

Management of positive blood culture results in adults and children: background, laboratory processes and initial steps

Target Audience: All clinical staff managing patients with positive blood cultures (Doctors, Advanced Nurse Practitioners) in NHS Dumfries and Galloway.

Purpose:

Bloodstream infections are associated with significant morbidity and mortality, and early effective treatment improves patient outcomes. This collection of documents provides a standardised overview of the management of positive blood cultures in adults (including pregnant women) and paediatric patients in NHS Dumfries and Galloway.

An appendix with Positive Blood Culture “Cheat Sheets” is included for use in Adult patients to assist with management/treatment decisions and actions. *The general principles in these documents are likely to be of general relevance to paediatric patients though all children with positive blood cultures should be discussed urgently with a Paediatric Consultant.*

Background information and laboratory processes

Importance of blood cultures

- Should be collected in patients with serious infections, prior to administration of antimicrobials.
- Should be taken using ANTT, to avoid contamination and subsequent false positive blood cultures, which can detrimentally impact patient care.
- Take 2 sets of cultures; the interval does not have significant influence. In suspected endocarditis, a minimum of 3 sets should be collected.
- Bottles should be filled to the marked fill line.
- Identifying causative pathogens is important in order to use appropriate antimicrobials on the individual patient level, and monitor resistance patterns.

Initial processing and incubation

- Blood culture samples are placed into an automated incubation system on arrival. Incubation continues until system detects metabolically active organisms is marked as “positive” OR the incubation duration threshold is reached.
- Positive blood culture processing:
 - Laboratory on-site working hours (see table below): Immediate
 - On-call hours: processed the following morning
- Incubation duration threshold:
 - Adult: 5 days, with an initial “no growth” report after 48 hours
 - Endocarditis: extended to 7 days
 - Paediatric: 5 days, with an initial “no growth” report at 36 hours

Gram stain, culture, and susceptibilities i.e. Stages 1-4

- For each positive culture, the following stages (1-4) are undertaken:

IMPORTANT: Gram stain offers a rapid preliminary shortlist of potential pathogens. It is not perfect and may occasionally mislead e.g. Gram positive organisms appearing Gram negative or vice versa, or contaminated BCs. **Results must be interpreted with the clinical picture.**

				Microbiology/ Infectious Diseases Consultant Review
	Gram stain	ID	Susceptibilities	
Stage 1: Initial Gram stain				
Available results:	✓	✗	✗	Advice available "In hours" only For availability, refer to https://tinyurl.com/NHSDG-MicroContact All new positive BCs are followed up the next working day / Monday morning. If the patient is unwell/deteriorating "in hours", we request senior clinicians (i.e. Consultants, Specialist Grades, GCH Doctors) to seek advice from the duty Consultant Microbiologist (ext 33294). Review of urgent cases will be prioritised e.g. significant pathogens with wider management implications (infection control, public health, urgent investigations), urgent change in antimicrobial treatment is required. Any BC with a significant pathogen will be discussed with the clinical team, though the timing of this follow up may vary.
*When:	Result available within 1-2 hours post-positivity within on-site hours. <ul style="list-style-type: none">Positive during off-site hours: processed the following morning			
Comments:	Phoned by Microbiology BMS to current patient location / clinical team. They are not trained to give management advice.			
Stage 2: Confirmation of organism ID				
Available results:	✓	✓	✗	
*When:	Result usually available within 8-24 hours post-positivity. <ul style="list-style-type: none">BCs positive before 10am: ID often available before 5pmBCs positive after 10am: ID available next day			
Comments:	These results are NOT phoned through; when available they are released via electronic reporting systems and <i>marked as provisional results</i> . Clinical teams are expected to actively follow-up and act on results as they become available at stages 2-4 , including re-review of the patient and assessing whether treatment/management changes are required.			
Stage 3: Provisional susceptibility results				
Available results:	✓	✓	✓	
*When:	Result usually available within 24-48 hours post-positivity.			
Comments:	These results are NOT phoned through; when available they are released via electronic reporting systems and <i>marked as provisional results</i> . Clinical teams are expected to actively follow-up and act on results as they become available at stages 2-4 , including re-review of the patient and assessing whether treatment/management changes are required. Likely contaminant organisms (e.g. Coagulase negative staphylococci) do not undergo routine susceptibility testing. Absence / presence of susceptibility results should NOT be considered indicative of clinical relevance – clinical correlation of a positive blood culture result by the clinical team is ALWAYS required. Any changes made based on provisional susceptibility information must be reviewed with the final report to confirm effective treatment.			
Stage 4: Final report				
Available results:	✓	✓	✓	
*When:	Result usually available within 48 hours post-positivity.			
Comments:	Final report with recommended IV and PO treatment options, based on Microbiology Consultant Review			
Laboratory on-site working hours*		Complex cultures		
Mon-Fri: 08:00 - 17:00 Sat: 08:00 - 16:00 Sun: 08:00 - 13:00		<ul style="list-style-type: none">Reporting delays (24-48 hours) may occur with e.g. multiple significant organisms, delayed growth, equipment failure.In rare cases, organisms seen on Gram stain may not grow on culture, preventing susceptibility testing. This will be noted in the final report.		

Advice available "In hours" only

For availability, refer to
<https://tinyurl.com/NHSDG-MicroContact>

All new positive BCs are followed up the next working day / Monday morning.

If the patient is unwell/deteriorating "in hours", we request senior clinicians (i.e. Consultants, Specialist Grades, GCH Doctors) to seek advice from the duty Consultant Microbiologist (ext 33294).

Review of urgent cases will be prioritised e.g. significant pathogens with wider management implications (infection control, public health, urgent investigations), urgent change in antimicrobial treatment is required.

Any BC with a significant pathogen will be discussed with the clinical team, though the timing of this follow up may vary.

Initial steps when a positive blood culture report is received

Every patient with a new positive blood culture requires clinical review

Seek urgent senior clinical review if NEWS 2 \geq 7

Ensure appropriate antimicrobial therapy is given in a timely manner

All new positive blood cultures are actively followed up by a Microbiology or Infectious Diseases Consultant the next working day / Monday morning, who will prioritise review of urgent cases e.g. likely ineffective current treatment, endocarditis, notifiable diseases

General advice

- Review the patient and gather information
 - Is there a clear source of infection?
 - Does the Gram stain correlate with the clinical picture (refer to Appendix 1-6)?
 - Are they on antimicrobials? If so, which ones?
 - Is the antimicrobial they are on likely to be effective (refer to Appendix 1-6)?
 - Are they clinically stable or not? Is there a clinical deterioration?
 - Is there any history of resistant organisms (MRSA, VRE, ESBL, CPE, C. auris)
- Refer to and consider actions detailed within the Positive BC Cheat Sheet relevant to the reported Gram result (refer to Appendix 1-6)
- Patient unstable or clinically deteriorating: **Seek urgent senior clinical review.**
 - In hours, we request senior clinicians (i.e. Consultants, Specialist Grades, GCH Doctors) to seek advice from the duty Microbiology Consultant (ext 33294).
- Document BC results and decisions on their initial management in the patient case notes.

Gram stain results and further clinical/antimicrobial guidance:

- Positive BC "Cheat Sheets" have been developed for all expected Gram stain results, and are available through the [NHS D&G Antimicrobial Handbook](#). They contain relevant information with regards to expected organisms and resistance, likely source(s) and suggested initial clinical actions (incl. antibiotics). *They have been developed for use in Adult patients*, though contain information that may be of relevance to paediatric patients as well:
 - **Appendix 1: Positive BC Cheat Sheet (Adults):** Gram negative bacilli (GNB)
 - **Appendix 2: Positive BC Cheat Sheet (Adults):** Gram positive cocci ?Staphylococcus
 - **Appendix 3: Positive BC Cheat Sheet (Adults):** Gram positive cocci ?Streptococci
 - **Appendix 4: Positive BC Cheat Sheet (Adults):** Gram negative cocci/coccobacilli (GNC/GNCB)
 - **Appendix 5: Positive BC Cheat Sheet (Adults):** Gram positive bacilli (GPB)
 - **Appendix 6: Positive BC Cheat Sheet (Adults):** Yeasts (?Candidaemia)
- Occasionally, the laboratory may report mixed Gram negative/positive blood cultures and/or is unable to report morphology with certainty (e.g. Gram positive cocci "unable to distinguish shape/morphology"). In these situations, multiple "Cheat Sheets" will need to be referred to.
Seek senior clinician input if there is any uncertainty with regards to the actions required.

Determining likely clinical significance

More likely a pathogen

- Single organism usually considered a significant pathogen *e.g. Staphylococcus aureus*.
- Short time to positivity
- Sustained bacteraemia over several hours/days with same organism detected in several samples

More likely a contaminant

- One or more organism(s) usually considered to be a contaminant *e.g. Coagulase negative staphylococci*
- Time to positivity >48hrs
- Single positive blood culture, not reproducible by repeat sampling

If there is uncertainty about the significance of an organism:

Repeat blood cultures before starting/adding/changing antimicrobials is often helpful.

3.2 Blood culture Gram stain report “organisms not seen”.

- This would not usually be rung out.
- What could this mean?
 - False positive due to:
 - Very high white cell count (white cells also produce CO₂, which causes BC bottles to flag positive)
 - Excess blood volume in bottle
 - Organism has died prior to sample being stained
 - Slow growing / indolent organism needing further incubation
- Further laboratory workup is performed to try to isolate potential pathogens. If further information becomes available, this will be communicated to the ward team.

Acknowledgements

This document was developed for local use within NHS Dumfries and Galloway.

They have been heavily inspired by several similar documents shared with us by NHS Ayrshire & Arran, Liverpool University Hospitals NHS Foundation Trust and University Hospitals of Leicester NHS Trust.