Improving the management and care of people with sepsis

David Fitzpatrick and colleagues review an online survey of how nurses and doctors perceive the use of a pre-hospital sepsis screening tool by ambulance clinicians

Abstract

Many hospitals struggle to implement the full sepsis care bundle, but research suggests that many patients with sepsis are transported to hospital by ambulance. In 2011, the Scottish Ambulance Service introduced a pre-hospital sepsis screening tool (PSST) to expedite sepsis identification and care delivery. However, ambulance clinicians have reported varying degrees of interest and enthusiasm from hospital staff during handover. Therefore, an online survey was set up to investigate medical and nursing staff perceptions and experiences of the introduction of a PSST. This article discusses the results, which show that participants perceive the PSST reduces time to treatment, improves continuity of care, benefits patients and is accurately applied by ambulance clinicians, but which also highlight problems with communication. The delivery of in-hospital and pre-hospital sepsis care is challenging, but simple measures such as improving and standardising communication and alert systems between ambulance services and receiving hospitals could improve the clinical effects of a PSST.

Keywords

Sepsis, pre-hospital care, pre-alert, screening tool

Recent evidence suggests that use of the Sepsis 6 has reduced mortality rates and the indicators have since become established as a core element of sepsis care in the UK (Daniels et al 2011).

The introduction and delivery of sepsis care are challenging, however. Many hospitals struggle to implement the full sepsis care bundle (Sivayoham 2007, McNeill et al 2008, Boon et al 2013), and compliance is a particular problem for emergency departments (EDs) (College of Emergency Medicine (CEM) 2012, Gray et al 2013). This is concerning given that, in patients with documented septic shock, mortality increases by 7.6% for every hour’s delay in antibiotic therapy (Kumar et al 2006).

Studies in the US and UK show that between 40% and 81% of patients with sepsis are transported to hospital by ambulance (Seymour et al 2012, Studnek et al 2012, Gray et al 2013), which suggests that sepsis screening and care could be delivered in pre-hospital rather than in-hospital environments. The delivery of sepsis care could therefore depend on the ability of ambulance clinicians to identify the relevant condition (Seymour et al 2012, Studnek et al 2012).

To help ambulance clinicians recognise the condition, pre-hospital sepsis screening tools (PSSTs) have been developed with varied success. Ambulance clinicians identify sepsis in between 43% and 75% of patients with the condition (Guerra et al 2013, Wallgren et al 2013) and similar variations in the reduction of mortality rates among such patients have been reported (Band et al 2011, Guerra et al 2013).

Despite the increasing enthusiasm to improve pre-hospital sepsis care, UK ambulance services have been slow to implement sepsis screening...
systems (Robson et al 2009, Small 2012, Oskam 2013, Scottish Patient Safety Programme 2013, Wallgren et al 2013). No study of the opinions of nursing and medical staff on the use of a PSST by ambulance clinicians appears to have been published.

In 2011, as part of a small ‘test-of-change’ (TOC) collaboration with the Scottish Patient Safety Programme (2013), the Scottish Ambulance Service introduced a PSST. The tool was tested by a small cohort of ambulance clinicians based at one ambulance station in central Scotland in line with the ‘plan, do, study, act’ (PDSA) method (Langley et al 2009). The PSST has been adapted for Figure 1, page 20.

The tool includes a way to identify the cause of infection and a measure of physiological parameters based on the standardised early warning system (SEWS) scoring method. It also includes a list of diagnostic signs associated with sepsis that, if present, mandate fluid intervention, high flow oxygen and a pre-alert to a receiving hospital. Use of the tool was restricted to one acute receiving hospital.

A prospective audit demonstrated that application of the tool through the TOC initiative reduced the time between identification of sepsis and its treatment (Beckett et al 2013). Ambulance clinicians involved in the process reported varying degrees of interest and enthusiasm from hospital staff during patient handover, however, so, as part of the evaluation process, the research team sought hospital staff’s opinions about the introduction of the PSST.

The results of the survey are reported in this article. Findings should be considered in the context of ‘spread’, a component of PDSA methodology (Langley et al 2009).

Survey
An electronic, online survey was conducted during September 2013 to investigate medical and nursing staff’s perceptions and experiences of the introduction of the PSST. A pragmatic approach was taken in the development of the questionnaire, and its wording was informed by the clinical experiences of the study team and by published research (Carlomb and Rubenfeld 2007; National Institute for Health and Care Excellence (NICE) 2007, van der Wees et al 2013).

Respondents could express their opinions using five-point Likert-type scales, in which a score of 1 indicates that they ‘strongly disagree’ and a score of 5 indicates that they ‘strongly agree’, or by simply answering ‘yes’ or ‘no’.

Questions about respondents’ demographic and professional characteristics, such as profession, years of service in current position and unit location, were included. Space was also included in the questionnaires to allow respondents to describe their perceptions of ambulance clinicians’ use of the PSST, and of associated pre-alert and communication systems.

Before the survey began, the questionnaire was piloted with two senior nurses and one doctor. Their feedback led to a few improvements to the questionnaire’s language and formatting, with one question being replaced by a more appropriate alternative. All staff likely to be in contact with ambulance clinicians who use the PSST, namely those who worked in the ED, acute admissions unit (AAU) and clinical assessment unit (CAU) (n=178), were then invited by email to participate anonymously in the survey, and they were emailed reminder invitations four weeks later. Each participant’s consent to taking part in the survey was assumed by his or her completion of the questionnaire, and all were free to opt out at any point.

Results from the survey were then analysed using Statistical Package for the Social Sciences v9 software. Summary statistics were drawn up to describe the data with each result being presented as a percentage, a median (M) and an interquartile range (IQR), or the range between the lower and upper quartiles. A non-parametric test, namely the Mann-Whitney U test, was carried out to measure differences in lengths of service and in opinion between professions, with a P<0.05 being deemed as significant.

The survey was considered to be a form of service evaluation by the NHS Research Ethics Committee, research and development approval was granted by NHS Forth Valley, and the survey was registered as ‘quality improvement’.

Results
Demographics Of the 178 people contacted, 39 (22%) took part in the survey. Of these 39 respondents, 18 (46%) were recorded as nurses, 20 (51%) as doctors and one participant did not state his or her profession. Nurse participants had practised in their areas significantly longer (M=14.18 years, standard deviation (SD)=5.34) than the doctors (M=5.61 years, SD=5.89) (U=39, P<0.001). Representation from the three hospital departments were: ED 36% (n=14), AAU 18% (n=7), CAU 33% (n=13) and ‘other’ 13% (n=5).

The ‘other’ category included those who were based in psychiatric services, other wards and in general practice.
Figure 1 Pre-hospital sepsis screening tool for all patients aged over 16 years unless pregnant

Ambulance clinicians begin screening of a patient who may have sepsis

Could the patient have had a serious infection? Examples include:
- Cellulitis.
- Meningitis.
- Pneumonia.
- Urinary tract infection.

Has the patient had a condition that can cause sepsis? Examples include:
- Abdominal pain or distension.
- An indwelling medical device.
- Chemotherapy over the past six weeks.
- Recent organ transplant.
- Septic or arthritic wounds.

Name another relevant condition the patient could have had: ............................

Is any one of the following symptoms present:
- Mottled and cold peripheries.
- A central capillary refill time of three seconds or more.
- A systolic blood pressure of less than 90mmHg or a mean arterial pressure of less than 60mmHg.
- Purpuric rash.
- Absent radial pulse.
- A lactate level of more than 2mmol/L.

Discontinue screening and apply standard treatment protocols

Has the patient been given a standardised early warning system (SEWS) score of 4 or more?

Following history taking and physical examination, is there a clinical suspicion that the patient has sepsis?

Patient details

Incident number: ........................................
Date: ..................................................

If patient label is available, affix it here

Would you have given the patient antibiotics?
Yes ☐ No ☐

Patient's SEWS score
- On first assessment: ..............................
- At handover to unit: ..............................

Note
Oxygen should be measured in L
0.9% saline should be measured in ml

If patient's life is clearly under threat, transport as if a 999 call with interventions carried out en route

Remember to record all actions in an electronic patient report form

Sepsis is possible
If SEWS is 4 or more:
- Transfer patient to hospital.
If SEWS is less than 4:
- Transfer patient to primary or secondary care to be assessed by a medical professional.

Septic shock is possible
Administer immediately:
- 250ml bolus of crystalloid, repeated according to patient response to a maximum of 2,000ml.
- 15L per minute of oxygen through a non-rebreather mask as would be the case in type two respiratory failure.
Then:
- Transfer patient using lights and sirens to the nearest emergency department (ED).
- Send a ‘suspected septic shock’ pre-alert to the ED.
**Staff awareness** Most (n=32, 82%) participants reported awareness of the PSST, though how they had been made aware varied (Table 1). Four of the seven participants who were unaware of the PSST were those who recorded their base as ‘other’.

**Knowledge and perceptions** Participants were asked whether they agree or disagree with a number of statements intended to identify their opinions of the PSST intervention. Thirty four (87%) responded to these questions, the results of which are presented in Table 2. Differences between professional groups were investigated. Participants agreed that they were aware of the content of the guidance on the PSST, and that pre-hospital screening reduced time to treatment, improved continuity of care and benefited patients. Doctors’ responses to all but one statement, concerning ‘time to treatment’, attracted significantly lower median values than those of nurses.

**Application and communication** Participants were then asked whether they agree or disagree with a number of statements about ambulance clinicians’ ability to apply the PSST and whether the PSST’s introduction had affected in-hospital practice (Table 3, page 22). Interprofessional differences were investigated.

Participants also agreed that ambulance clinicians could apply the PSST accurately, that the pre-hospital alert was useful to help organise treatment before patients arrive and that they were comfortable treating patients based on PSST results. In relation to the pre-hospital alert mechanism introduced as part of the PSST, participants agreed that pre-alerts were not distracting, although the statement that pre-alerts ‘can be time consuming’ received a mixed response.

The statement ‘written documentation was received for all sepsis patients’ produced the greatest disagreement between doctors (M=1, IQR=1-3) and nurses (M=4, IQR=3.5-4.5). Participants agreed that the inclusion of a ‘sepsis alert’ box on the patient report form would be useful.

**Method of pre-alert** Participants were asked about methods of pre-alert and whether they preferred an airwave radio call or telephone call, or thought that face-to-face verbal handovers were sufficient. Of those in favour of pre-alerts (n=26, 67%), most preferred to receive them by telephone (n=21, 54%) than by airwave radio (n=5, 13%).

Seven participants (18%) preferred not to receive pre-alerts for sepsis, choosing face-to-face verbal handovers instead, and six (15%) thought no alerts of any kind were required.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>How staff were made aware of the tool</th>
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<tbody>
<tr>
<td><strong>Method</strong></td>
<td><strong>Frequency</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Number</strong></td>
</tr>
<tr>
<td>Staff meeting</td>
<td>13</td>
</tr>
<tr>
<td>Email</td>
<td>6</td>
</tr>
<tr>
<td>Ambulance clinicians</td>
<td>2</td>
</tr>
<tr>
<td>Informal or through hospital colleagues</td>
<td>11</td>
</tr>
<tr>
<td>Not aware</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Ambulance staff knowledge and perceptions of the sepsis screening tool</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Survey statement</strong></td>
<td><strong>Median number who agreed</strong></td>
</tr>
<tr>
<td></td>
<td><strong>All</strong></td>
</tr>
<tr>
<td>'I am aware of the pre-hospital sepsis screening tool (PSST) guidance'</td>
<td>4</td>
</tr>
<tr>
<td>'Use of the PSST reduces time to treatment'</td>
<td>4</td>
</tr>
<tr>
<td>'The PSST improves continuity of care'</td>
<td>4</td>
</tr>
<tr>
<td>'The PSST benefits patients'</td>
<td>4</td>
</tr>
<tr>
<td>'The PSST should be mandatory'</td>
<td>3</td>
</tr>
</tbody>
</table>

*Interquartile range † P value obtained with Mann-Whitney U test, where P<0.05 indicates a significant difference*
When questioned about the adequacy of pre-alert information, 87% (n=20) of the 23 participants who had received such information said it had been adequate. Meanwhile, 89% (n=23) of the 26 participants who had received a face-to-face handover from ambulance clinicians said it had been adequate.

Written responses suggested variability in the quality of face-to-face handovers. Comments included: ‘[Handovers] vary depending on crew’, ‘Some handovers lack specific details’ and ‘Handovers need to be standardised’. One participant, a nurse, commented: ‘Doctors never seem to get the handover from paramedics.’

Participants were asked whether pre-alerts should be mandatory for patients with SEWS scores of 4 or more. About half of the participants (n=21, 54%) said such alerts should be mandatory, while 12 (31%) said they should not. Six (15%) participants did not complete this question. Written responses are listed in Box 1.

Discussion

Positive perceptions Most participants thought that ambulance clinicians could apply PSSTs accurately and, by doing so, would reduce times to treatment and benefit patients. These findings are important given that earlier studies of the effectiveness of PSSTs have produced inconsistent results (Band et al 2011, Guerra et al 2013).

The findings also indicate a high degree of interprofessional trust and confidence, which are crucial to pre-hospital interventions that require a multiprofessional approach (Bradley et al 2005). Nurses’ average length of service was greater than that of doctors, and positive perceptions of ambulance clinicians’ abilities to use the PSST among nurses may have been informed by their additional experience.

Communication When introducing new systems of care, particularly those that require multiprofessional involvement and prompt interventions, consideration must be given to communication between teams (Bradley et al 2005, Budd et al 2007).

The more negative responses to the survey concerned communication, which may help to explain ambulance clinicians’ concerns about the varying degrees of interest and enthusiasm expressed by nursing and medical staff during handovers. The issue of communication deserves further discussion because, if communication systems are not improved, implementation of a PSST and streamlining of care could be hindered.

Participants said they prefer to be alerted about patients who may have sepsis by telephone, rather than by airwave radio, which is the standard method of ambulance pre-alert. This could be due to staff familiarity with telephones and the perception that they allow greater freedom of conversation (Yamamoto 1988). To use airwave radio systems, nurses require training in radio procedures (Airwave Direct 2013) and so probably perceive them to be a less intuitive communication method.

### Table 3 Ability of ambulance staff to apply the screening tool and its effect on in-hospital practice

<table>
<thead>
<tr>
<th>Survey statement</th>
<th>Median number who agreed</th>
<th>Interprofessional difference, or P value†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>IQR</td>
</tr>
<tr>
<td>‘Ambulance clinicians applied the tool accurately’</td>
<td>4</td>
<td>3-4</td>
</tr>
<tr>
<td>‘The pre-alert is useful in organising receipt of patients’</td>
<td>4</td>
<td>3-4</td>
</tr>
<tr>
<td>‘Treatment is comfortable based on tool results’</td>
<td>4</td>
<td>3-4</td>
</tr>
<tr>
<td>‘The pre-alert can be distracting’</td>
<td>1</td>
<td>1-4</td>
</tr>
<tr>
<td>‘Answering pre-alert calls can be time consuming’</td>
<td>3</td>
<td>1-4</td>
</tr>
<tr>
<td>‘I receive written documentation for all sepsis patients’</td>
<td>3</td>
<td>1-4</td>
</tr>
<tr>
<td>‘A sepsis alert box on the patient report form would be useful’</td>
<td>4</td>
<td>3-4</td>
</tr>
</tbody>
</table>

*Interquartile range † P value obtained with Mann-Whitney U test, where P<0.05 indicates a significant difference
Thus, if the main purpose of a pre-alert is to prompt shared decision making, the telephone is the preferred medium (McLean 2008), but if its main purpose is to prompt staff to prepare to manage a patient with sepsis, the airwave radio is more appropriate and reliable (Airwave Direct 2013).

Although most participants reported that they receive appropriate clinical information during pre-alerts, a small proportion stated that the information they receive is inadequate. Perhaps information exchange during pre-alerts could be improved, therefore, by the introduction of a standardised pre-alert format, such as Situation, Background, Assessment, Recommendation (NHS Institution for Innovation and Improvement 2008), or a bespoke format, such as that proposed by Booth and Bloch (2013).

Some participants did not perceive a need for pre-alerts, despite evidence that they decrease door-to-needle times in pre-hospital thrombolytic therapy (Learmonth et al 2006, Lambert et al 2011). However, given that mortality rates among patients with septic shock increase by 7.6% for each hour’s delay in antibiotic treatment (Kumar et al 2006), lack of, or inconsistencies in, the pre-hospital alert system could have a profound effect on patient care.

Although survey participants perceived ambulance clinicians’ handovers to be generally good, it should be remembered that the PSST was being applied by a small number of ambulance clinicians who are committed to the process. Handovers by other, less enthusiastic, ambulance clinicians may have been perceived less favourably.

Moreover, some participants identified inconsistencies in the handover process, and doctors’ and nurses’ opinions about it differed. For example, nurses tended to agree, but doctors to strongly disagree, with the statement: ‘I receive written documentation for all sepsis patients.’

Anecdotal evidence suggests that most handovers involve ambulance clinicians and nurses but not doctors, which means that medical authorisation for sign-off and administration of antibiotics must be sought after handover has taken place. One consequence of this is that times from diagnosis to treatment are increased.

Some of those who have studied handovers between ambulance clinicians and nurses or doctors have recommended the use of structured, evidence-based handover systems (Bost et al 2012, Ledema et al 2012). The system developed by Ledema et al (2012), for example, is said to have increased the amount and improved the consistency of information conveyed during handover, while reducing handover times, which is an important consideration for staff under constant performance pressure.

It follows that the introduction of a structured handover process in which doctors are required to be present would most likely reduce inconsistencies, accelerate sepsis treatment and probably improve care for patients with time-critical sepsis.

**Limitations** The low response rate to this study, and its location at a single centre, limits its findings and generalisability, and so its results should be interpreted with caution.

In setting up the survey, the authors were required by the health board to use software that is accessible only through NHS computers, which probably served to reduce response rates.

If more accessible survey platforms, or paper-based questionnaires, had been used, the response rate may have been higher. The low response rate may also be due to the perceptions among staff that, due to workplace pressures, they had too little time to complete it, or that it was irrelevant to their practice.

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**Box 1** Comments on whether pre-alerts should be mandatory for patients with standardised early warning system (SEWS) scores of 4 or more

**Reasons participants said ‘yes’:**
- ‘[Pre-alerts] allow preparation and prioritisation.’
- ‘Organising a bed is easier with a pre-alert.’
- ‘If such parameters arose in hospital, we would treat for sepsis on those grounds so best to know in advance so there is no delay in finding out and starting treatment.’
- ‘[Pre-alerts] improve patient care.’
- ‘[Pre-alerts] help to allocate appropriate patient placement and expedite treatments.’
- ‘[Pre-alerts] ensure we have a trolley space ready and medics alerted.’
- ‘We can then try and organise a bed, especially when there are capacity issues.’
- ‘We make sure we have a trolley space ready and relevant medical staff ready to receive patient.’

**Reasons participants said ‘no’:**
- ‘[Pre-alerts] are unnecessary as long as [relevant information] is passed over on arrival.’
- ‘Because not everyone scoring a 4 in SEWS is septic. There could be underlying problems [instead].’
- ‘[Pre-alerts] can be distracting and should be done only if team standby is required.’
- ‘It should be mandatory for SEWS of 6 or more and with evidence of suspected infection. Many patients would score 4 based on age or temperature, so many patients who may not even have severe sepsis would have to be phoned in.’
- ‘Because many patients arrive [at hospital] with sepsis, the need to communicate a pre-alert would be frequent, hence additional workload for staff to answer phones and airwaves.’
- ‘Because some patients may not [need] active treatment.’
Conclusion

The delivery of pre-hospital sepsis care is challenging but simple measures, such as improving and standardising communication between ambulance and receiving hospital staff could increase the effectiveness of PSSTs. Such interventions would benefit from further robust testing to determine their effects on diagnosis to treatment times.

The function of pre-alert should be defined and their method of communication, either radio or telephone, should be standardised. If the requirement of pre-alerts is to prompt staff to prepare for patients with sepsis, rather than to prompt shared decision making, training in radio communication procedures may be required by some nursing and medical staff.

In addition, information delivered through pre-hospital alerts and during handovers should be standardised and evidence based. Handovers of patients with sepsis should be undertaken, where possible, in the presence of nursing and medical staff to ensure rapid and seamless intervention.

Online archive

For related information, visit our online archive and search using the keywords

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