

# Introducing a total sepsis solution at NHS Greater Glasgow and Clyde

A campaign to raise awareness of sepsis in Scotland, combined with the introduction of the latest technology in microbiology, has had a positive impact on the speed of clinical intervention and potential outcomes in the fight against this serious condition, as Janet Young explains.

Sepsis is recognised as a significant healthcare challenge, with someone dying from the infection every four hours in Scotland. In 2012, a nationwide initiative was launched to tackle this issue. At the same time, NHS Greater Glasgow and Clyde microbiology department has been striving to improve working practices through the introduction of innovative technology and increased automation. The results have been increased awareness of sepsis, faster microbial identification and susceptibility testing, and prompt initiation of appropriate therapy for patients.

## Scottish sepsis campaign

In 2012, the Scottish Patient Safety Programme, NHS Scotland and the Scottish government launched a campaign in Scotland to reduce the harm and mortality caused by severe sepsis. The aim of the campaign was to raise awareness of the signs and symptoms of sepsis among the public and health professionals in Scotland, and to ensure appropriate steps are taken where sepsis is suspected. In addition to radio and social media advertising, posters and leaflets were displayed in pharmacies, hospital wards, waiting areas and other public places (Fig 1).

In September 2018, the results of the campaign were published.<sup>1</sup> The number of people in Scotland aware of the disease increased to 77%. Almost half of people asked could recall the specific symptoms of sepsis, while awareness of the need for urgent medical treatment (in the first hour) increased to 79%, with 76% expressing some level of confidence about what to do if they suspect sepsis.<sup>1,2</sup>

Significantly, the mortality rates from sepsis in Scotland have fallen by 21% since 2012,<sup>2</sup> underpinning the importance of raised awareness and the overall, ongoing success of the campaign.

## Implications for NHS Greater Glasgow and Clyde

NHS Greater Glasgow and Clyde (NHS GG&C) is the largest Health Board in Scotland, serving a population of over 1.2 million and employing around 38,000 staff. Its newest and largest hospital is the Queen Elizabeth University Hospital (QEUH) and Royal Hospital for Children in Glasgow, with 1677 beds and treating around 750,000 patients per year.

As in all hospitals around the country, a number of measures have been introduced at the QEUH to ensure patients with sepsis are identified promptly and receive treatment within one hour. Such measures include the introduction of the Sepsis Six care bundles; the redesigning of ward trolleys to include a specific 'sepsis' drawer, containing elements of the Sepsis Six bundle and a checklist (eg for oxygen saturation levels, collection of blood cultures, administration of intravenous antibiotics and fluids, and measurement of haemoglobin and lactates); the display of information and guidelines throughout the hospital; and the introduction of a new sepsis screening app that helps to score patients with suspected sepsis (Fig 2).

The importance of early identification of sepsis also has implications for the microbiology department at NHS GG&C. The department has two large microbiology laboratories (one at QEUH and another at Glasgow Royal Infirmary), which process around one million microbiology specimens annually, including over 65,000 blood cultures. With a 12% positivity rate, this means that well over 7000 positive blood cultures are processed in the laboratories every year.



Fig 1. Examples of posters aimed at the general public (left) and health professionals (right) displayed during the Scottish sepsis campaign.

## Introducing a Total Sepsis Solution

In 2009, the NHS GG&C microbiology department began to look at how it could use innovation and automation to improve patient care. By 2017, a major part of this work included the aim to increase the speed, efficiency and productivity of their blood culture workflow; and to implement a Total Sepsis Solution that would provide clinicians with the vital information they need to treat sepsis patients promptly and effectively.

One of the first things examined was the time it took for blood cultures to be transported from the ward to the laboratory and incubated. UK guidelines state that blood culture bottles should be incubated within four hours of the blood sample being taken.<sup>3</sup>

Once specimens arrive in the laboratory they are incubated immediately in the blood culture system. With the large number of blood cultures arriving in the laboratories every day, the value of automated technologies, such as the bioMérieux Full Microbiology Laboratory Automation (FMLA) solution deployed within NHS GG&C, was evident.

### Automated detection of positive blood cultures

The introduction of the NHS GG&C microbiology department's Total Sepsis Solution began with the installation of the bioMérieux BacT/ALERT 3D blood culture system. This modular automated blood culture system detects microbial growth in blood culture bottles quickly and efficiently by way of a colorimetric change. Continuous monitoring provides immediate notification of positive cultures, which are then further investigated for identification purposes and antimicrobial susceptibility testing.

The planned installation of BacT/ALERT VIRTUO will further enhanced the blood culture workflow by introducing smart scanning of bottle barcodes, reducing operator hands-on time, and providing even earlier detection (up to three hours earlier) of bacterial growth.<sup>4-6</sup>

### Automated identification and sensitivity testing

The next step in the sepsis workflow to be automated in the NHS GG&C microbiology laboratories was microbial identification (ID) and antibiotic susceptibility testing (AST) using VITEK 2. A standardised inoculum is loaded into the system and linked virtually to an appropriate ID/AST card. Once loaded, the incubation and reading of each card is managed by the system without the need for further operator intervention, performing automated AST to European

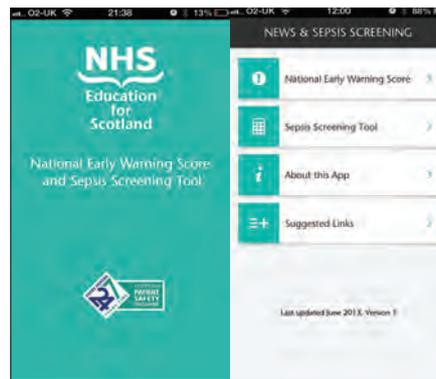


Fig 2. The NHS Education for Scotland News and Sepsis Screening Tool App.

Committee on Antimicrobial Susceptibility Testing (EUCAST) guidelines.<sup>7</sup> This eliminates the need for repetitive manual tasks, improves standardisation and ensures rapid (next day) reporting of results. An extensive database and expert rules ensure accurate interpretation and confidence in results.

In 2012, microbial identification was transformed at NHS GG&C with the introduction of VITEK MS, an automated mass spectrometry (MS) microbial identification system that uses matrix-assisted laser desorption/ionisation-time of flight (MALDI-TOF) technology. Fully integrated with VITEK 2 for an optimised workflow, VITEK MS provides rapid and accurate microbial identifications from a comprehensive and regularly updated phenotypic global database. Results are obtained within just 30 minutes, allowing an identification to be telephoned to the ward on the same day.

The combination of VITEK 2 and VITEK MS encourages better antibiotic stewardship, ensuring that patients receive the correct, most effective antibiotic at the earliest opportunity.

### Fully automated specimen processing and reading

The most recent advances in automation to be added to the NHS GG&C Total Sepsis Solution are WASP and WASPLab.



Fig 3. The WASP and WASPLab solution at the Queen Elizabeth University Hospital.

Empowered by bioMérieux, these fully automated, connected solutions have minimised specimen handling and enhanced standardisation within the microbiology laboratories (Fig 3).

WASP (the Walk Away Specimen Processor) is a robotic platform that automatically plates out positive blood culture samples. Using bacterial loops of 1  $\mu$ L, 10  $\mu$ L or 30  $\mu$ L and reproducing human gestures, it can adapt to various sample sizes and performs the streaking pattern preferred by the laboratory. Once inoculated, WASPLab automatically transfers the plates to another part of the system for incubation and imaging.

The full WASPLab solution went live at the Glasgow Royal Infirmary in November 2018 and at the Queen Elizabeth University Hospital in March 2019.

### Change management process

The automation made possible by WASP and WASPLab at the NHS GG&C laboratories ensures a safer and more efficient workflow by minimising the need for repetitive manual tasks. However, the introduction of this technology involved a significant change in practice and mindset for staff. The smooth and successful transition to WASPLab automation at NHS GG&C was enhanced by bioMérieux's unique change management consultancy.

### Faster microbial identification and AST results

The new, automated Total Sepsis Solution at NHS GG&C has the potential to improve the management of sepsis significantly by ensuring patients are receiving the correct treatment as soon as possible. For example, if a patient presents in A&E with suspected sepsis and blood cultures are taken at 14:00, these would be sent immediately to the microbiology laboratory and loaded onto BacT/ALERT 3D (or, in the future, BacT/ALERT VIRTUO) for incubation. If the bottle flags positive then a sample

**Table 1. Example time to WASPLab identification and AST results compared to previous method.**

Previous method			WASPLab identification			WASPLab AST result		
DAY 0	14:00	Blood cultures taken	DAY 0	14:00	Blood cultures taken	DAY 0	14:00	Blood cultures taken
DAY 1	09:00	Blood cultures +ve	DAY 1	09:00	Blood culture +ve	DAY 1	09:00	Blood culture +ve
				09:15	Blood onto WASP		09:15	Blood onto WASP
				15:15	Read on WASPLab		15:15	Read on WASPLab
				15:30	Load on VITEK MS		15:30	Load on MS
				16:00	MS ID phoned to ward		16:00	MS ID phoned to ward
								Inoculate VITEK AST card
DAY 2	09:30	Organism ID on MS				DAY 2	09:00	AST RESULT
DAY 3	09:30	AST RESULT						
			<b>ID 17 hours earlier</b>			<b>AST result 24 hours earlier</b>		

of blood culture is then loaded onto WASP for plating out. These plates are read on WASPLab after six hours' incubation and an MS identification can be telephoned to the ward that same day, some 17 hours earlier than the previous method (Table 1).

At the same time, a VITEK AST card can be inoculated, with AST results available in the morning of the second day. This is 24 hours earlier than the previous method, which is game-changing for the management of sepsis patients. Earlier results allow both prompt adjustment of empiric treatment using broad-spectrum antibiotics (Sepsis 6 protocol) and faster initiation of appropriate targeted treatment, as well as preventing unnecessary use of antibiotics where they are not required or indicated.

In the initial validation of WASP and WASPLab for processing blood cultures, it was shown that, in two cases of sepsis due to a Gram-negative bacterium, the laboratory was able to provide the identification of the causal organism 17 hours earlier than would have been possible previously. More importantly, the antibiotic sensitivity result was provided 24 hours earlier, allowing patients to be changed from a broad-spectrum antibiotic (used as per the Sepsis Six protocol) to a narrower targeted antibiotic against the organism. This earlier intervention aided patient recovery.

### Improved laboratory processes

Enhancing workflows and processes through automation and innovation has helped the Greater Glasgow and Clyde Microbiology laboratories cope with expanding blood culture numbers, particularly following the recent consolidation of laboratories from three to two locations. The modular design of the equipment also ensures that the capabilities of the department are secure for the future.

Staff feedback following installation of WASPLab has been extremely positive. They find the equipment to be reliable and easy to use, reducing stress and



UK guidelines state that blood culture bottles should be incubated within four hours of the blood sample being taken.

repetitiveness in their work. They particularly like how the imaging software allows faster screening of large numbers of culture plates, allowing rapid elimination of negatives and earlier work up of positive plates.

A United Kingdom Accreditation Service (UKAS) audit was required to add WASPLab to the scope of the NHS GG&C microbiology department's UKAS accreditation. This took place at the Glasgow Royal Infirmary laboratory two weeks after the system went live. There were no significant findings and the department was commended for project management, good collaboration and teamwork, as well as for the success of its cascade training programme.

In the future, the department hopes to extend its Total Sepsis Solution by increasing its operating hours, which will offer further potential for faster results and even greater improvements to the management of the sepsis patient pathway at NHS GG&C. The Scottish government continues to raise awareness about sepsis in a new campaign that focuses on spotting the early signs of the disease.<sup>8</sup> While such campaigns can help to ensure that patients seek help at the earliest opportunity, technology that is able to impact the speed of clinical

intervention and potential outcomes also has an important role to play in the fight against sepsis.

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