BD PLMR HEALTHCOMMS IBMS Institute of Biomedical Science

Lost in the bloodstream: A Holistic Approach to Blood Culture Improvement

April 2025

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Becton Dickinson (BD) have commissioned PLMR Healthcomms to undertake this data collection and analysis of current blood culture pathways across NHS Trusts. In commissioning this work, BD have agreed to relinquish editorial control of this report, which has been compiled by PLMR Healthcomms based on evidence collected through Freedom of Information requests to NHS Trusts and oral evidence sessions with individuals across the blood culture pathway.

With particular thanks to the following for sharing their experiences of their local blood culture pathway and for contributing to this report:

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Ricardo Davis – Microbiology Laboratory Manager, The Princess Alexandra Hospital NHS Trust
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Foreword from Chief Executive David Wells, Institute of Biomedical Science

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Blood cultures are fundamental in the rapid detection and management of bloodstream infections (BSIs), crucial for effective patient care and the global fight against antimicrobial resistance. This timely report provides valuable insights into current practices, identifies barriers to improvement, and offers actionable recommendations to strengthen diagnostic pathways across healthcare services.

The IBMS fully supports the methodology and findings of this report, particularly the emphasis on improving education, training, and awareness of best practice and guidance. We recognise that achieving consistent adherence to national standards requires not only robust frameworks but also a highly skilled, adequately supported workforce. Biomedical Scientists and laboratory teams play a pivotal role in ensuring diagnostic accuracy and quality assurance. However, their ability to contribute effectively relies on dedicated investment in workforce development, protected time for training, and appropriate resources.

We strongly advocate for measures that prioritise laboratory professionals in strategic decision-making and resource allocation. Continued investment in laboratory infrastructure, workforce training, and integrated diagnostic IT solutions is essential for addressing current challenges and enabling continuous improvement.

The IBMS remains committed to supporting initiatives that promote equitable access to diagnostic services and enhance patient safety. We urge healthcare leaders and policymakers to act on the recommendations within this report, ensuring that laboratory professionals are given the necessary support to fulfil their critical role in managing bloodstream infections effectively and consistently.

By recognising and empowering biomedical scientists and laboratory staff, we can collectively improve diagnostic accuracy, patient safety, and the effectiveness of the entire blood culture pathway.

Executive Summary

Blood cultures remain the primary diagnostic test for detecting bloodstream infections (BSI) and determining the appropriate course of treatment. If adherence to existing best practice standards for collecting and processing blood cultures are followed, the benefits include quicker detection and treatment for BSI and the opportunity to yield many more BSI diagnoses in an acute hospital Trust at the speed required.

Furthermore, accurately and efficiently collected blood cultures are crucial to ensure targeted antibiotic administration and improve antimicrobial stewardship. Early identification of the specific infection supports more accurate infection diagnosis, targeted investigation and management, and early identification of infection control implications.

This report explores the challenges and potential opportunities within the blood culture pathway in optimising and implementing best practice and sets out recommendations to support standardisation and improvements in the pre-analytical stage of the blood culture pathway.

It details the outputs of a series of focussed discussions with individuals across the blood culture pathway, from those taking the cultures, to those testing samples in the laboratories, through to Trust and regional leadership. This data collection sought to understand the real-world barriers to local uptake of blood cultures best practice, what solutions can be applied to different areas across the country, and what support Trusts, hospitals and healthcare professionals still need to make recommended improvements a consistent reality.

The evidence collected identified three common challenges facing Trusts and individuals in implementing blood cultures best practice including:

1. Large scale regional variation in implementation plans across Trusts resulting in considerable variation in practice.
2. Infrastructure challenges and technological constraints.
3. Education, training and awareness of best practice and guidance.

To address these challenges and optimise blood culture pathways, this report outlines a series of recommendations for Trusts, NHS regional leaders, and central government.

The NHS should:

- Encourage local Trusts to develop a clear implementation framework for their blood cultures pathway improvement with clear milestones and timelines for achieving these, along with benchmarking data for the country. This should include a portfolio of best practice examples.
- Establish a national reporting system that annually collects audit data on the blood cultures pathway that can be used to continually identify variation in practices, areas requiring support for improvement, and track progress over time.
- Invest in and support the training, development, and retention of the biomedical scientist and laboratory workforce to ensure ongoing excellence in blood culture processing, quality assurance, and innovation.
- Continue to evaluate current e-learning materials and training modules, update where necessary and disseminate widely in collaboration with universities, professional bodies and societies, royal colleges, charities and advocacy groups, pathology networks, Trusts, and individual hospitals.

NHS regional leaders should:

- Optimise blood culture analyser utilisation and audit existing equipment and resources, exploring options to streamline workflows and collaborate across disciplines and Trusts to increase analyser capacity.
- Support the ongoing building and establishment of pathology networks to support the facilitation and purchasing of upgraded, integrated, and effective technologies to improve data integration and communication within and across Trusts.

NHS Trusts and hospitals should:

- Integrate the quality and governance systems for the blood culture pathway within Trust governance and improvement structures. Data on contamination rates should be shared regularly and actioned by Trust leadership.
- Designate a blood culture champion responsible and accountable for leading improvement efforts in the blood culture pathway.

We hope this resource will support healthcare providers and professionals to make informed decisions about practices, protocols, training, and resource allocation to address barriers to best practice and enhance patient care.

Introduction

Bloodstream infections (BSI) are one of the most serious acute infections and over 130,000 are detected every year in the UK.[1] Bloodstream infections account for approximately 40% of emergency admissions and 66% of total hospital deaths.[2]

Blood cultures remain the primary diagnostic test for detecting BSI and determining the appropriate course of treatment. If patients are to have a BSI diagnosed and treated quickly, it is vital that the process of blood cultures collection is undertaken correctly the first time, and that cultures are analysed quickly to produce a timely diagnosis. By optimising collection and analysis there is potential to yield many more BSI diagnosis in an acute hospital Trust and treat patients, particularly with sepsis, at the speed required.[3]

Furthermore, accurately collected blood cultures are crucial to ensure targeted antibiotic administration, vital in the battle against antimicrobial resistance (AMR). With fewer effective antibiotics being made available and increasing failure rates of antimicrobial therapies, missed opportunities to optimise the blood culture pathway puts the effectiveness of these remaining antibiotics at risk.[4]

Over the last ten years, NHS England, Public Health England, and now the UK Health Security Agency have sought to determine and publicise national standards and guidelines for optimal blood culture collection and processing. While NHS Trusts and hospitals have made good progress in improving their blood culture pathways, it has been slow, with incremental improvements over many years. There are continuing gaps in best practice and variation in the pathway, people, process, and technology.

As this report explores, effective implementation relies not only on consistent adherence to national guidelines but

[1] W. V. Kern and S. Rieg, 'Burden of bacterial bloodstream infection - a brief update on epidemiology and significance of multidrug-resistant pathogens', *Clinical Microbiology and Infection, 26,* (2020), 151-157.

[2] Public Health England, 'Infection Prevention and Control: An Outbreak Information Pack for Care Homes', (Sept, 2017); National Institute for Health and Care Excellence, 'Healthcare-associated infections', *Quality Standards: QS113,* (2016); NHS England, 'Improving the blood culture pathway: A national review of blood culture pathway processes to support better antimicrobial stewardship and improved patient safety', NHS England, (2023).

[3] S. Powis, S. Hill and M. Wilcox, 'Diagnosing sepsis and serious infections', *NHS England*, (Feb, 2024), accessible via: https://www.england.nhs.uk/long-read/diagnosing-sepsis-and-serious-infections/#_ftn1 (last accessed 29/07/24); M. J. Weinbren and M. Collins, 'A request for standardization of publishing of blood culture processing interventions'. *Clinical Infectious Disease,* 66, (2018), 1484–1485.

[4] R. Stevenson, P. Pillai and J. Freeman, 'Blood Culture Pathway', *The Royal College of Pathologists*, (Jan 2023), accessible via: https://www.rcpath.org/profession/publications/college-bulletin/january-2023/blood-culture-pathway.html (last accessed 29/07/24).

also on the expertise of those responsible for processing and analysing blood cultures – including the pathology networks and laboratory staff who play a vital role in ensuring accurate and timely diagnostics.

To understand why hospitals, Trusts, and regional services have been unable to consistently implement improvements across the NHS over the last 10 years, PLMR Healthcomms, in partnership with Becton Dickinson, has undertaken a programme of oral evidence sessions to collect the insights and the experiences of individuals across the blood culture pathway. We have heard evidence from those taking the cultures, to those testing samples in the laboratories, through to Trust and regional leadership. This data collection sought to understand the barriers to local uptake of blood cultures best practice, what solutions can be applied to different areas across the country, and what support Trusts, hospitals, and healthcare professionals still need to make recommended improvements a consistent reality.

The evidence collected identified three common challenges facing Trusts and individuals including:

1. Large scale regional variation in implementation plans across Trusts resulting in considerable variation in practice.
2. Infrastructure challenges and technological constraints.
3. Education, training and awareness of best practice and guidance.

NHS England have highlighted the need for a board to ward approach, and it is key that this is continued to improve results for patients across the blood culture pathway. This approach requires buy-in from individuals across a range of different roles and locations across the entire blood culture pathway. Laboratories are not able to deliver successful pathways alone and improvement requires cross-departmental collaboration, with targeted education and appropriate governance and recording mechanisms in place to audit, monitor, and report on blood culture pathway performance against set standards.

NHS England's most recent guidance, published in March 2023, announced a two-year implementation period for its recommendations. This report explains the challenges facing acute care in optimising the blood culture pathway and makes recommendations on how Trusts, regional leads, and NHS England can support hospitals and healthcare professionals to overcome these challenges. Included are examples of instances where innovative and cost-effective solutions have been developed to improve blood culture pathways, reduce AMR, and ultimately improve patient care and safety.

Existing National Standards and Guidelines

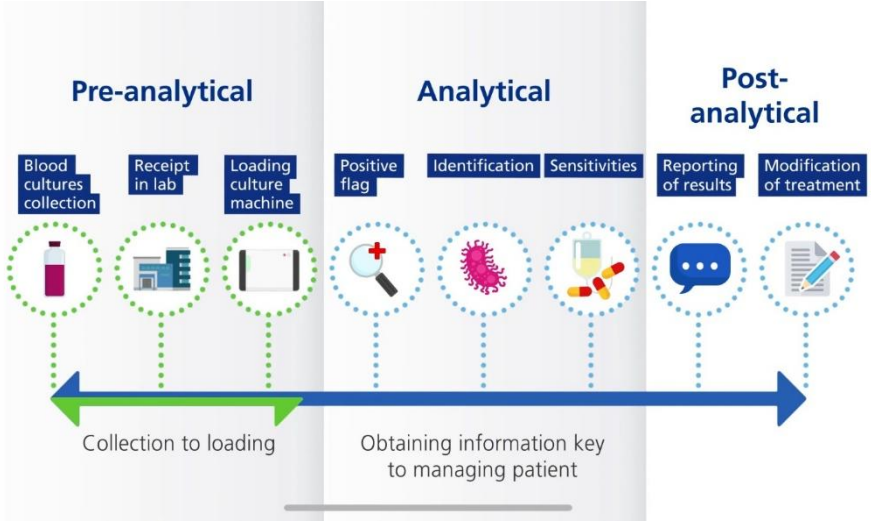

Figure 1: Image from NHS England Workforce, Training and Education YouTube video 'Improving the blood culture pathway - Overview'

Despite the importance of blood cultures in diagnosing BSIs and in antimicrobial stewardship, achieving consistent best practices in blood culture collection and processing across all hospitals in England has remained a challenge. Over the last ten years, the UK Health Security Agency (UKHSA), formerly Public Health England (PHE), and NHS England have published recommendations and guidance for the microbiological investigation of BSIs and how Trusts and hospitals can optimise their blood culture pathways to

improve patient outcomes and antimicrobial stewardship. Nonetheless, implementation of published national guidelines and standards has been inconsistent across the country and there remains huge variation in practice and compliance with standards.

In 2014, Public Health England published UK Standards for Microbiology Investigations *(SMI) B37: Investigation of blood cultures* that aimed to set standards for each stage of the blood culture pathway.[5] UK SMIs are a comprehensive resource for both laboratory professionals and clinicians. They outline recommended procedures covering all stages of the investigative process in microbiology from the pre-analytical (clinical) stage to the analytical (laboratory testing) and post analytical (result interpretation and reporting) stages, ensuring consistency and public health surveillance.

To track progress against SMI B37 standards, in 2018 through to 2020, NHS England carried out a national survey to investigate blood culture practices across NHS Trusts using the standards as a benchmark. The survey showed the need for substantial improvement in the adoption and accreditation of the existing SMI B37 standards and highlighted the need for a board-to-ward-to-laboratory approach.

In parallel to NHS England's survey, the UK Government was developing a 20-year vision for tackling antimicrobial resistance which identified BSIs and sepsis as clinical priorities in the first 5-year increment from 2019-2024.[6] The plan sought to outline a strategy for optimising the use of antimicrobials and encouraging innovation in new diagnostics, therapies, and interventions. To help achieve the ambitions set out in the AMR National Action Plan, NHS England called for action to improve the blood culture pathway to ensure accurate and prompt diagnosis of sepsis and BSIs.

In response to the findings of their 2018 survey, NHS England convened a blood culture pathway Task and Finish Group to work with the AMR Diagnostics Board and NHS Improvement. Using NHS England's 2018 survey findings, the Group made a series of recommendations and outlined key improvement steps to help NHS Trusts optimise their blood culture pathway, which were published in a report titled 'Improving the blood culture pathway'. Alongside expediting the time to analysis, the guidance sought to increase the diagnostic yield by increasing the number of blood cultures taken from patients with suspected sepsis to two sets (two aerobic and two anaerobic bottles) and increasing the volume of blood taken to a total of 40ml. The executive summary, published and updated in March 2023, is publicly available.[7] The report does not change the standards set out in SMI B37, but outlines the key actions required by Trusts to support pathway improvement and focuses specifically on the pre-analytical stage of the pathway.

It makes four key recommendations:

1. Build upon existing national guidance and best practice.
2. Implement local monitoring to identify areas for improvement.
3. AMR must be a core part of clinical leadership and Trust governance with the integration of blood culture improvement worked into existing governance structures.
4. Improve regulation and accreditation assessment by Care Quality Commission and UK Accreditation Service of end-to-end pathways to embed best practice.

In alignment with NHS England's recommendations and recent guidance, the UKHSA updated the microbiology standards for collecting and processing blood cultures with *SMI S12: Sepsis and systemic or disseminated infections* in January 2023.[8] These standards highlighted that significant changes were needed in both clinical and laboratory

[5] Public Health England, 'UK Standards for Microbiology Investigations: Investigation of blood cultures (for organisms other than Mycobacterium species', *Public Health England, B37: 8.2,* (Sept 2019).
[6] Department of Health and Social Care, 'Tackling antimicrobial resistance 2019-2024: The UK's five-year national action plan', (Jan 2019).
[7] NHS England, 'Improving the blood culture pathway', (2023).
[8] UK Health Security Agency, 'UK Standards for Microbiology Investigations: Sepsis and systemic or disseminated infections', S 12: 1 (Jan, 2023).

practice to improve the sensitivity and utility of blood cultures, crucial to the control of inappropriate usage of antimicrobials. Nevertheless, SMI S12 has largely built on SMI B37 with little substantial changes made between the two sets of guidance. Key provisions within both sets of SMI standards and NHSE England's recommendations include:

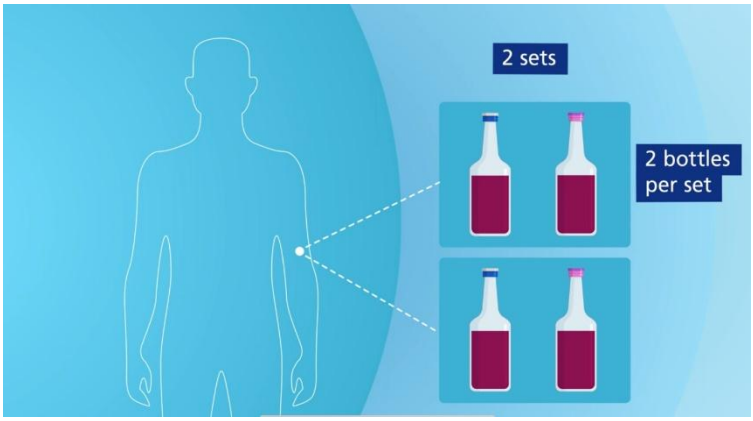

Figure 2: Image from NHS England Workforce, Training and Education YouTube video 'Blood Culture Pathway: Taking a blood culture'

- The collection of adequate volumes of blood for culture, as every ml of blood increases the sensitivity of the blood culture by 3%.
- A minimum of two blood cultures sets (2x2 bottles), with 8-10ml of blood per bottle are recommended to detect bacteriaemia, which can be collected in one draw.
- Blood culture bottles should be transported to the laboratory and loaded into a blood culture analyser without delay, ideally within four hours of collection.

NHS England's, 'Improving the Blood Culture Pathway', report recommended a phased approach to embedding good practice and recommended two phases of implementation. In year one it recommended that the volume of blood culture should be routinely measured, and this should form part of a programme to improve performance, including education around the importance of blood cultures in delivering effective patient care. This report also outlined that Trusts should take concrete steps to monitor, record and report the impact of these education efforts. It recommended that by the end of year two (March 2025) "the majority of adult patients with suspected BSI should have two blood culture bottle sets collected".[9]

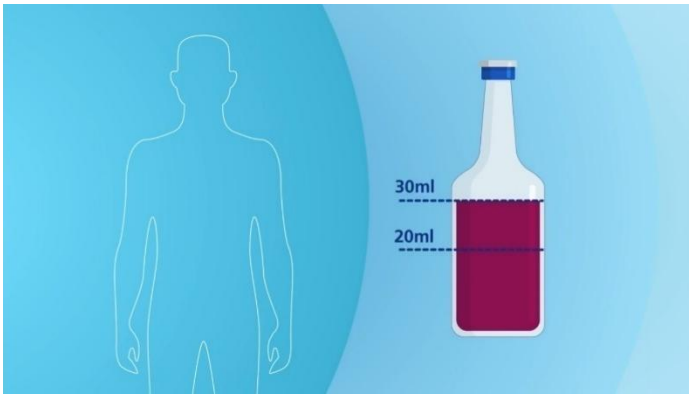

Figure 3: Image from NHS England Workforce, Training and Education YouTube video 'Blood Culture Pathway: Taking a blood culture'

Further, the report built on SMI B37 in recommending that Trusts undertake regular audits as a way of maintaining and improving quality across the blood culture pathway. It noted that without audits, it is difficult to determine whether the pathway is functioning optimally and where there are local challenges in implementation. As such, in 2023, NHS England instructed regional quality and AMR leads to support their local Trusts to audit the pre-analytical stage of the blood culture pathway, where blood is collected from the patient, transported to the laboratory and loaded onto the blood culture analyser.[10] This audit would determine baseline performance against SMI S12 standards and inform the development of local improvement actions plans.[11] To aid this baseline data collection, the Office of the Chief Scientific Officer at NHS England developed an audit tool, available via the FutureNHS platform. Further, NHS England committed to working with the Care Quality Commission (CQC) and UK Accreditation Service to ensure that their recommendations and audit data is reflected in their laboratory assessments, using ISO 15189.2022 standards.

[9] NHS England, 'Improving the blood culture pathway', (2022).
[10] Powis, Hill and Wilcox, 'Diagnosing sepsis and serious infections'.
[11] Powis, Hill and Wilcox, 'Diagnosing sepsis and serious infections'.

Room for Improvement

To support NHS England's audit data collection and to provide a snapshot of progress halfway through the auditing phase, PLMR Healthcomms, supported by BD, circulated Freedom of Information (FOI) requests across NHS Trusts in the UK throughout 2023. This sought to understand the operational practice of blood culture pathways across the NHS and to understand the progress made against NHS England's 2018 survey results and since the publication of its 2022 recommendations. The focus of investigation was later refined to focus solely on England due to the lack of data received from the devolved nations. NHS England's 2022 local and national recommendations were used as a basis for the FOI campaign. The data collected from over 90 NHS Trusts in England found significant improvement in blood culture practices in comparison to NHS England's 2018 survey results but indicated continuing gaps in best practice and variation in the pathway, people, process and technology. In particular, the data showed that:

- 100% of Trusts have a process in place for skin preparation and cleaning prior to blood collection.
- 37% of Trusts routinely took 2 sets of blood cultures when collecting blood from patients.
- 35% of Trusts outlined that they record collected blood culture volumes.
- 64% of Trusts routinely measure the time between blood culture collection and analysis.
- 68% of Trusts collect data on blood sample contamination.
- 32% of Trusts report data of blood contamination to a Board level.

A further FOI outreach in 2024 found that:

- 67% of Trusts use a licensed skin antisepsis applicator prior to blood culture collection.
- 62% of Trusts know their contamination rate of blood cultures, with just 20% of Trusts reporting contamination rates equal to or less than the 3% benchmark.

Fig 4. ICS average of Trusts which measure the volume of blood drawn in each blood culture

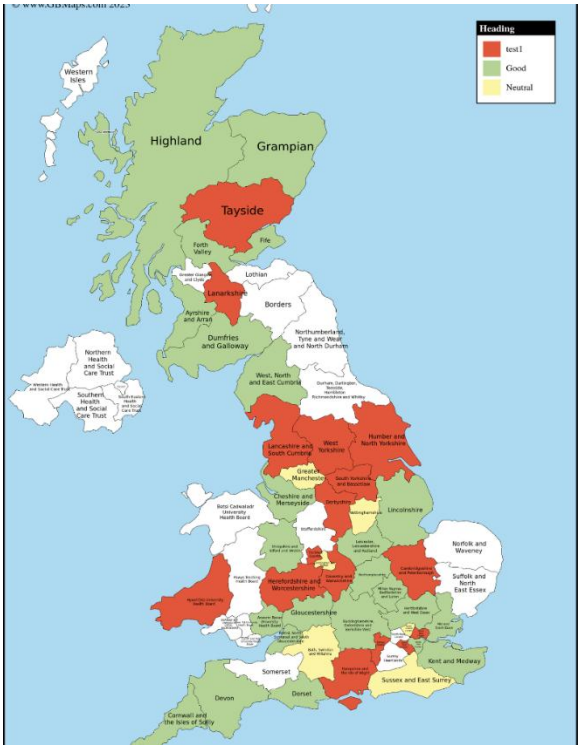

Fig 5. ICS average Trust times from blood sample collection to analysis

The data collected alongside the existing national standards and guidelines for blood cultures highlights the need for cross-departmental collaboration and an end-to-end pathway approach that looks beyond disciplinary boundaries. Executive teams, Trust boards, and clinical teams must work together to ensure optimised pathways are being established and followed.

While the local audit data has now been collected and is being analysed by NHS England, regional and AMR leads wait for the results and guidance on creating and implementing their local improvement plans to avoid variation across the country. Each region will produce a summary which shows how the acute Trusts and/or pathology network are improving, as well as how an improvement action could be put in place by each pathology network of Trusts.

Methodology

While results of this FOI exercise show improvements in NHS blood cultures practice relative to NHS England's 2018 survey, national guidelines and standards for blood culture pathways have not yet translated into consistent best practice, and there is still variation in pathways, people, process, and technology across the NHS.

To understand why hospitals, Trusts, and regional services have been unable to implement improvements in full over the last ten years, PLMR Healthcomms, in partnership with BD, has in 2024 undertaken a programme of oral evidence sessions to collect the insights and the experiences of individuals across the blood culture pathway. This data collection sought to understand the real-world barriers to local uptake of blood cultures best practice, what solutions can be applied to different areas across the country, and what support Trusts, hospitals and healthcare professionals still need to make recommended improvements a consistent reality.

Over a series of focused discussions, each lasting a minimum of 30 minutes, evidence was collected from 24 individuals across the blood culture pathway from those taking the cultures, to those testing samples in the laboratories, through to Trust and regional leadership. Evidence was collected from nurses, microbiologists, sepsis leads, pathology directors, pathology network leads, regional healthcare leads, and individuals from within the UKHSA, the Sepsis Trust and National Association of Phlebotomists.

Participants included:

Bruce Daniel – Head of Pathology, NHS England South West
Claire Burnett – Sepsis Lead Nurse, Royal Berkshire NHS Foundation Trust
Debra Jackson – Microbiology Operational Manager, Northumbria Healthcare NHS Foundation Trust
Faisal Bin-Reza - Clinical Director of Pathology at Mid and South Essex NHS Foundation Trust & East of England Regional Pathology Lead
Helen Liggett – North West Regional Healthcare Science Lead, NHS England
Ian Sturgess – Group Director of Operations, Clinical Diagnostics, University Hospitals Coventry and Warwickshire NHS Trust
Jacqui Hough – Phlebotomy Manager, Ashford and St Peter's Hospital NHS Foundation Trust; Phlebotomy Co-ordinator, Berkshire and Surrey Pathology Services; and President, National Association of Phlebotomists.
Jane Thomas – Senior Biomedical Scientist, Microbiology, Wye Valley NHS Trust
Jon Steer – South West Head of Laboratory Operations, UK Health Security Agency
Katy Lomas – Infection Sciences Service Manager, UK Health Security Agency
Kenneth Barr – Clinical Director of Pathology, Wye Valley NHS Trust
Kevin Nulty – Pathology Service Manager, Bedfordshire Hospitals NHS Foundation Trust and Regional Pathology Lead for the Midlands.
Libby Mills – Diagnostic Programme Manager, NHS England North West
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Ron Daniels –Founder and Joint CEO, Sepsis Trust
Selina Hoque – Consultant Medical Microbiologist Laboratory Lead, Torbay and South Devon NHS Foundation Trust
Shabnam Iyer – Consultant Microbiologist, Royal Berkshire NHS Foundation Trust
Simon Eccles – Microbiology Laboratory Manager, Manchester University Hospitals NHS Foundation Trust

The questions posed were designed to understand and unpick the real-world challenges faced by individuals, hospitals, and Trusts across the blood culture pathway and discover any ways of working and implementing improvements that can be applied to other areas of the country. Participants were asked about their current blood culture pathways, the biggest challenges they have faced individually, or their hospital/Trust has faced in optimising performance across the blood culture pathway, and what areas or processes are prone to errors and delays. Participants were then asked about resource and equipment limitations that hinder adherence to best practice, and about the communication channels between laboratories, clinicians, other departments and upwards to hospital/Trust/regional leadership. Discussions then focused on specific interventions or initiatives aimed at improving the pathway that had been successful, alongside those that had struggled to secure board buy-in, resource, or a change in practice. Lastly, participants were asked what interventions or changes they thought would have the greatest impact on improving patient outcomes and what initiatives or programmes would have the most potential to improve the efficiency and accuracy of the blood culture pathway.

Through these focused conversations, a comprehensive understanding of the challenges and opportunities within the blood culture pathway emerged, fostering a shared commitment to progress and improvement. Nevertheless, what became clear was that executive teams and Trust boards must work with clinical teams and pathology to set timelines

for improvement delivery and establish reporting and accountability structures to ensure that pathway improvements are made, and optimised pathways are being followed.

Reporting Headlines

The evidence collected identified three common challenges facing Trusts and individuals in implementing blood cultures best practice including:

1. Large scale regional variation in implementation plans across Trusts resulting in considerable variation in practice.
2. Infrastructure challenges and technological constraints.
3. Education, training and awareness of best practice and guidance.

(1). Large scale regional variation in implementation plans across Trusts resulting in considerable variation in practice.

NHS England's national guidance is perceived as lacking clarity on implementation with no repercussions for non-compliance or incentives for improved patient outcomes. NHS England are not in a position to mandate the blood culture pathway guidance implementation. However, there is clear instruction in the E-learning platform as to how to continuously improve the blood culture pathway, but these resources are not being accessed by interviewees. This also includes a business case template to be utilised by stakeholders.

Without a clear implementation framework for guidance and consequences for non-compliance, staff within Trusts have struggled to develop convincing business cases for pathway improvement measures, despite templates existing. With no mandate attached to blood culture collection and processing, quality data collection is not always carried out and reporting of this does not always reach board level, meaning potential long-term savings achieved through improvements are not discussed and recognised at the level receiving and deciding on the financial requests. Further, board leadership tends to focus on immediate cash-releasing efforts, rather than prioritising longer-term cost-effectiveness and the return on investment that blood culture collection and processing can provide. Consequently, financial and resourcing requests for instruments, including critically bottles and analysers, staff, and transport/portering, have been de-prioritised and struggle to receive cut-through with Trust leadership.

Several staff groups are involved in the blood culture pathway, which necessitates a multidisciplinary team approach by NHS Trusts. The benefits of an optimised blood culture pathway include better patient outcomes, reduced length of hospital stays, and improved antimicrobial stewardship, helping to preserve antibiotics for future use. Each member of the multidisciplinary team plays a crucial role in developing local practices that significantly impact patients, the community, and healthcare services. NHS England's work with the Care Quality Commission and UK Accreditation Service to improve regulation and accreditation has focused on laboratory assessments, placing a large financial and resource burden on laboratories to ensure that NHS England's recommendations for key processes are complied with outside the laboratory and their remit. Trusts have a responsibility to put a service level agreement in place to abide by NHS England recommendations in relation to blood cultures. Efforts to regulate and ensure implementation of the recommendations must not penalise laboratories alone, and the financial cost of improvements should be spread across all disciplines along the pathway.

Furthermore, a breakdown in the flow of information both up to regional leads and NHS England, and down to Trusts, hospitals and healthcare professionals has impeded on effective implementation of guidance. Many individuals were unaware of their regional leads, best practice sharing between Trusts is rare, and many were unsure on how to access relevant resources and data from NHS England and the Future NHS platform. Moreover, many Trusts lack the necessary champions responsible and accountable for blood culture pathway improvement that is required to coordinate communication, identify gaps in best practice, develop business cases and drive improvement at all levels. This has impacted on staff's ability to develop convincing business cases that communicate the importance of correct blood

culture collection, including collecting sufficient volume in two sets and loading onto an analyser within four hours, and which use data on long-term cost savings and system benefits of implementing change.

Recommendations

- Quality and governance systems for the blood culture pathway should be integrated within Trust governance and improvement structures to strengthen accountability. This should include the measurement of appropriate quality assurance indicators and the identification of an accountable board member within Integrated Care Boards.
- The NHS should continue to develop a tiered implementation framework for their blood cultures pathway improvement guidelines with clear timelines and milestones. This framework should outline the different stages of implementation for Trusts of NHS England's guidelines, with achievable goals and benchmarks. It should also specify timelines for achieving these milestones.
- The NHS should establish a national reporting system that annually collects audit data on the blood culture pathway. This system should collect data annually on compliance with fill volume and sets, contamination and time to loading rates, and reporting of data to board level, much like the initial audits completed by Trusts for NHS England in 2023/24. This data can be used to continually identify areas for improvement and track progress over time across Trusts and regions.
- It is vital that communication channels between NHS England, regional leads, Trusts, and healthcare professionals are improved. Trusts should designate blood culture leads responsible and accountable for leading improvement efforts in the blood culture pathway within the Trust. This individual will have direct and regular communication with Trust, regional and NHS leadership, and with clinical teams. The individual should be a senior leader with the authority to influence resource allocation and drive change, creating blood culture champions within Trusts.

Success Spotlight: Manchester University Hospitals NHS Foundation Trust

Manchester University Hospitals NHS Foundation Trust has been particularly successful in collating, analysing and presenting potential cost-savings and returns on investment of optimising aspects of the blood culture pathway to Trust leadership. Champions within the Trust have split up best practice guidelines into manageable and realistic targets, focusing first on ensuring that the correct volume of blood is collected across all settings, before implementing targets on collecting two sets of blood cultures. It is widely understood that the number of blood culture bottles collected is a poor surrogate for the volume of blood cultured, with higher blood volumes associated with an increased likelihood of detecting a pathogen.[12] As such, champions have recommended the following to their Trust to optimise the blood culture pathway:

1. Engage with blood culture analyser suppliers and invite them to hospital sites to educate practice education facilitators in best practice to achieve optimal fill volume for onward cascade training.
2. Create messaging and promote NHS England's e-learning modules, alongside creating their own training programmes which reinforce the optimal fill volume of 8-10ml per bottle.
3. Targeted training provided to high usage areas in how to comply with blood culture standards with microbiology supporting the creation of training materials.
4. To facilitate compliance, microbiology will continually monitor fill volume and engage with areas showing poor compliance directly through trust quality team.

In applying a phased approach to implementing improvements, the Trust will be able to directly attribute results to their efforts. Further, the Trust's exemplary financial modelling, used to develop the business case to support financial requests for pathway improvement measures, has been helpful for neighbouring Trusts in their regions developing their own business cases.

[12] E. Birkhamshaw and G. Winzor, 'Increasing the volume of blood received in adult paired blood culture bottles at a Regional Public Health Laboratory: results of a quality improvement project to optimise the diagnosis of bacteraemia, *Infection Prevention in Practice*, 1:1 (Mar, 2019).

(2). Infrastructure challenges and technological constraints.

In order to comply with NHS England's guidance in full, many Trusts may require a re-organisation of their current infrastructure and technology and/or additional resources, staff and technology.

NHS England's guidance requiring two sets of blood cultures puts a strain on many Trusts' current analyser capacity. Compliance would require many Trusts to submit funding requests for additional analysers and in turn, source space to accommodate the additional analysers which can incur extra cost. Given budgetary pressures, Trusts have had to make hard decision in terms of priorities, unfortunately meaning that blood cultures can sometimes be de-prioritised. This has meant that Trusts are struggling to obtain the necessary analyser capacity to implement the guidance in full. Blood cultures have to be treated as a priority, with NHS England asking for staggered improvement in terms of moving on to 2 sets, urging Trusts to adhere to guidance on fill volumes and time taken to load to analysers as the first step.

Further, to meet the standard for incubating blood cultures within four hours of collection, Trusts require the capacity and capability to load blood cultures onto analysers 24 hours a day, seven days a week. However, many hospitals have limited numbers of staff trained to load blood cultures onto incubators out of hours. Many hospitals do not house laboratories on site and struggle to secure the necessary resources and staff required to regularly transport blood cultures from hospitals to laboratories and analysers off-site to meet the four-hour target. All Trusts should promote blood culture champions who are passionate about this work to achieve guidance implementation, such as sepsis lead nurses in acute hospitals.

Continuous improvement and targeting of areas with high contamination rates and delays in loading to analysers, requires robust data collection, digital integration and clear reporting mechanisms. Many Trusts have noted inconsistent data collection on blood contamination data, a lack of effective communication between the laboratory and the individuals carrying out poor practice, and a lack of reporting of contamination rates to senior management. This was seen acutely in the challenges experienced by Trusts in completing their recent audits for NHS England. While the audit tool provided by NHS England was sound, some sites found it harder to collect data depending on their digital systems. Many Trusts struggled without a single Laboratory Information Management System (LIMS) across their Trust and often had many point of care systems link into the LIMS. This leads to delays in accessing results and effectively and consistently monitoring and improving practices. If laboratories lack the necessary infrastructure to meet guidance, this should be flagged as a risk to senior leaders for resolution.

Recommendations

- Regional leaders should optimise blood culture analyser utilisation by conducting an audit of current blood culture analyser usage across Trusts and individual hospitals. This should lead to an exploration of options for leveraging existing equipment and resources more effectively, streamlining workflows and collaborating with other disciplines and neighbouring Trusts to increase capacity.
- The NHS should continue to encourage and support the ongoing building and establishment of pathology networks. These would support the facilitation and purchase of upgraded, integrated and effective Laboratory Information Management Systems (LIMS) and additional blood culture analysers across regions to increase capacity and support integrated and consistent monitoring. This will improve data integration and communication within and across different hospitals, allowing for more efficient data collection, reporting and identification of areas for improvement.
- The NHS should develop a portfolio of examples of best practice on extending blood culture processing capabilities that is readily accessible online- some of which is already available on the NHS futures platform, but is not currently being readily used by staff. This should give an estimate of the staffing levels, resources and logistics required to achieve 24/7 processing and should explore alternative solutions for Trusts that are unable to implement full 24/7 processing, such as improved transportation logistics to alternative centres or point-of-care testing options. This will support blood culture champions within Trusts to put together business cases for increased funding and resources to improve their blood culture pathway.

Success Spotlight: Royal Berkshire NHS Foundation Trust

Until 2016 Royal Berkshire Hospital, situated within the Royal Berkshire NHS Foundation Trust, had an onsite pathology unit comprising of microbiology, haematology and biochemistry departments. In 2016, Royal Berkshire's pathology services became part of Berkshire and Surrey Pathology Services which brought together five acute NHS Foundation Trusts. During this organisational restructuring, the dedicated microbiology laboratory at Royal Berkshire was moved to Wexham Park Hospital, 26 miles away. This meant that, dependent on traffic, blood cultures from Royal Berkshire would be in transit from between 20 minutes to an hour and a half for analysis at Wexham Park Hospital. Given that delays in processing can be the difference between life and death in severe sepsis cases, the consequences of this reorganisation for patients were potentially life threatening. With this in mind, champions within the hospital, such as Claire Burnett, Sepsis Lead Nurse, fought to have several continuous monitoring blood culture systems remain at Royal Berkshire to ensure that the collection and pre-analytic stages of the blood culture pathway could be carried out as quickly as possible, without delays due to transit. Continuous monitoring blood culture systems were moved to sit directly adjacent to the pneumatic air tube system that transported blood culture samples directly from the Emergency Department (ED) at Royal Berkshire.

Whilst this change dramatically reduced transit time within the hospital, the problem remained as to how to ensure that the blood culture samples which are collected 24/7 in ED were also loaded and processed 24/7 to ensure that positive tests were available in a timely manner. It was initially determined that Specimen Reception staff at Royal Berkshire would be ideally placed to process these samples between 7am and 10pm, given their newly established proximity to the continuous monitoring blood culture systems. To avoid a hiatus in blood culture processing overnight between 10pm and 7am, it was determined, after much deliberation and negotiation, that the blood sciences staff who worked during these hours would load and process blood culture samples during these hours. This ensured that the potential for continuous monitoring blood culture systems to process blood culture samples 24/7 was met.

In describing the journey to secure continuous 24/7 blood culture processing at Royal Berkshire NHS Hospital, Shabnam Iyer, Consultant Microbiologist at the hospital, describes the importance of communicating the lifesaving potential of timely and accurate blood culture samples to the range of clinical roles that have a part to play in any blood culture pathway. ED clinicians are vital supporters in communicating the need to keep elements of pre-analytic testing on site at Royal Berkshire; specimen reception staff are crucial in ensuring timely loading and testing of samples during daytime hours; whilst blood sciences staff are vital in ensuring that there isn't a lull in sample processing overnight. Without the engagement and buy-in of these often siloed clinical roles, avoidable delays and insufficient samples can endanger patient lives.

Success Spotlight: Nottingham University Hospitals NHS Trust

In July 2020, a multidisciplinary group was formed at Nottingham University Hospitals NHS Trust to drive antimicrobial stewardship and improve patient care through an improved blood culture pathway. Nottingham University Hospitals houses one of the largest microbiology labs in England onsite and collects upwards of 36,000 blood cultures a year, serving two large hospitals in Nottingham. This group was formed to address the fact that many patients were being treated with broad-spectrum antibiotics due to the lack of a timely and accurate infection diagnosis and a concern that antibiotic therapies cannot be optimised if a causative pathogen is not known. Delays in accurate diagnosis in the pre-analytic stage were two-fold and have been echoed throughout this report: quality of sample and time to process. The initial barrier was that the microbiology lab at Nottingham was only open and funded to be staffed until 8pm on weekdays, with shorter opening hours at weekends, meaning that while samples were being taken continuously 24/7 throughout the Trust, there was a significant gap in their processing overnight. The consequence of this position was significant delays in clinicians gaining access to the results of patients' blood cultures. This led to delays in targeted antimicrobial decision making. Having made a significant business case for the improvement of the laboratory service and the knock-on impact of timely blood cultures processing on in-patient capacity, by December 2021 the

microbiology lab at Nottingham was funded to operate 24/7, with continuous blood culture processing at the heart of this change. It was vital that improvements in laboratory processing were optimised in conjunction with a frontline clinician education drive on blood culture sample quality. A failure to have these two elements of blood cultures improving in parallel would result in limited tangible outcomes in accelerated patient pathways. As part of the effort to provide clear data and improvement metrics to clinical staff and senior management, the antimicrobial stewardship team worked closely with the laboratory, sepsis team and clinical educators to collect quarterly data on blood cultures in ED (where 50% of blood culture samples at Nottingham are taken).

(3). Education, training and awareness of best practice and guidance.

Awareness of the importance of proper practice around blood culture collection is low among those taking blood cultures and there is a disconnect between those taking the cultures, those analysing them and those receiving the results and implementing treatment plans. Ensuring that all staff at all times are aware of and understand how to implement proper technique and best practice in taking blood cultures has been a challenge for a number of reasons.

With staff rotating in and out of hospitals with varying clinical skill levels, there is a constant requirement to upskill and train staff to ensure compliance with protocol. This includes ensuring that staff both new to clinical practice and those well established, understand protocol but also understand the importance of getting blood cultures right and the significant ramifications of non-compliance with for instance, sufficient fill volume, aseptic technique, and timely loading to analyser.

Communication and collaboration between the laboratory and clinical teams is often low resulting in a stunted feedback loop on contamination rates and a lack of targeted support and upskilling for those recording consistently high contamination rates. This is exacerbated by the rarity of clinical champions and ward staff with responsibility and accountability for improving the blood culture pathway and the absence of reporting at board level of contamination rates. This results in a lack of awareness on ways to improve practice, a disconnect between individuals along the pathway and the absence of collaboration to make improvements.

Lastly, while some Trusts have had champions who have taken the time to produce and implement programmes that provide clear instructions on protocols accompanied by visual aids and integration into the existing training, the centralised training and educational materials developed by NHS England have not been widely disseminated resulting in variation across the country in quality and content. The platform used by NHS England, FutureNHS, to house advice on guidelines, educational materials, and best practice, is convoluted and overloaded by a multitude of materials for all therapeutic areas. While a useful space, NHS England must find a more effective way of disseminating educational materials and best practice examples at pace, something which NHS England are in the process of doing.

Recommendations

- The NHS should evaluate current e-learning materials on blood culture collection and processes, update where necessary and disseminate widely in collaboration with universities, professional societies, royal colleges, charities and advocacy groups, pathology networks, Trusts and individual hospitals. Although it is available online, the uptake of this training should be further encouraged through wider dissemination.
- NHS Trusts should ensure that competency-based training modules such as BSAC are mandatory for staff, which are tailored to different staff roles and experience levels. These modules should focus on competency-based learning, ensuring staff can demonstrate proficiency before progressing.
- Trusts should integrate ongoing reinforcement into daily workflows through embedding reminders and best practice guidance into electronic medical records or other readily accessible systems. This could include point-of-care prompts, visual aids, or checklists that appear during the blood culture collection process, for instance within blood culture packs.

- Trusts should promote a culture of open communication and feedback between laboratory staff and clinical teams. Data on contamination rates should be shared regularly and targeted training provided for staff who regularly receive high results.
- The NHS should establish a national network for blood culture champions which would connect individuals within Trusts who are responsible for leading blood culture pathway improve efforts. The network should facilitate the sharing of best practice and resources.
- Laboratory managers should highlight the unavailability of facilities, including the late arrival of blood culture samples as a risk in their risk register.
- Provide funding and protected time for training and continuous professional development of biomedical scientists and laboratory staff. This will ensure consistent adherence to best practices, maintain quality standards, and support the effective implementation of national guidance.

Success Spotlight: Nottingham University Hospitals NHS Trust

A key piece of feedback from clinical staff who were taking blood cultures samples in ED was that often there was limited understanding and awareness of the reason for, or importance of, the sample that was being obtained. With this in mind, staff at Nottingham now undertake a series of clinical education sessions for ED staff emphasising the impact of proper blood culture sampling on patient outcomes. This equation of what is often perceived to be a mundane and routine aspect of patient care into real life examples of improved patient outcomes, was crucial to ensuring the uptake of blood cultures best practice across clinical roles. This education drive is also supported by a dedicated blood cultures improvement nurse (funded by an external grant) and a regular routine of observation, feedback, and support on blood cultures practice. These training sessions were also supplemented with real life examples of where an optimised blood culture pathway had impacted patient care and saved patients' lives. These included patient stories of a 68-year-old man with myeloma admitted to ED with sepsis who received narrowed antibiotics in less than 24 hours; or of a 3-month-old baby who had presented with sepsis and who, through urgent processing of urine and blood cultures samples, was prescribed targeted therapy in less than 36 hours.

The results of optimising the blood culture pathway have been transformational for patient care at Nottingham University Hospitals. Over 50% of blood culture results are now available from 8:30am in time for clinical ward rounds, ensuring antibiotic related decisions can be made early in the patient's clinical pathway. Average fill volume of ED blood cultures has improved from 3.4ml to 6.5ml. The result of this being that compared to 2020, pathogen yield rate has increased from 7.5% to 10.1% and contamination rate has decreased from 6.3% to 4.4%. Whilst work remains to be done to improve the number of the patients with two sets of blood cultures taken, the changes and efforts highlighted above, have caused a marked improvement in care for patients with severe infection at Nottingham University Hospitals.

Success Spotlight: Bedfordshire Hospitals NHS Foundation Trust

Champions at Bedfordshire Hospitals NHS Foundation Trust identified a tendency to use a canula for routine blood culture collection, leading to additional costs and likely contamination. To address the challenges identified in blood culture collection, Bedfordshire Hospitals NHS Foundation Trust created their own blood culture packs, containing all the instruments required for blood culture collection including pre-packaged skin antiseptics, labels and collection bottles. On the front of the packs is a QR code through which clinical staff can access online instructions and videos. To facilitate widespread adoption, the Trust has implemented a robust communication strategy involving ward rounds to inform clinician staff about the new process and how it will work. A working group, comprised of consultant microbiologists, lead nurses and practitioners has also been formed to provide ongoing support and address any concerns on the wards.

While these packs are awaiting approval, the business case included examples of where these have worked well in other Trusts. Blood culture packs have streamlined processes and reduced the risk of errors. By providing all necessary materials, along with easy-to-follow instructions on how to use them, the packs ensure consistent adherence to best practices and minimise contamination rates, reducing unnecessary costs and improving patient outcomes. Nonetheless, blood culture packs have seem varying levels of success across different Trusts and Bedfordshire Hospitals NHS Foundation Trust had been advised by neighbouring Trusts that accountability across teams to ensure that the packs are best practice are being implemented is fundamental.

Conclusion and next steps

This report provides a comprehensive analysis of the current state of blood culture practices across NHS Trusts in England. It highlights significant challenges that hinder optimal patient outcomes and offers solutions for improvement through collaborative efforts and strategic interventions.
One of the primary conclusions drawn from this study is the urgent need for a robust implementation framework for blood culture guidance. The existing guidelines are perceived as lacking clarity and provide neither sufficient incentives for compliance nor penalties for poor practice. This has resulted in blood culture practices being de-prioritised within Trusts, leading to missed opportunities for improving patient care. Without a clear framework, healthcare professionals have struggled to advocate for necessary changes, making it difficult to secure the required resources and support from Trust leadership. The NHS should mandate the KPIs for blood culture optimisation to support improvements across the pathway.

Moreover, the report identifies infrastructure challenges and technological constraints as significant barriers to effective blood culture practices. Many Trusts face limitations in their current analyser capacity, which is exacerbated by the requirement to collect two sets of blood cultures. This necessitates additional funding and space for new analysers, which is often not available due to tightening budgets. Furthermore, the lack of 24/7 processing capabilities hampers the ability to meet NHS England's targets, leading to delays in diagnosis and treatment.

Lastly, education and training are critical components in enhancing blood culture practices. Contributors to this study have highlighted a widespread lack of awareness regarding best practices among healthcare professionals, which contributes to high contamination rates and errors in blood culture collection and processing. Targeted educational initiatives are essential to ensure that all staff involved in the blood culture process are equipped with the knowledge and skills necessary to adhere to best practices. This includes not only the technical aspects of blood culture collection but also the importance of communication and collaboration across departments to foster a culture of safety and quality.

The report advocates for stronger language around guidance to drive improvements in practice. In establishing clear accountability for blood culture practices, Trusts can create an environment conducive to change. The involvement of executive teams and Trust boards is crucial in this respect, and their support can facilitate the necessary cultural shift and resource allocation needed to implement improvements effectively. This must include not only investment in infrastructure but also in workforce support, ensuring that laboratory teams are equipped with sufficient resources, protected time for training, and professional development opportunities. By valuing and supporting laboratory staff, Trusts can build and sustain a resilient diagnostic pathway, delivering consistent and high-quality patient care.

This report underscores the need for a multifaceted approach to address the challenges facing implementation of blood culture best practice. By establishing a clear implementation framework, addressing infrastructure and technological constraints, enhancing education and training, and fostering collaboration across departments, published guidance and standards can be consistently applied across the country. In turn, patient outcomes will be improved and contamination rates reduced. The collective will to move forward, as expressed by the participants in the report, is a promising sign that with concerted efforts, these challenges can be overcome and the pathway optimised for the benefit of patients.

For More Information

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