apart from a dip in May) to 100%.

Figure 1

![Emergency Department Hand Hygiene Audit 2009](image)

Role modelling
Role modelling according to (Ford, 2009) involves timely feedback and good communication between nursing and medical staff. If you are able to give timely feedback to the multidisciplinary team there should be change in behaviour and practice. The project
presented opportunities, such as the training programme, for the project team to role model effective challenge of practice. Florence Nightingale stated:

‘Let whoever is in charge keep this simple question in her head not how can I always do this right thing myself, but how can I provide for this right thing to always be done.’ (Taken from Notes on Nursing, Florence Nightingale, 1969)

Florence Nightingale’s words were interesting because she had clearly recognised the important concept of leadership by influencing the delivery of high quality care through delegation and empowerment. The team was only able to do this by education, support and also the evidence from the hand hygiene data (Figure 1) and the ongoing reduction in MRSA bacteraemias in the Trust (see below)

Evaluation

Improvements in contamination rates
Figures 2 and 3 below show the different types of contamination in blood cultures before the project began in the Emergency Department. These contamination levels were high and costly to the Trust. There is a Department of Health expectation that there will be a contamination rate of less than 5%

Figure 2.
In the financial year 2008/2009, the Trust had a hospital preventable rate of 67% (see Figures 4). However, Figure 5 demonstrates that, following the introduction of a number of systems, policies and procedures as part of this project, the hospital preventable infection rate was reduced to 33%. In addition to reducing absolute numbers, the Trust had reduced the percentage of preventable bacteraemias acquired in hospital by 50%.

Figure 3.

Comparision of positive and negative blood cultures over six month period

In the financial year 2008/2009, the Trust had a hospital preventable rate of 67% (see Figures 4). However, Figure 5 demonstrates that, following the introduction of a number of systems, policies and procedures as part of this project, the hospital preventable infection rate was reduced to 33%. In addition to reducing absolute numbers, the Trust had reduced the percentage of preventable bacteraemias acquired in hospital by 50%.

Figure 4.

MRSA bacteraemia 2008/2009
Conclusion
The project team were able to meet the project aim of reducing healthcare associated infections by changing the approach to the taking of blood cultures and thus, improving patient care. This initiative also had the potential to reduce the length of stay in hospital and the financial burden on the Trust.

This project began by starting to understand the Emergency Department team’s beliefs and values and by taking the time to look at current practice. This involved a process of observation, audit and review, as well as engagement with staff and the development and implementation of a training programme. Agreement was reached that only persons trained in the taking of blood cultures would complete blood culture sampling. The project also demonstrated that effective leadership, leaders acting as role models and promoting best practice, and good communication were vital for any positive change to occur.

This process was supported by meetings with the team at handover times (morning and night) and the provision of visible data that kept them informed of the positive impact of the changes to practice. The staff felt involved as they were kept informed and had the opportunity to provide feedback on the process. There were guidelines on the intranet for the medical team so that they were aware of the changes and the Trust e-mail system was used to disseminate information.

As a result, the changes introduced were beneficial to staff and patients, enhancing the quality and efficiency of the patient journey, and strengthening and sustaining improvement of practice.

This project was supported by the FoNS Developing and Sustaining a Practice-based Strategy for Reducing Healthcare Associated Infections Programme in partnership with NHS London.
References


# APPENDIX A

## Clinical skill – Blood Cultures

### Competency for collection of blood cultures

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<thead>
<tr>
<th>Name:</th>
<th>Date:</th>
<th>Designation:</th>
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<table>
<thead>
<tr>
<th>Competency</th>
<th>Achieved</th>
<th>Not achieved</th>
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<tbody>
<tr>
<td><strong>Pre-procedure</strong></td>
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<tr>
<td>Has a current Trust venepuncture certificate</td>
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<tr>
<td>He/ She is aware of current Trust guidelines on taking blood culture and SPECIFICALLY</td>
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<tr>
<td>a) knows the indications for taking a blood culture and documents this in the notes</td>
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<tr>
<td>b) knows the correct site(s) for taking a peripheral blood culture</td>
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<tr>
<td>c) knows when a central line culture is indicated</td>
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<tr>
<td>d) knows the correct timing for taking a blood culture</td>
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<tr>
<td>e) is able to demonstrate understanding of the procedure as being one that is NOT routine</td>
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<tr>
<td>f) knows the ideal volume of blood to be collected in each bottle</td>
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<tr>
<td>g) has a clear understanding of contraindications to the procedure</td>
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<tr>
<td>h) has a clear understanding of risks of the procedure</td>
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<tr>
<td>Understands the implications of a positive result</td>
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<tr>
<td>Can demonstrate risk to patient of sample not being obtained aseptically</td>
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<tr>
<td>Can identify correct equipment to take to bedside to correctly and safely obtain sample</td>
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<tr>
<td>Valid blood sample request on EPR made – including indication for sampling/ checked/ labels printed and checked for accuracy</td>
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<tr>
<td><strong>Procedure</strong></td>
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<tr>
<td>Introduces self to patient, exchanging pleasantries and discussing reason for test</td>
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<td>Ensures that labels are taken to bedside, and identity confirmed both with patient and wristband</td>
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<tr>
<td>Consent was obtained; explanation and opportunity to ask questions provided</td>
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<tr>
<td>All appropriate equipment was selected (2% chlorhexidine in 70% alcohol/ winged butterfly device/ vacutainer/ gauze/ sharps bin/ blood culture bottles) and prepared prior to procedure</td>
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<tr>
<td>2 sets of 2% chlorhexidine in 70% alcohol swabs identified and collected – 1 for skin, 1 for bottles (2 for bottles if central line culture being performed)</td>
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<tr>
<td>Blood culture bottles checked and deemed suitable for use</td>
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<tr>
<td>He/ She washed his/ her hands prior to the procedure (social handwash)</td>
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<tr>
<td>An appropriate vein was selected</td>
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<tr>
<td>A disposable tourniquet was applied appropriately</td>
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<tr>
<td>The skin was cleansed with 2% chlorhexidine in 70% alcohol</td>
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<tr>
<td>The skin was allowed to dry before venepuncture</td>
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<tr>
<td><strong>Competency</strong></td>
<td>Achieved</td>
<td>Not achieved</td>
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<tr>
<td>The venepuncture site was NOT palpated after cleansing</td>
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<tr>
<td>Plastic lids of bottles removed and bottle tops cleansed with</td>
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13

| 2% chlorhexidine in 70% alcohol swab |   |
| Bottle tops allowed to dry prior to inoculation |   |
| Washed/ decontaminated hands and applied gloves |   |
| Insertion technique was satisfactory |   |
| An adequate blood sample was obtained in each bottle |   |
| Culture bottles held in vertical position to prevent backflow of culture medium into patient |   |
| Aerobic bottle filled first followed by anaerobic |   |
| Asepsis was achieved throughout the procedure |   |
| All equipment and sharps were disposed of correctly |   |
| Pressure applied to puncture site and suitable dressing placed |   |
| Patient assessed for complications |   |
| Collection bottles were correctly labelled immediately at the bedside (labels not removed from bottles) |   |
| He/ She washed his/ her hands (social handwash) |   |
| **Post procedure** |   |
| Documentation completed – The blood culture sticker was filled in and inserted into the patients notes accurately documenting the procedure |   |
| Ensure patient comfortable post procedure |   |
| The procedure for specimen transfer to the lab was followed |   |
| Demonstrates a good standard of communication and professional behaviour with patient and assessor throughout |   |

1) ................................. has today undertaken a blood culture specimen assessment. They have demonstrated the required competence to undertake this skill in the training environment.

2) ................................. has today undertaken a blood culture specimen assessment. They have not demonstrated the required competence to undertake this skill in the training environment and will require further training prior to undertaking this procedure

Assessed by .................................................................

Date .................................................................
Appendix B

Emergency Department

Sepsis
- SIRS plus focus of Infection
- Severe sepsis - sepsis plus organ failure or evidence of tissue hypoperfusion
- Septic shock - severe sepsis plus hypotension refractory to fluid

Indicators of severe sepsis/septic shock:
- CVIS: S (< 90) or drop of > 40 from baseline or MAP < 65
- Hypotension refractory to initial fluid resuscitation
- Resp: New or increased O2 requirement to maintain sats > 90%
- PaCO2/FiO2 ratio < 40 or PaCO2 > 16 on 40% O2. RR < 30
- Renal: Creatinine > 170 or urine > 7, UOP < 0.5 ml/kg/hr for > 2 hrs
- CNS: Altered mental status
- Bloods: Lactate > 4 mmol/L, Thrombin > 35 mmol/L
  Platelets <100, INR > 1.5 or APTT > 60 secs

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SIRS?

Infected likely?

Infections likely?

Initial Sepsis Management - within 1 hour of diagnosis:
- Blood cultures x2, MSU, urine culture as indicated
- ADG if SaO2 < 95% or lactate > 4
- Consider: CXR, amylase, CT, LP

Infection likely?

Inform senior ED doctor

Severe sepsis or septic shock?

Call ITU bleep 087 or Outreach bleep 118

Severe Sepsis / Septic Shock Management

If no response to initial fluid resuscitation or developing pulmonary oedema:
- Insert CVP and arterial lines. Send blood for: central venous and arterial gas, LFT, clotting, C&G, Ca, PO4, blood culture from line
- Catheterise and send CSU - gentamycin 80 mg iv; hourly urine output

Target:
- Sustained rise in CVP to 8 - 12 mmHg (12 - 15 if ventilated)
- MAP = 65, P < 110, UOP 0.5 ml/kg/hour, lactate = 4
- Central venous sats > 70%
- haemacrit > 30% or Hb 7 - 9 (in absence of bleeding or transfusion)
- If bleeding or significant Hb aim Hb 10

Ventriculosty lone unless contraindicated:
- CVS < 70% despite fluids, transfusion, vasopressors and dobutamine
- Pulmonary oedema
- Respiratory failure
- Falling GCS

Indications for Ventilation:
- Prepare fluid bolus 20 mL/kg
- TV 10 - 12 mL/kg, aim to reduce to 6 mL/kg
- Don't forget NGT
- Sedation
- Propofol & Morphine
- CR
- Midazolam & Morphine

Induction:
- TV 10 - 12 mL/kg, aim to reduce to 6 mL/kg
- Don't forget NGT
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- Midazolam & Morphine
- [replace morphine with fentanyl in renal impairment]

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- [replace morphine with fentanyl in renal impairment]
Appendix C

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### Appendix C

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