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NHS England

Improving the blood culture pathway

A national review of blood culture pathway processes to support better antimicrobial stewardship and improved patient safety

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1. Executive Summary

Optimising the blood culture pathway is essential in ensuring the best outcomes for patients with sepsis and in providing the most effective antimicrobial stewardship programs.

This document sets out proposals to improve and standardise the pre-analytical phase of the blood culture pathway.

It details the outputs of the antimicrobial resistance (AMR) diagnostics improvement workstream at NHS England and NHS Improvement and examines the required changes to improve existing processes within the blood culture pathway. It concludes with a set of recommendations for best practice.

If adherence to existing microbiology standards is followed, the detection of significant bloodstream infection (BSI) in the population can be substantially improved. Each significant positive blood culture provides an opportunity to improve patient care.

There is also the opportunity for improved speed of detection of positive blood cultures, resulting in: improved antimicrobial stewardship (AMS), improved outcomes from sepsis, early identification of a specific organism, supporting a more accurate infection diagnosis, guiding specific investigations and further management, and early identification of infection control and public health implications.

An increased rate of reporting negative neonatal blood cultures (within 36 hours of collection) also allows early cessation of antimicrobials and earlier discharge where appropriate.

Standardised practice will help to reduce variations in service delivery to improve antimicrobial stewardship, and to improve patient outcomes.

NHS England and NHS Improvement make the following four recommendations for improving the blood culture pathway:

- **Recommendation 1**: Build upon existing national guidance and best practice.
- **Recommendation 2**: Implement local monitoring to identify areas for improvement.

- **Recommendation 3**: AMR to be a core part of clinical leadership and trust governance.
- **Recommendation 4**: Improve regulation and accreditation.

The full NHS England and NHS Improvement report into improving blood culture practices, including national survey results, can be found on the FutureNHS Collaboration Platform

2. Introduction

The burden of disease caused by bacterial infections is immense, making it a leading draw on demand for healthcare resources.

Bacterial infections account for approximately 40% of emergency admissions[1], with 33% of inpatients being on antibiotics at any one time. 66% of total hospital deaths, and 50% of all total bed days[2] are also attributed to this, further demonstrating the catastrophic effects that rising AMR may have.

100,000 BSIs are detected every year in the UK

Despite significant progress in the management of sepsis in England, the sepsis agenda and role of blood cultures in management and diagnosis are rarely discussed in the same forums. Blood cultures are part of The Sepsis Six bundle[2], but once the data is collected, no further detail is provided on what can or should be achieved. The endpoint currently appears to be the collection of the blood culture, but not what can be done with the specimen result to benefit patient management.

There is an urgent need to co-ordinate all the elements required to effectively manage patients with a severe infection in the rapidly changing environment of healthcare provision.

The wide-ranging benefits to improving the blood culture pathway include:
- Improved rates of detection of patients with blood stream infections (BSI)
- Improved patient outcomes
- Reduced length of stay

[1] UKHSA SMI S12 Guidance
[2] ED/ AMU Sepsis Screening & Action Tool, The UK Sepsis Trust

- Rapid identification of specific organisms, supporting a more accurate diagnosis and management of infections
- Improved antimicrobial stewardship

- Reduction in the unrequired use of antibiotics
- Early cessation of antimicrobial therapy in neonates
- Timely infection control and public-health interventions

2.1 Existing microbiology standards

Blood cultures remain the primary diagnostic test available to detect BSI, ascertain the causative organism, and direct the most appropriate antimicrobial to treat the infection. It comprises three interdependent stages, taking place outside and inside the laboratory: pre-analytical, analytical, and post-analytical.

In an optimised blood culture pathway, the most significant positive cultures will be detected within 12 hours of collection.

A 2018 national survey conducted by NHS England and NHS Improvement into blood culture practices showed scope for substantial improvement in the adoption and accreditation of the existing UK SMI S12 standards. The full results from this survey can be found on the FutureNHS Collaboration Platform

3. From sample collection to laboratory

3.1 Blood volume

The volume of blood cultured is key to the detection of BSI**.** There is a direct relationship between blood volume and yield, with approximately a 3% increase in yield per mL of blood cultured[1].

NHS England and NHS Improvement therefore recommend the collection of two sets of blood cultures (two aerobic and two anaerobic bottles) from patients with suspected sepsis. These two sets should provide a volume of 8-10mL per bottle. In alignment with UK standards for microbiology investigations S12 the manufacturers' optimum blood volume recommendations vary and should be followed according to their guidance.

This will be an immediate requirement from April 2022[3]. We will develop further education, training, and implementation materials to support NHS trusts and laboratories meet this requirement. This supporting material can be found on the FutureNHS Collaboration Platform

3.2 Time to analyser

Blood culture systems are monitored for blood cultures from the point at which the blood is placed directly on the analyser. For each hour delay to loading on the blood culture analyser there is both a loss of viability of organisms and an incremental delay to obtaining a result.

Additionally, any delays will cause the temperature of the blood culture to migrate to ambient, also resulting in delays to obtaining a positive culture.

In alignment with laboratory standards, NHS England and NHS Improvement recommends for blood culture sample bottles to be incubated in a blood culture analyser as soon as possible, ideally within a maximum of four hours.

Whilst imperative to the accurate detection to BSIs, minimising delays between collection and receipt in the laboratory is good practice for all specimens, not just blood cultures.

4. Best practice

Good practice across the blood culture pathway encompasses a range of clinical, reporting, and management practices, including:

- An infection service uniting the management of sepsis, the blood culture pathway and AMS, with the provision of learning resources relating to the pathway.
- A regulator and accreditor utilising and auditing key performance indicators of the blood culture pathway that have a significant impact on patient management.

[3] NHS Standard Contract 22/23 (paragraph 41.5)

- Establishing an environment within Trusts where the blood culture pathway is actively managed ‘from board to ward’ by informed multidisciplinary teams (MDTs) utilising data from regular audits of critical components of the pathway.
- Utilising blood culture pathway data by the local sepsis and AMS committees. Local MDTs have the capacity to decide how local pathways are designed to meet the requisite standards. Where required, advice can be sought from regional AMR leads.

The greater the volume, the higher the BSI detection rate.

- *At least* 40mL of blood should be cultured from adult patients for optimum detection of BSI; this requires at least two sets of blood culture tubes to be collected.
- The number of blood culture bottles collected is a poor surrogate for the volume of blood cultured, as bottles are frequently underfilled.

5. Recommendations

Based on the findings of the survey, we propose the following recommendations to improve pre-analytical aspects of the blood culture pathway and standardise best practice by the end of 2024/25:

- **Recommendation 1:** Build upon existing national guidance and best practice
- **Recommendation 2:** Implement local monitoring to identify areas for improvement
- **Recommendation 3:** AMS and AMR to be a core part of clinical leadership and trust governance
- **Recommendation 4:** Improve regulation and accreditation

5.1 Recommendation 1: Build upon existing national guidance and best practice

Implement a governance framework across the blood culture pathway from regulator through to board to the ward, thereby ensuring everyone understands their role, the value of the blood culture pathway, and how to monitor the performance of this pathway accurately.

Ensure all Trusts harness the value, benefits, and expertise microbiology staff (medical, healthcare scientist, and biomedical scientist) can bring to patient pathways. Microbiology staff are unable to improve and develop these pathways in isolation – it is therefore essential that MDTs are formed to improve the blood culture pathway.

Use the blood culture pathway as a pilot and catalyst to improve the pre-analytical phase of other infection pathways in pathology. The pre-analytical phase, although critical to determining the accuracy and validity of tests, is generally overlooked, with current emphasis placed on the analytical phase. A balanced approach is required across all three phases (pre-analytical, analytical, and post-analytical) to yield optimum patient benefits.

Develop a practical summary of UK SMI S12, outlining roles, responsibilities, and 'what good looks like' in terms of the blood culture pathway for the various models of pathology service delivery. This will link to existing resources as well as encompass new resources as they are developed to support performance management, which can be monitored through the NHS Standard Contract to deliver pre-analytical improvements.

Work with education providers to develop training resources on aspects of the blood culture pathway.

Work with national system partners, eg National Contracting, UKAS and the CQC, to develop and implement national levers to support laboratories, NHS trusts, and health systems to meet standards as set out in national guidance. Key performance indicators (KPIs) could then be published by trusts so that these could be available to the public.

Work with national partners (such as the NHS laboratories, NHS Trusts, and health systems, Royal College of Pathologists and the Institute of Biomedical Science) to capture, develop and share examples of best practice, as well as create opportunities for peer-learning via pathology networks.

Work with patient groups, for example The Sepsis Trust, to provide a better understanding of the role blood cultures play in sepsis management and in optimising patient care. This will enable them to assess and challenge local ways of working, where necessary.

5.2 Recommendation 2: Implement local monitoring to identify areas for improvement

Promotion of regular local audits in line with national guidance focusing on two main quality indicators:

- *Collection-to-load time into the incubator*: An indicator to monitor and support local improvements on collection-to-load times, which would be regularly reviewed by organisations, as well as published nationally.
- *Volume of blood*: An indicator to monitor and support local improvements in blood culture sample volumes, which would be regularly reviewed by organisations, as well as published nationally

Through collaborative work with NHS England and NHS Improvement Pathology Transformation teams and the UK Accreditation Service (UKAS), these quality indicators may become the basis of strengthened assessment of pre-analytical pathways in other infection diagnostics.

In addition, regional AMS leads could help organisations to develop and implement strategies that could be shared as standardised practice across networks or regions, reducing variation in practice.

Performance data against these pre-analytical key indicators should be scrutinised at the Trust Board level, where there should be an understanding of the impact of the information on patient care, and by local and Regional sepsis and AMS teams, who can use this data to drive improvement work.

5.3 Recommendation 3: AMS and AMR to be a core part of clinical leadership and trust governance

This will need a QI approach across the whole pathway, through collaborative working between those who obtain specimens, transport providers, and pathology services. With the use of QI cycles, or other improvement methodologies that use local audit and national indicator data to drive improvement.

Clear local leadership of a multidisciplinary approach to blood culture QI, bringing together microbiology and AMR/AMS teams, sepsis leads, frontline clinical

representatives, healthcare scientists, and clinical support teams, with assistance from NHS regions and ICSs.

Integration of blood culture improvement work into existing governance structures, such as those in place for sepsis, AMR/AMS, and/or IPC oversight to help secure a ‘board to ward’ focus on improvement.

5.4 Recommendation 4: improve regulation and accreditation

Work with UKAS and CQC to ensure a balanced end-to-end pathway focus on key processes inside and outside of the laboratory to ensure test results support the best outcomes for patients and appropriate use of antibiotics.

6. Next steps

Following on from the publication of this guidance, the National AMR Diagnostics Team intend to implement the recommendations by undertaking the following next steps. Please refer to the AMR Diagnostics FutureNHS Collaboration Platform for further detail:

- Develop with UKAS and laboratories a ‘checklist’ or practical ‘what good looks like’ assessment guide for inspectors and laboratory teams to be able to self-assess against KPIs of the pre-analytical blood culture pathway that have a significant impact on patient management.
- The local MDTs have the capacity to decide how the local pathways are designed to meet the requisite standards. Where required, advice can be sought from regional AMR leads.
- Work with our National Pathology Transformation Team to include indicators in the Pathology Quality Assurance Dashboard (PQAD) dataset to help measure baselines and monitor improvement. Also, work with our contracting and commissioning teams for consideration of key indicators to be included in the NHS Standard Contract for commissioners to work with regarding improvement, and potential inclusion in the Model Health System.

- Work with system partners to develop education and training.
- Support the establishment of an environment within Trusts where the blood culture pathway is actively managed ‘from board to ward’ by informed MDTs using data from regular audits of critical components of the pathway.

7. Acknowledgements

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- UKAS
- Institute of Biomedical Science

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