London Ambulance Service NHS Trust

Clinical audit of the diagnosis, management, and treatment of sepsis in the London Ambulance Service

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Clinical Audit & Research Unit

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Executive summary

Introduction

The total number of patients developing potentially life-threatening sepsis within the UK every year is now over 100,000. The awareness and understanding of sepsis is poor by both healthcare professionals and the public leading to mortality rates of 35% and 50% for severe sepsis and septic shock respectively.

Ambulance personnel may be the first healthcare professionals to see septic patients, yet despite this there is little training and guidance for ambulance clinicians on how to recognise and treat these patients. Clinicians should use the Systemic Inflammatory Response Syndrome (SIRS) criteria to recognise abnormal observations associated with sepsis, and the Review of Systems (ROS) to determine a possible source of infection.

The aim of this clinical audit was to examine clinicians' ability to diagnose, treat and manage patients with suspected sepsis.

Methodology

A retrospective clinical audit of 200 patient report forms (PRFs) was undertaken to determine the level of care provided to patients with suspected sepsis. These PRFs were manually reviewed for evidence of sepsis from a selection of the most likely illness codes (generally unwell, other medical condition, respiratory – chest infection, urological and pyrexia of unknown origin).

In addition, SurveyMonkey was used to explore the understanding and knowledge of sepsis within the LAS. One hundred and seventy one responses were included in the analysis.

Results

Clinical audit

Most patients (87%) had the observations recorded needed to identify sepsis. However, for only one patient (1 %) did the clinicians acknowledge these met the SIRS criteria. A ROS was conducted and clinical evidence of an infection was identified for 44% of patients.

Seventy patients (35%) were identified by the author as having clinical evidence of severe sepsis or septic shock. However, this was not identified by the clinicians for any patients. Of the 70 patients with clinical evidence of severe sepsis or septic shock, only 14% received high flow oxygen (15 litres per minute via a non-rebreather mask) and 18% received IV fluid resuscitation. Just 40% of these patients were then transported to hospital with a pre-alert.

Questionnaire

59% of respondents had heard of both sepsis and SIRS and 69% knew the correct definition of sepsis. However, only 23% respondents knew all three stages of sepsis; and worryingly, only 2% believed the definition of these stages was always used in the pre-hospital setting to suspect, treat and manage sepsis. In addition, only 4% of respondents knew all of the signs and symptoms of sepsis.

52% of respondents were aware of the high mortality rate of sepsis compared with other conditions and just 22% knew how to manage sepsis in the pre-hospital setting, with only 40% knowing the appropriate maximum dose of fluid therapy.

71% of respondents thought Paramedics were able to identify sepsis, but 94% agreed pre-hospital recognition of sepsis and interventions may improve outcomes in sepsis.

Recommendations and Actions

1. CARU will raise awareness of sepsis and how to identify it, using posters and an article in the Clinical Update. Current LAS training materials will also be reviewed and a sepsis screening tool produced with the potential to include in the pocket book.
2. CARU will examine the feasibility of a sepsis pathway, to increase the number of patients with severe sepsis or septic shock who receive a pre-alert.
3. CARU will investigate other sepsis recognition techniques, such as end-tidal carbon dioxide monitoring, by conducting a review of the literature.
4. The Medical Directorate will explore the possibility of including prompts for sepsis on the PRF and introduce a sepsis illness code to improve documentation of sepsis.
5. CARU will help to inform future pre-hospital guidelines by sharing this report with the Association of Ambulance Chief Executives and The UK Sepsis Trust.
6. CARU will maintain the focus on sepsis care, and ensure these changes have led to improvements by developing an LAS Sepsis CPI.

Introduction

The total number of patients developing potentially life-threatening sepsis within the UK every year is now over 100,000 (Daniels, 2014). Approximately 37,000 of these patients will die (Levy, 2010), with survivors suffering long-term physical and psychological problems, resulting in significantly reduced quality of life (Daniels, 2014). In addition to the loss of life and long-term problems associated with survival, sepsis is estimated to cost the NHS £2.3 billion per year in intensive care bed days alone (Daniels, 2014).

The awareness and understanding of sepsis is poor by both healthcare professionals and the public. Old fashioned and incorrect terms such as blood poisoning and septicaemia are still commonly used (Daniels, 2014) both associated with a rare condition that will affect only a small number of people. In truth, sepsis is one of the biggest killers, responsible for more deaths annually than myocardial infarction, stroke, chronic obstructive pulmonary disorder (COPD), or lung cancer (Daniels, 2014). Sepsis, unlike many of the other big killers, is not age or gender specific and can affect anyone at any time (Daniels, 2014). Sepsis often begins with a minor infection that over time develops into wide-spread illness and subsequent organ dysfunction. The delayed commencement of interventions, due to poor identification, drives the high mortality (Daniels, 2010).

In 1992, to help improve understanding among healthcare professionals, an international consensus agreed the definition for sepsis as a systemic inflammatory response to an infection. It was later in 2003, that a second international consensus defined the stages of sepsis, based on the level of organ function affected (Angus & van der Poll, 2013). It was agreed that sepsis would consist of three stages (Dellinger et al. 2013): uncomplicated simple sepsis (often referred to as sepsis); severe sepsis; and septic shock (see appendix 1 for definitions). These definitions introduce the concept of a systemic inflammatory response or SIRS (systemic inflammatory response syndrome). SIRS is defined by the measurement of vital signs outside a normal range (appendix 2).

Considering the high incidence rate and major impact sepsis has on patients and healthcare resources (Daniels, 2011), it is concerning that awareness and understanding remains poor. Despite increased focus on sepsis following the introduction of internationally agreed definitions and management guidelines set out by the Surviving Sepsis Campaign (SSC), mortality for severe sepsis and septic shock remains at 35% and 50% respectively (Daniels, 2014).

Ambulance personnel may be the first healthcare professionals to see septic patients. Despite this, the Joint Royal College Ambulance Liaison Committee (JRCALC) clinical guidelines of 2006 include very little information on sepsis, with no information on recognition, and treatment information limited to fluid resuscitation (JRCALC, 2006). Sepsis treatment has been included in the recent UK Ambulance Services Clinical Practice Guidelines (2013), implemented after this clinical audit was conducted, although these still lack depth, and do not follow the international sepsis consensus definitions and guidelines.

Delayed recognition and intervention can have dire consequences for the septic patient. Early recognition and commencement of treatment has been shown to reduce mortality and morbidity significantly (Herlitz et al., 2012). In 2004, the SSC promoted a resuscitation bundle based on Early Goal Directed Therapy that involved series of interventions to be performed within the first six hours of the recognition of sepsis (Daniels et al. 2011). A major problem with the SSC resuscitation bundle is that the majority of the interventions involved require critical care skills that are often not available in an emergency department and rarely available in the pre-hospital phase (McCelland & Moxon, 2014). The 'Sepsis Six' care bundle (appendix 3) was later developed to enable lifesaving treatment to be commenced promptly following the recognition of severe sepsis. The simple nature of the Sepsis Six means it can be delivered by a wide variety of healthcare professionals, and does not require specialist skills (Robson & Daniels, 2008).

The Sepsis Six can be started in the pre-hospital phase and continued in the emergency department. It is thought that if pre-hospital staff treat sepsis with the same passion that they do myocardial infarction, stroke and major trauma this could significantly improve care and reduce mortality (Robson et al., 2008), as more than 40% of sepsis cases are thought to develop in the community (Seymour, 2012).

Ambulance services often attend to patients who look systematically unwell without an obvious cause, or patients who have a temperature likely to be due to an infection. Evidence suggests that the most common cause of sepsis is a respiratory tract infection, followed by an intra-abdominal infection and a urinary tract infection, although sepsis can originate from any area of the body (Daniels, 2010). Currently in the London Ambulance Service NHS Trust (LAS) there is no way to measure the incidence of sepsis. When a clinician suspects a patient is septic, this is coded as 'other medical condition' as no specific sepsis code exists. In addition, as staff have received little or no sepsis training, care provided to septic patients may be based on the current UK Ambulance Services Clinical Practice Guidelines (2013), the British Thoracic Society Oxygen guidelines (O'Driscoll et al, 2008), or the SSC (Daniels, 2014), three guidelines with conflicting information.

For clarification, the LAS Clinical Update outlines the process staff are expected to follow in order to identify patients with sepsis by using SIRS criteria to recognise abnormal observations associated with sepsis, and the ROS to determine possible sources of infection. Once identified, patients who have severe sepsis (or septic shock) should receive high flow oxygen and fluid therapy (two elements of the Sepsis Six) and be transported to hospital with a pre-alert (Dutfield, 2011).

In the last 18 months there have been seven sepsis related incidents reviewed by the LAS Serious Incident Group, but so far only one has been declared a serious incident. Most of these were associated with failure to recognise possible sepsis by the Emergency Operations Centre, resulting in long waits for an ambulance to arrive. However, in one case the seriousness of the patient's condition was also not identified by the clinicians when they arrived on scene.

Aims & objectives

The aim of this clinical audit was to examine clinicians' ability to diagnose, treat and manage patients with suspected sepsis, and more specifically to:

1. determine accuracy in the recognition of the signs of SIRS, infection and sepsis, and
2. assess whether treatment and management of suspected septic patients follows guidelines set out by the JRCALC, British Thoracic Society, LAS Clinical Updates, and the SSC.

And through the questionnaire:

3. investigate current awareness and ability to differentiate between uncomplicated simple sepsis, severe sepsis and septic shock, and to examine the current knowledge and understanding of sepsis by LAS clinical staff.

Methodology

Design

The Clinical Audit and Research Unit (CARU) recruited a Paramedic to work with CARU on a project to examine how well ambulance staff identify and manage patients with sepsis within the pre-hospital environment. The project consisted of two parts: a retrospective clinical audit to determine the level of care provided to patients with suspected sepsis, and an online survey to explore the understanding and knowledge of sepsis within the LAS.

As there is currently no illness code for sepsis in the LAS, patient report forms (PRFs) were identified by selecting illness codes most associated with sepsis (generally unwell, other medical condition, respiratory – chest infection, urological, and pyrexia of unknown origin). In order to find 200 PRFs, it was necessary to review a total of 1,092 PRFs from July 2013 in order to find sufficient patients in whom the Paramedic author suspected the patient may have been suffering with sepsis, based on the documented history and assessments. All paediatric patients were excluded, because of the varying definitions of paediatric sepsis. The data collected were entered into an Excel spread sheet and quality assured to ensure accuracy.

SurveyMonkey was used to design an online questionnaire to assess LAS clinical staff's awareness, understanding and attitudes towards sepsis within the pre-hospital environment. The survey was advertised in the LAS Routine Information Bulletin (RIB) on two consecutive weeks and was available to all clinical staff from 4th February until the 2nd March 2014. The full questionnaire with correct answers highlighted in yellow can be found in appendix 4.

A total of 171 questionnaires, in which all of the clinical questions (questions 1-9) were complete, were analysed.

Audit standards

Adherence to guidelines set out by the JRCALC, British Thoracic Society, LAS Clinical Updates, and the SSC were measured (Table 1).

	Aspect of Care	Target	Exceptions*	Evidence
1	Observations needed to identify sepsis recorded (See appendix 2 for definition)	100%	Patient refused	LAS Clinical Update issue 26, October 2011 Surviving Sepsis Campaign (Dellinger et al. 2013)
2	Signs of Systemic Inflammatory Response Syndrome (SIRS) identified (See appendix 1 for definition of SIRS)	100%	Patient refused	LAS Clinical Update issue 26, October 2011 Surviving Sepsis Campaign (Dellinger et al. 2013)
3	Review of Systems (ROS) conducted and signs of infection identified (See appendix 5)	100%	Unconscious patient Patient refused	LAS Clinical Update issue 26, October 2011 Surviving Sepsis Campaign (Dellinger et al. 2013)
4	Signs of severe sepsis or septic shock identified (See appendix 4)	100%	Not severe sepsis or septic shock	LAS Clinical Update issue 26, October 2011 Surviving Sepsis Campaign (Dellinger et al. 2013)
5	High flow oxygen given (15 litres per minute via a non-rebreather mask)	100%	Patient refused Not severe sepsis or septic shock	LAS Clinical Update issue 26, October 2011 Surviving Sepsis Campaign (Dellinger et al. 2013) Guideline for emergency oxygen use in adult patients (O'Driscoll et al., 2008) JRCALC 2009 (Oxygen)

6	IV access and fluid resuscitation started	100%	Patient refused Unable to gain IV access Not severe sepsis or septic shock	LAS Clinical Update issue 26, October 2011 Surviving Sepsis Campaign (Dellinger et al. 2013) JRCALC 2006 (Medical Emergencies)
7	Pre-alert to hospital	100%	Not severe sepsis or septic shock	LAS Clinical Update issue 26, October 2011 Surviving Sepsis Campaign (Dellinger et al. 2013)

*Table 1: Clinical audit standards *Concern for clinician safety is an exception to every aspect of care*

Clinical audit findings

Table 2 summarises the overall compliance to the clinical audit standards.

Standard	Exceptions n	Sample n	Appropriate n (%)	Not appropriate n (%)
Observations needed to identify sepsis recorded	1	199	174 (87%)	25 (13%)
Signs of Systemic Inflammatory Response Syndrome (SIRS) identified	4	196	1 (1%)	195 (99%)
Review of Systems (ROS) conducted and signs of infection identified	0	200	88 (44%)	112 (56%)
Signs of severe sepsis or septic shock identified	130	70	0 (0%)	70 (100%)
High flow oxygen given (15 litres per minute via a non-rebreather mask)	130	70	10 (14%)	60 (86%)
IV access and fluid resuscitation started	133	67	12 (18%)	55 (82%)
Pre-alert to hospital	130	70	28 (40%)	42 (60%)

Table 2: Compliance to clinical audit standards
Key: Red: 0-74% Amber: 75-94% Green: 95-100%

Patient demographics

Of the 200 patients included in the clinical audit sample, there was an even distribution among the sexes with both males (n=100) and females (n=100) contributing 50% to the cohort. The average age of the patient was 69 years, with ages ranging from 18 to 103 years. The largest proportion of patients were aged 70-79, as shown below in Figure 1.

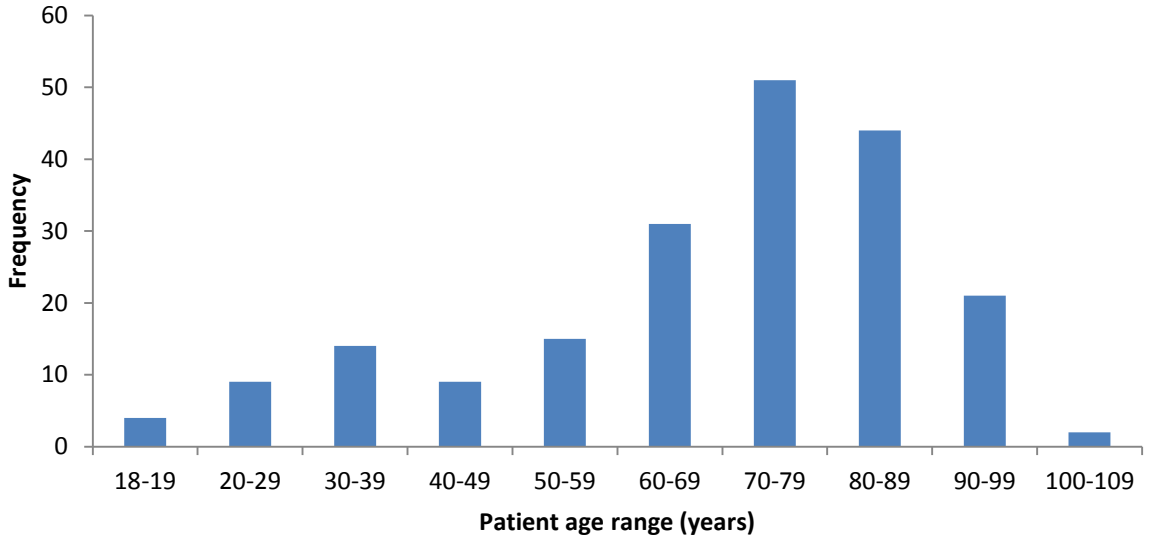

Figure 1: Age distribution

Medical Priority Dispatch System determinant

At 999 call, patients were most often triaged as having breathing problems (n=66, 33%), followed by Healthcare Professional (HCP) admission protocol (n=35, 18%) and sick person (specific diagnosis) (n=31, 16%) as shown in Figure 2.

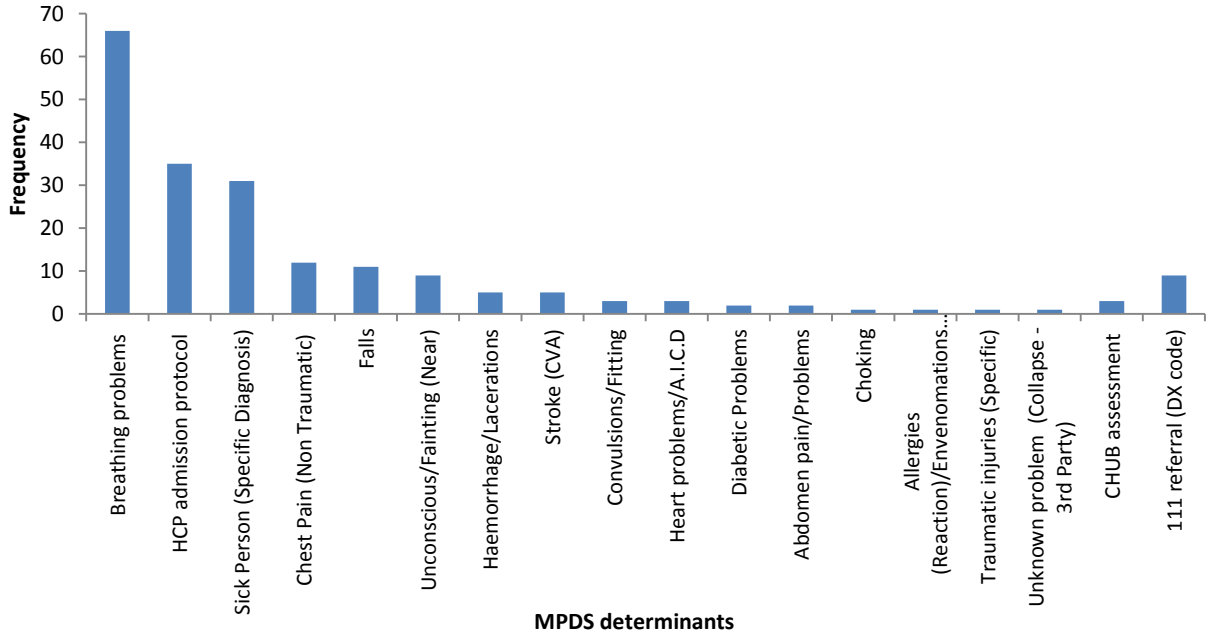

Figure 2: Telephone triage

Illness code

In addition to the five illness codes used to select the data (respiratory – chest infection n=53, 27%; pyrexia of unknown origin n=52, 26%; generally unwell n=51, 26%; other medical condition n=50, 25%; and urological n=18, 9%), the most commonly used primary and secondary illness code was dyspnoea (n=41, 21%) as shown in Figure 3.

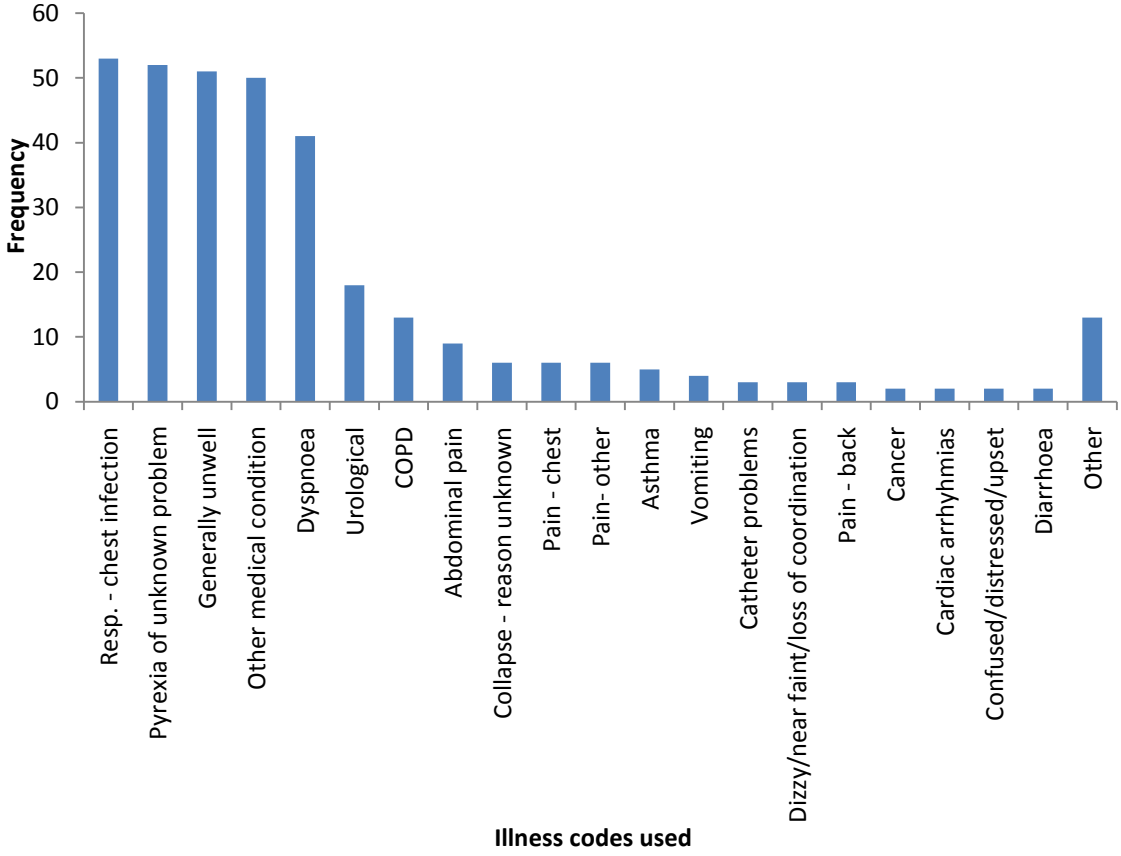

Figure 3: Primary and secondary illness codes

Suspected Sepsis

Of the 200 patients in the sample, only 26 (13%) had any suspicion of sepsis documented. This includes four patients (2%) who were suspected to be suffering from sepsis by the attending clinician, but whose vital signs and physical assessment did not meet the defined criteria to suspect sepsis. The remaining 174 patients (87%) had no mention or suspicion of sepsis on the PRF, but were suspected to be suffering sepsis by the author.

1. Observations recorded

Of the five observations needed to identify sepsis, 174 patients (87%) had all five observations undertaken, as shown in Figure 4. Every patient in the sample had their Respiration Rate (RR), Heart Rate (HR) and level of consciousness (AVPU)

measured. However, six patients (3%) did not have a temperature measured because there was no equipment available. Nineteen patients (10%) did not have their blood glucose (BM) measured where:

- equipment was not available (3%, n=6)
- unknown reason measurements could not be performed (1%, n=2)
- a patient refused to have their blood glucose measured (1%, n=1)

This left ten patients (5%) who did not have their capillary blood glucose measured without explanation on the PRF.

In addition to the five observations required to identify sepsis, oxygen saturation (SpO_2) and blood pressure (BP) measurement are required to assess organ dysfunction, if the patient is suspected of having severe sepsis or septic shock. One hundred and ninety five patients (98%) had their SpO_2 measured, although this includes six patients who had their SpO_2 measured only during oxygen administration. Of the remaining five patients:

- equipment was not available (1%, n=1)
- a reading was unobtainable, but it was not stated why (1%, n=2)
- there was no explanation as to why a SpO_2 reading was not measured (1%, n=2)

One hundred and ninety eight patients (99%) had their blood pressure measured, with one measurement (1%) unobtainable due to hypotension and one measurement (1%) not obtained but no reason documented.

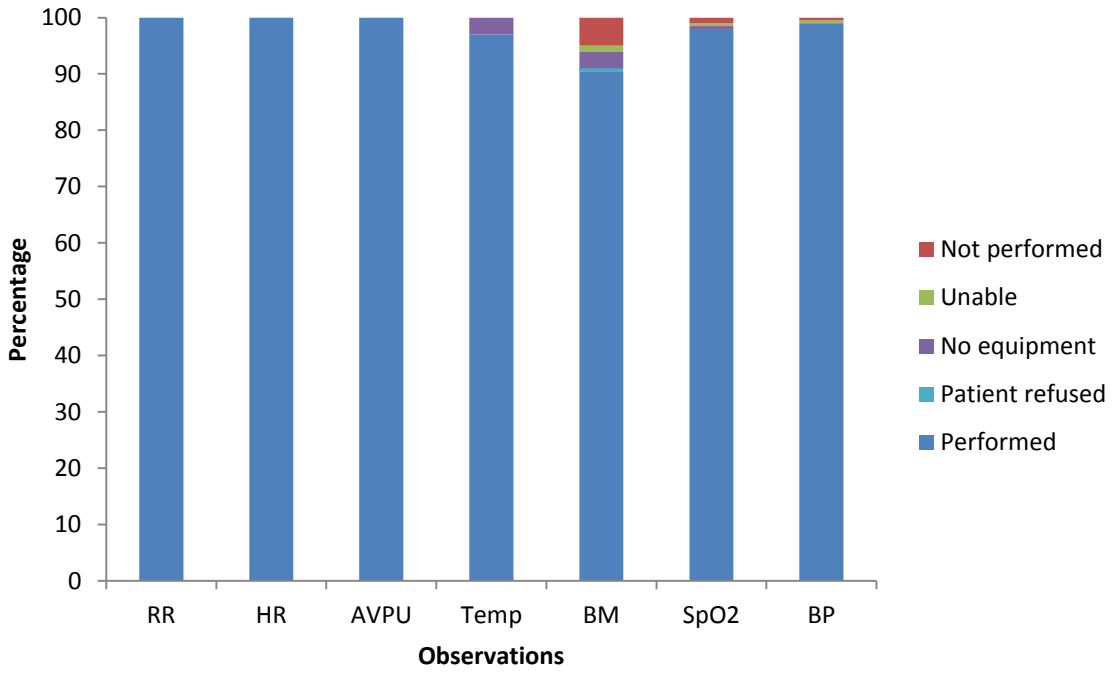

Figure 4: Observations undertaken

2. SIRS

Only one patient (1%) had recognition of SIRS documented. For the remaining 199 patients (99%) SIRS was not recognised.

3. a) Review of systems (ROS)

Only 88 patients (44%) received an adequate ROS. The remaining 112 patients (56%) did not. This varied from no obvious attempt of a ROS (n=81, 72%) to an inadequate attempt (n=31, 28%). 'Inadequate attempts' included comments on only a small number of systems, for example "no chest pain, no difficulty in breathing and no vomiting" which does not constitute a sufficient review.

b) Evidence or suspicion of infection

Clinicians suspected the presence of an infection for 119 patients (60%), and the author identified a further 77 patients (39%) with evidence of infection. The remaining four patients (2%) had sepsis documented on the PRF, but showed no clinical evidence of an infection.

The most common source of infection was lower respiratory tract infection (LRTI: n=73, 37%) followed by urinary tract infection (UTI: n=45, 23%) and gastrointestinal infection (GI: n=26, 13%). There were other sources of infection (n=17, 9%) and a combination of multiple sources, such as symptoms of a LRTI and UTI (n=28, 14%), as shown in Figure 5. There were ten patients (5%) in whom the source of infection could not accurately be identified. The source of the infection in these patients could not be determined because of poor documentation, for example: lack of adequate history of presenting complaint; poor ROS documentation; or the presence of non-specific symptoms, such as fever or general lethargy.

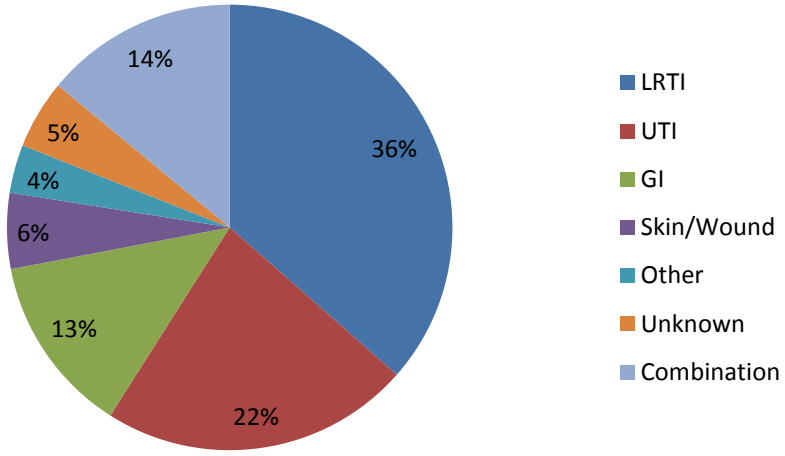

Figure 5: Sources of infection

4. Stage of sepsis

Only one patient (1%) had a stage of sepsis documented and this was incorrectly stated as 'early sepsis' which is not a recognised term.

One hundred and twenty six patients (63%) were deemed by the author to have uncomplicated simple sepsis. Seventy patients (35%) had suspected severe sepsis, with the remaining four patients (2%) incorrectly diagnosed by the clinicians as having sepsis (Figure 6). Of the 70 patients the author identified as having severe sepsis, some were likely to have had septic shock. However, it is not possible to identify this in the pre-hospital phase, because clinicians have no means of recognising continuing organ dysfunction in this environment.

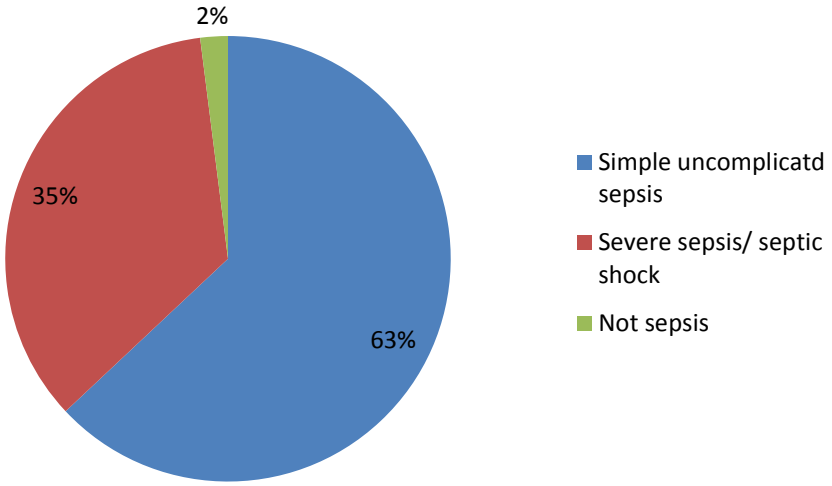

Figure 6: Stages of sepsis

5. Oxygen

One hundred and thirty patients (65%) did not require oxygen therapy (126 patients with uncomplicated simple sepsis and four without sepsis). The remaining 70 patients (35%) were eligible to receive initial oxygen therapy at 15 litres per minute as they were suspected of having severe sepsis or septic shock. Of these, only ten (14%) received high flow oxygen (15 litres), five patients (7%) received no oxygen therapy, and the remaining 55 patients (79%) received oxygen therapy in a range of inappropriate dosages as shown in Table 3.

Oxygen dose	Frequency (%)
2 LPM	23 (33%)
3 LPM	9 (13%)
4 LPM	9 (13%)
5 LPM	3 (4%)
10 LPM	1 (2%)
15 LPM	10 (14%)
24%	1 (2%)
28%	2 (3%)
32%	1 (2%)
6 litres via nebuliser	1 (2%)
8 litres via nebuliser	1 (2%)
Unknown dose	4 (6%)
None given	5 (7%)

Table 3: Oxygen administration. Key: 15 LPM appropriate administration

6. Cannulation and fluid therapy

Patients with severe sepsis should receive IV fluid therapy. Eleven severely septic patients (16%) were attended by a clinician not trained to cannulate patients. Of the remaining 59 patients with severe sepsis, 14 (20%) were successfully cannulated; three (4%) had unsuccessful IV cannulation attempts, and 42 (60%) received no cannulation attempt for no documented reason.

Of the 14 patients successfully cannulated, 12 (17%) were started on fluid resuscitation and the remaining two patients (3%) did not receive fluid resuscitation (with no reason given).

7. Pre-alert

Only 28 severely septic patients (40%) had a pre-alert placed before they were transported to hospital. This left 42 severely septic patients (60%) who were not transported to hospital with a pre-alert, preventing the hospital from starting the sepsis resuscitation bundle within an appropriate time frame.

Questionnaire findings

Table 4 outlines answers given by the 171 respondents to the questionnaire that provide reassurance or concern for the LAS.

Question	Reassuring answers n (%)	Concerning answers n (%)
1. Heard of Sepsis and SIRS	100 (59%)	71 (42%)
2. Knew stages of sepsis	40 (23%)	131 (77%)
3. Understood sepsis mortality	88 (52%)	83 (49%)
4. Identified the definition of sepsis	118 (69%)	53 (31%)
5. Signs and symptoms to suspect sepsis	7 (4%)	164 (96%)
6. Understood the definition of sepsis	39 (23%)	132(77%)
7. Pre-hospital management of severe sepsis	37 (22%)	134 (78%)
8. IV fluid therapy for a severe sepsis	68 (40%)	103 (60%)
9. a) Paramedic ability to identify sepsis b) Improving outcome for sepsis	121(71%) 160 (94%)	50(29%) 11(6%)

Table 4: Reassuring and concerning questionnaire responses
Key: Red: 0-74% Amber: 75-94% Green: 95-100%

Question 1: Heard of Sepsis and SIRS

One hundred respondents (59%) indicated that they had heard of both sepsis and SIRS. Seventy respondents (41%) indicated that they had heard only of sepsis and one respondent (1%) had not heard of either. However, the one respondent who allegedly had not heard of either did correctly answer most other questions, suggesting that this was stated in error.

Question 2: Knew stages of sepsis

Severe sepsis and septic shock were well recognised as stages of sepsis with 145 (85%) and 158 respondents (92%) correctly selecting these stages, respectively. Uncomplicated simple sepsis was poorly identified as a stage of sepsis, with only 69 respondents (40%) identifying this stage. Of the 171 respondents, only 40 (23%) correctly identified all three stages of sepsis. Of concern, a high number of respondents thought major sepsis (n=47, 28%), minor sepsis (n=47, 28%) and blood sepsis (n=60, 35%) were stages of sepsis, all of which were terms made up by the author.

Question 3: Understood sepsis mortality

One hundred and fifty one respondents (88%) correctly identified cardiac arrest as having a higher mortality than sepsis; however, only 88 respondents (52%) correctly identified that it was only cardiac arrest that had a higher mortality. Major traumatic injury was thought to have a higher mortality than sepsis by 60 respondents (35%).

Twenty seven respondents (16%) thought myocardial infarction had a higher mortality and 13 respondents (8%) incorrectly believed stroke had a higher mortality.

Question 4: Identified the definition of sepsis

One hundred and eighteen respondents (69%) correctly identified the definition of sepsis as 'the suspicion or presence of infection with an inflammatory response' (Seymour et al. 2012). Thirteen respondents (8%) incorrectly thought that the 'suspicion or presence of infection' alone was the definition of sepsis and 29 respondents (17%) incorrectly selected 'multiple organ failure'. Eleven respondents (6%) were not sure of the definition of sepsis and no respondents thought the definition of sepsis was 'an allergy'.

Question 5: Signs and symptoms to suspect sepsis

The signs and symptoms that respondents most commonly reported as increasing their suspicion of sepsis were: increased heart rate (n=168, 98%); increased respiratory rate (n=168, 98%); acutely altered mental state (n=151, 98%); pyrexia (n=160, 94%), and hypotension (n=151, 88%). Notably, these are all vital signs that can be indicative of sepsis. The options associated with symptoms of an infection were less likely to be selected by respondents (Figure 7).

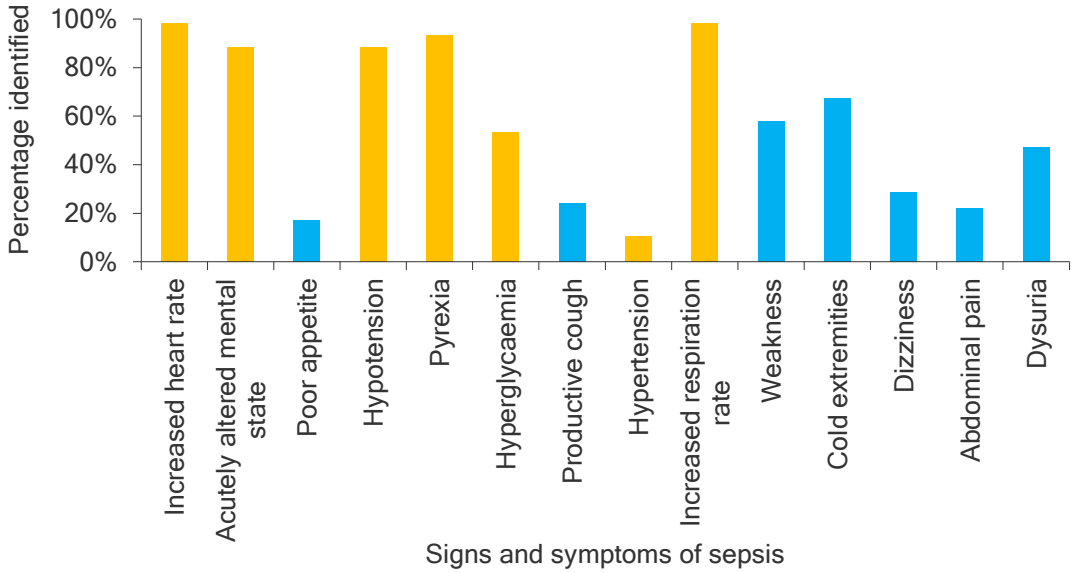

Figure 7: Signs and symptoms of sepsis. Key: □ vital signs □ symptoms of infection. Note: All except hypertension can be signs and symptoms of sepsis.

Question 6: Understood the definition of sepsis

Seventy-three respondents (42%) believed that the international definition of sepsis is used only occasionally in the pre-hospital setting to suspect, treat and manage sepsis and 56 respondents (33%) felt it was rarely used in the pre-hospital setting. Worryingly, only four respondents (2%) felt the correct definition was always used (Figure 8).

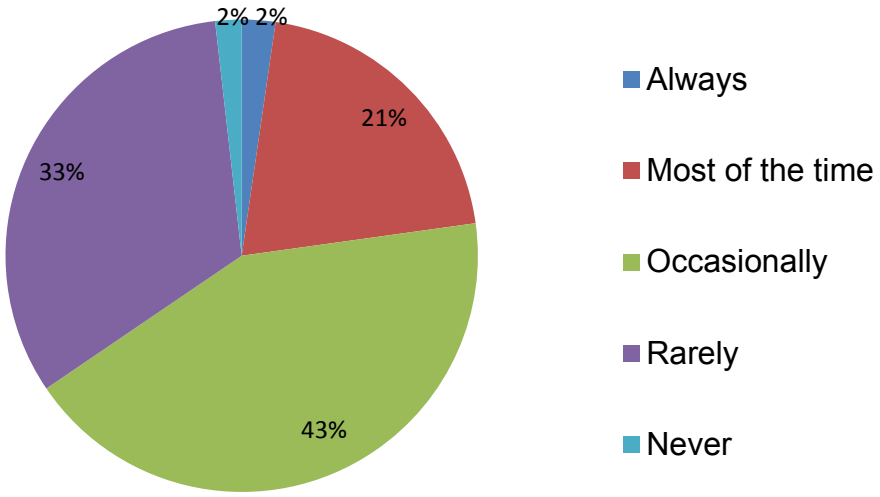

Figure 8: Frequency of use of the international definition of the stages of sepsis

Question 7: Pre-hospital management of sepsis

Overall, most respondents accurately identified the appropriate interventions that should be undertaken to treat sepsis: IV access (n=167, 98%), high flow oxygen administration (n=154, 90%) and IV fluid therapy (n=147, 86%). A total of 37 respondents (22%) correctly identified all of these appropriate interventions. Ninety-nine respondents (59%) also suggested ECG monitoring was appropriate (Figure 9).

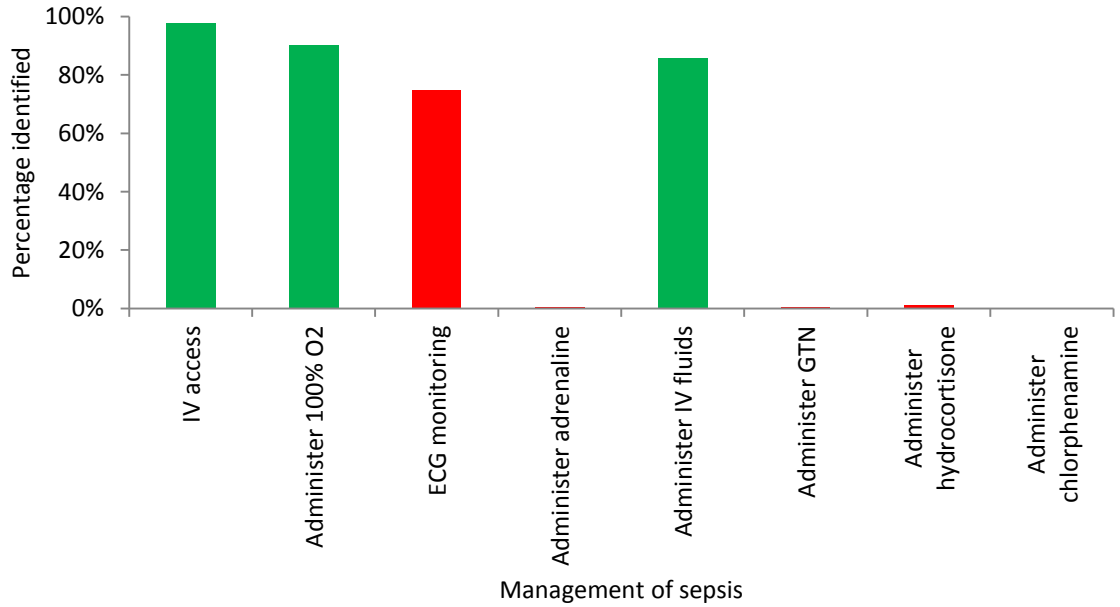

Figure 9: Management of sepsis. Key: correct management management not specific to sepsis

Question 8: IV fluid therapy for severe sepsis

Sixty-eight respondents (40%) accurately identified that patients suffering severe sepsis or septic shock can be administered up to 2000 ml of fluid. The remaining respondents indicated that they were unsure (n=22, 13%), would not administer any fluids (n=5, 3%) or indicated an incorrect maximum amount of fluid (n=76, 44%; Figure 10).

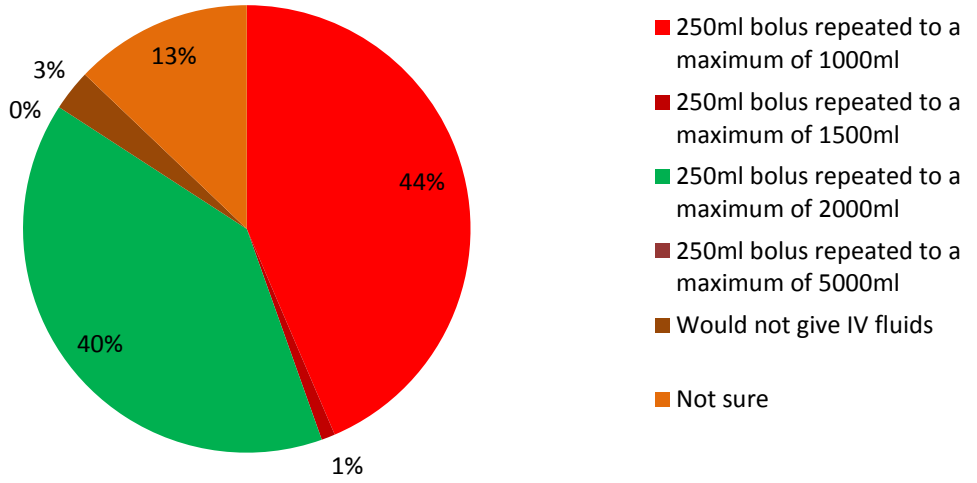

Figure 10: Fluid therapy

Question 9: Improving outcomes for sepsis

One hundred and twenty-one respondents (71%) agreed that Paramedics can identify patients at high risk of sepsis compared with 26 respondents (15%) who disagreed. One hundred and sixty respondents (94%) agreed that pre-hospital recognition and interventions may improve outcome in septic patients whilst two respondents disagreed (Figure 11).

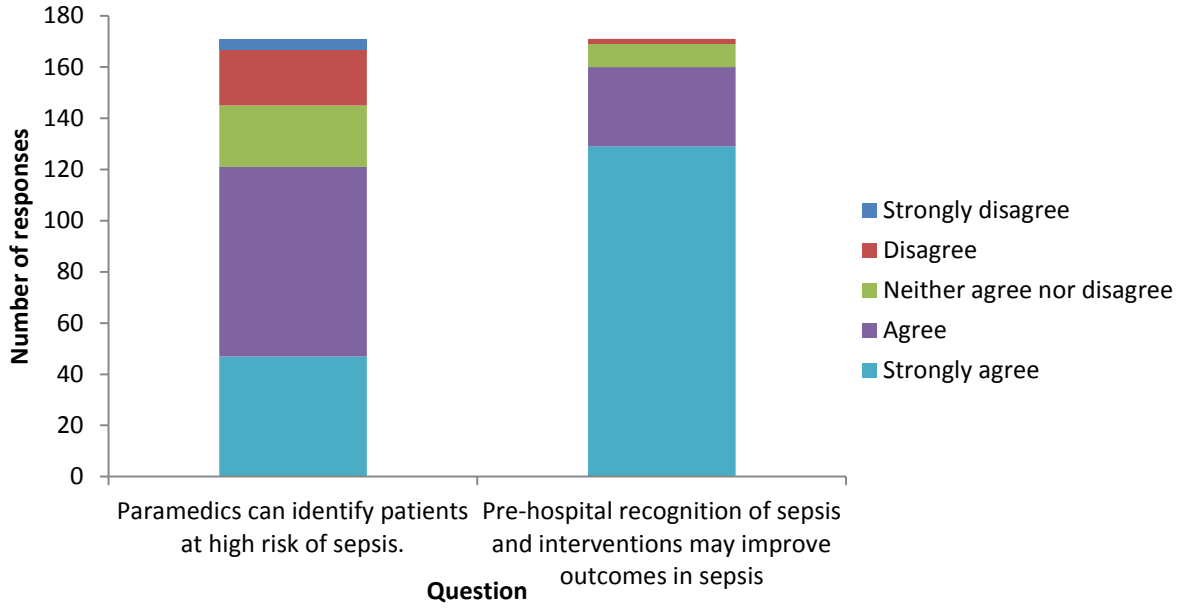

Figure 11: Recognition and improvement of sepsis in pre-hospital care

Question 10: Respondent demographics

Of the 171 respondents, three (2%) chose not to answer the demographic questions and 48 (28%) did not provide the length of time in their current role. The majority of respondents were Paramedics (n=142, 93%) educated via: an IHCD training course (n=54, 32%); a higher education route (n= 35, 21%); or a Student Paramedic course (n=33, 20%). There were 24 respondents who were not Paramedics, including: seven Apprentice Paramedics (4%); six Student Paramedics (4%); six A&E Support staff (4%); and five Emergency Medical Technicians (3%). Seventeen of the Paramedics were Clinical Team Leaders (10%) and three Clinical Tutors (2%). The remaining two respondents (1 %) did not state their role.

One hundred and twenty-three respondents (72%) provided their length of service in their current role. The average duration of service was seven years and three months. The longest length of service was 30 years and the shortest two months.

Discussion

This clinical audit found that overall recognition and management of sepsis was poor. This is likely to be due to the lack of understanding shown through the questionnaire and mirrored in other literature (McCelland et al. 2014; Robson et al. 2008; Small, 2012). However, it is reassuring that most respondents agreed that pre-hospital recognition and interventions could improve outcomes for sepsis.

The clinical audit included patients with similar demographics to those found in existing literature (Daniels et al. 2011) with equal numbers of male and female patients and a wide age range. This suggests that the patients encountered by ambulance staff may not differ from patients within a hospital setting.

A large proportion of patients were identified as having breathing problems both at the 999 call and by the clinicians on scene. This is understandable, given that respiratory infections are the most common cause of sepsis (Daniels et al. 2011) and breathing problems is one of the main symptoms highlighted by the UK Sepsis Trust as part of their campaign (The UK Sepsis Trust, 2014). Many of our patients present with breathing problems and therefore it is important that clinicians gain further information to distinguish patients who have sepsis from those who do not. The number of patients with sepsis referred to us by healthcare professionals was also high and it was concerning that sepsis was rarely identified by the referring healthcare professional, again emphasising a lack of awareness across the rest of the NHS (McCelland et al. 2014; Robson et al. 2008; Small, 2012).

One of the greatest challenges in sepsis management is recognition. Understanding how to recognise the signs and symptoms, and doing so in a timely manner, is of paramount importance to starting early life-saving treatment. Some patients did not have observations taken because of missing equipment; however, this has now been rectified by making it personal issue (LAS, 2014). Whilst observations were on the whole well completed, clinicians did not appear to use SIRS to associate abnormal observations with possible sepsis. After using observations to identify SIRS clinicians should then have used the ROS to identify potential sources of infection. However, given that an adequate ROS was undertaken for less than half of the patients, this contributed further to the poor identification of sepsis. The signs and symptoms that were poorly identified as being indicators of sepsis were those that would have been identified by the use of a ROS approach. An adequate ROS is crucial, as signs and symptoms of an infection may be quite subtle. As most of these indicators would need to be written as pertinent negatives in the free text if not present, it is possible that a ROS may have been performed but was not adequately documented. These findings are mirrored in the questionnaire where very few respondents were able to identify all of the signs and symptoms of sepsis. This provides strong evidence that LAS clinicians need further education in recognising the signs and symptoms of sepsis. In the short term, awareness of sepsis and how to identify it can be raised through a poster sent to ambulance stations and via an article in the Clinical Update. Following this, a more detailed overview of sepsis should be included in LAS training and a sepsis screening tool should be produced to help aid the detection of sepsis. This should be formatted so there is the potential to also include this in the pocket book.

In addition to poor recognition, sepsis was also poorly managed with less than one in five patients with severe or septic shock receiving oxygen appropriately, with an even smaller proportion being cannulated and receiving fluids. These are the only two elements of the Sepsis Six (Daniels et al. 2011) that the LAS is able to provide to patients and it is therefore disappointing that so few received these treatments. The poor management in terms of oxygen and fluid therapy is likely to be linked to the poor recognition of sepsis. However, even without recognition of sepsis these patients were clearly unwell and therefore should have been transported to hospital with a pre-alert. This is again supported by the respondents' answers to the questionnaire, indicating a lack of education in the management of sepsis, particularly fluid therapy. The pre-alert enables hospitals to prepare for patients and in the case of sepsis; this means being able to take blood cultures and measure lactate quickly, as well as having IV antibiotics ready. Along with the measurement

of urine output, these form the remaining elements of the Sepsis Six which, if given within the first hour, have been shown to improve patient outcomes (Robson et al., 2008). Therefore it is also recommended that a feasibility study be undertaken to encourage the use of the pre-alert for septic patients, which in turn would mediate commencement of the Sepsis Six on arrival at hospital.

As identification of sepsis is currently an area for improvement, lactate measurement has been trialed in the pre-hospital phase as a way of improving identification. A number of unpublished studies have demonstrated some logistical problems with pre-hospital lactate testing, primarily due to equipment problems. Younger and McClelland (2014) have shown some positive results. However, they recruited only nine specialist Paramedics and their primary measured outcome was feasibility as opposed to diagnostic value. Current evidence suggests that although lactate measurement is very specific and is a valuable prognostic tool, it has poor sensitivity (Singer, Taylor, Domingo, Ghazipura, Khorasonchi, Thode & Shapiro, 2014; McLean, Tang & Huang, 2015). Reliance on lactate measurement may therefore take away the focus that is needed on education and awareness. Blood cultures, urine output measurement and antibiotics administration are unlikely to benefit patients in London due to our short journey times to hospital. However, end-tidal carbon dioxide monitoring ($EtCO_2$), which LAS clinicians routinely use, has been considered to aid recognition of sepsis and inform prognosis (Hunter, Silvestri, Dean, Falk, & Papa, 2013; Hunter, Silvestri, Ralls, Bright, & Papa, 2014). Further investigation is needed to determine whether this could be a useful tool for sepsis in the pre-hospital phase.

The questionnaire showed that general awareness of sepsis was poor, particularly understanding around the high incidence and severity of this condition. This is mirrored in other healthcare settings (McCelland et al. 2014; Daniels et al. 2011) and has led NHS England to issue a Patient Safety Alert to raise awareness of this condition (NHS England, 2014). Some other ambulance and hospital trusts have started to act on The UK Sepsis Trust's calls to improve recognition (Robson, Nutbeam, & Daniels, 2009) with initiatives such as introducing a sepsis screening tool and point of care lactate testing, as mentioned above (McClelland & Younger, 2013; Younger & McClelland 2014). The Isle of Wight Ambulance Service has also undertaken a study looking at commencing the Sepsis Six in the pre-hospital phase and are due to publish their results this year. However, in the LAS there is currently limited training, guidance, or a satisfactory way to monitor and improve the care provided to septic patients. The possibility of including prompts for sepsis on the PRF will be explored. A sepsis illness code will also be introduced to allow for easier identification of sepsis paperwork for any future improvement work.

Although the ECG is not part of the Sepsis Six, many respondents considered that an ECG should be undertaken for a patient with severe sepsis or septic shock. This is likely to be due to the association of sepsis with tachycardia, which is an indication for an ECG. It does not form part of the Sepsis Six, however, so conducting an ECG should not delay treatment or transportation to hospital and could be undertaken en-route if indicated for another condition.

The findings of this clinical audit should also be fed back to the Association of Ambulance Chief Executives (AACE) who are responsible for the UK Ambulance Services Clinical Practice Guidelines and The UK Sepsis Trust to help inform the next set of pre-hospital guidelines. Finally, an LAS Sepsis Clinical Performance Indicator (CPI) should be developed to maintain focus on this area of care and ensure the recommendations have led to improvement. If any of the recommended actions are not implemented then this could pose a risk to patients and subsequently the Service. Therefore, inclusion of the lack of recognition and management of sepsis should be considered for the risk register.

Overall, care provided to patients with suspected sepsis needs significant improvement. LAS clinicians require additional education and training to recognise, treat and manage patients with sepsis. Should any of the recommended actions not be completed in a timely manner, the identification of sepsis should be included on the LAS risk register.

Recommendations and Actions

	Recommendations	Actions	Responsible Officer	Director	Deadline
1	Raise awareness of sepsis and how to identify it	Produce a poster for every ambulance station Write a Clinical Update article about the pathophysiology, recognition, treatment and management of sepsis Review and update current LAS training materials Produce a sepsis screening tool with potential to include in the pocket book	Authors Authors Department of Clinical Education and Standards Sepsis Working Group	Medical Director Director of Paramedic Education	Feb 2015 Feb 2015 Jul 2015 Jul 2015
2	Increase the number of patients with severe sepsis or septic shock who receive a pre-alert	Examine the feasibility of a sepsis pathway	Authors	Medical Director	Dec 2015
3	Investigate other recognition techniques e.g. $EtCO_2$	Undertake a literature review on the use of $EtCO_2$ as a prognostic marker for sepsis	Authors	Medical Director	Jul 2015
4	Improve documentation of sepsis	Explore the possibility of including prompts for sepsis on the PRF Introduce a sepsis illness code	Medical Directorate	Medical Director	Jul 2015
5	Help to inform future pre-hospital guidelines	Share this report with AACE and The UK Sepsis Trust	Authors	Medical Director	Feb 2015
6	Ensure these changes lead to sustained improvements	Develop an LAS Sepsis CPI	Authors	Medical Director	Jul 2015

Table 5: Recommendations and actions

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Cost analysis

Table 6 shows a breakdown of the approximate cost of this clinical audit project. The authors conducted the majority of this project in their own time at no cost to the LAS therefore the 118 voluntary hours have not been included in the table below. Cost analysis is reported to provide the Service with an understanding of the resources involved in conducting this clinical audit project.

Description of staff activity	**Approximate Cost**
Project design	£30.26
Data collection	£0
Quality assurance	£24.74
Clinical review/advice	£83.46
Data analysis	£74.22
Report write up	£60.52
Feedback on report	£30.26
Report re-drafting	£83.85
Report to LAS multidisciplinary Clinical Audit and Research Steering Group	£24.74
Management Information	£48.26
Total	**£406.72**

Table 6: Cost analysis for this clinical audit project

Appendices

Appendix 1

Definitions of uncomplicated simple sepsis, severe sepsis and septic shock

Sepsis: Suspected or known infection, in the presence of Systemic Inflammatory Response Syndrome (SIRS).

This first stage is termed Uncomplicated Simple Sepsis

SIRS is defined as two or more of the following:

- Temperature <36C or >38.3C
- Heart rate >90BPM
- Respiration rate >20 breaths per minute
- Blood Glucose level >6.6mmol/l (If no diabetes mellitus)
- An acutely altered mental state
- White cell count <4 or >12 x 10*9/l (If known)

Severe sepsis is defined as sepsis with any sign of organ dysfunction, which can include:

- Systolic blood pressure <90mmHg or a decreased systolic >40 mmHg from their norm.
- New O_2 to keep SpO_2 >90%
- Lactate >2mmol/l
- New onset of confusion
- Decreased urine output
- Jaundice

Septic shock is defined as continued evidence of severe sepsis (organ dysfunction) despite adequate fluid resuscitation.

(Dellinger, Levy, Rhodes, Annane, Gerlach, Opal et al., 2013).

Appendix 2

Definition of Systemic Inflammatory Response Syndrome (SIRS)

Two or more of the following findings:

- Temp <36 or >38.3°C
- Heart rate >90bpm
- Respiratory rate >20 pm
- Acutely altered mental status (V, P or U)
- Blood glucose >6.6mmol/l (Unless diabetic)

(Daniels, 2014)

Appendix 3

The Sepsis Six (to be delivered within one hour):

1. Deliver high-flow oxygen
2. Take blood cultures
3. Administer empiric intravenous antibiotics
4. Measure serum lactate and send full blood count
5. Start intravenous fluid resuscitation
6. Commence accurate urine output measurement

(Daniels, Nutbeam, McNamara & Galvin, 2010).

Appendix 4

All correct answers are highlighted in yellow.

Clinical Audit & Research Unit: Recognising pre-hospital sepsis questionnaire

Thank you for agreeing to take part in our survey. On behalf of CARU, we thank you for completing these questions. The purpose of this questionnaire is to gain an understanding and gather information about clinician's perception of sepsis in the pre-hospital environment. The information gathered from the questionnaire will be combined with data obtained from PRF audit to produce a report on sepsis within the LAS. This survey should take less than 10 minutes to complete and all responses are anonymous. No attempt will be made to link any personal identifying information to you or to your answers. By completing this questionnaire you consent to the information gathered to be used for clinical audit and research purposes.

You will be asked to answer 10 questions and will be instructed on each page on how to complete the question. After advancing to the next questions, you will not be able to return to the previous questions. Two demographic questions will conclude the survey. Although some questions may seem outside your scope of practice or training, please answer to the best of your knowledge.

Question 1. Have you heard the terms Sepsis and / or Systemic Inflammatory Response Syndrome (SIRS)?

Check one answer:
O Yes to both terms
O Yes to Sepsis only
O Yes to SIRS only
O No
O Not sure

Question 2. Which of the following are included in the stages of sepsis?

Check all that apply:
O Severe sepsis
O Major sepsis
O Blood sepsis
O Uncomplicated simple sepsis
O Septic shock
O Minor sepsis

Question 3. Check the condition(s) which have a higher mortality than sepsis.

Check all that apply:
O Major traumatic injury
O Stroke
O Cardiac arrest
O Myocardial infarction

Question 4. Which of the following is a definition of sepsis?

Check one answer:
O An allergy
O Suspicion or presence of infection
O Suspicion or presence of infection with an inflammatory response
O Multiple organ dysfunction
O Not sure
O Other. Please state…….

Question 5. What signs and symptoms increase your suspicion of sepsis?

Check all that apply:
O Increased Heart rate
O Acutely altered mental state
O Poor appetite
O Hypotension
O Pyrexia
O Hyperglycaemia
O Productive Cough
O Hypertension
O Increased respiration rate
O Weakness
O Cold extremities
O Dizziness
O Abdominal pain
O Dysuria

Current guidelines define sepsis by the following criteria:

Suspected or known infection, in the presence of Systemic Inflammatory Response Syndrome (SIRS). This first stage is termed uncomplicated simple sepsis

SIRS is defined as two or more of the following
Temperature <36C or >38.3C
Heart rate >90BPM
Respiration rate >20 breaths per minute
Blood Glucose level >6.6umol/l (If no diabetes mellitus)
An acutely altered mental state
White cell count <4 or >12 x 10*9/l (If known)

Severe sepsis is defined as sepsis with any sign of organ dysfunction, which can include:

Systolic blood pressure <90mmHg or a decreased systolic >40 mmHg from their norm.
New O2 to keep SpO2 >90%
Lactate >2mmol/l
New onset of confusion

Decreased urine output
Jaundice

Septic shock is defined as continued evidence of severe sepsis (organ dysfunction) despite adequate fluid resuscitation.

Question 6. How often do you believe this definition of sepsis is used in the pre-hospital setting to suspect, treat and mange sepsis?

Check one answer:
O Yes
O No
O Not sure

Question 7. Which of the following assessment(s)/ intervention(s) should be undertaken for the treatment of SEVERE sepsis or SEPTIC shock within Paramedic scope of practice?

Check all that apply:
O IV access
O Administer 100% O_2
O ECG monitoring
O Administer adrenaline
O Administer IV fluids
O Administered GTN
O Administered hydrocortisone
O Administer chlorphenamine

Question 8. If you were to provide IV fluid therapy for a patient suffering from severe sepsis or septic shock, what dose would you give?

O 250ml bolus repeated to a maximum of 1000ml
O 250ml bolus repeated to a maximum of 1500ml
O 250 ml bolus repeated to a maximum of 2000ml
O 250 ml bolus repeated to a maximum of 5000ml
O Would not give fluids
O Not sure

Question 9. The following items address your opinion regarding sepsis within the pre-hospital environment.

	Strongly agree	**Agree**	**Neither agree nor disagree**	**Disagree**	**Strongly disagree**
Paramedics can identify patients at high risk of	O	O	O	O	O

sepsis					
Pre-hospital recognition of sepsis and interventions may improve outcomes in sepsis	O	O	O	O	O

Demographic Questions

Question 10. Please indicate your current role and how many years practicing in that role rounded to the nearest year.

Check one answer:
O Paramedic (IHCD training)
O Paramedic (Student Paramedic courses i.e. Hannibal house)
O Paramedic (Higher educational institute (HEI) training)
O Student Paramedic (inclusive of all courses). Please specify……
O Emergency Medical Technician (EMT any grade)
O Apprentice Paramedic
O A & E support
O Clinical Team Leader
O Other. Please specify…….

Years of practice

Appendix 5

Definition of review of systems and signs and symptoms of infection

Signs and/or symptoms of infection might not always be obvious – a systematic approach includes a 'review of systems' (ROS) and can be achieved through simple examination and history taking.

Review of systems

A brief structured review of body systems which may not have been discussed in the history of presenting complaint. The review of systems helps identify signs and/or symptoms that the patient may be experiencing or has experienced.

For some of the symptoms you may want to describe the:

- Onset
- Duration
- Course
- Severity
- Precipitating factors
- Relieving factors
- Associated features
- Previous episodes

The review of systems should cover the following areas:

- General (fatigue, weight, appetite, fever and general health)
- Central Nervous system (Headaches, dizziness, fits/faints/funny turns, vision)
- Cardiovascular (Chest pain, SOB, SOBOE, palpitations)
- Respiratory (Chest pain, SOB, SOBOE, cough, sputum, haemoptysis)
- Gastrointestinal (Nausea, vomiting, abdominal pain, urinary and bowel habits)
- Musculoskeletal (pain, swelling, stiffness, mobility)
- Genito-urinary (Urinary habits, abdominal, flank and back pain)
- Skin (rashes, warmth, itchiness)

Possible sources of infections

Neurological:

- New confusion
- Signs of meningitis or encephalitis

Respiratory:

- Cough +/- sputum
- Pleuritic pain
- Raised respiratory rate

Gastrointestinal:

- Diarrhoea +/- vomiting
- Abdominal pain +/- peritonitis
- Abdominal distension/constipation/localised tenderness

Genito-urinary:

- Discharge/sexually transmitted disease (STD)
- UTI – Loin pain on urination, urgency, frequency

Musculo-skeletal:

- Hot painful joint +/- non weight bearing
- Back pain

Other:

- Dental problems
- Foreign travel
- Exposure to sick contacts
- Cellulitis
- Diabetic foot and ulcers
- Pupuric rash
- Burns

This is not an exhaustive list and clinical judgement should be used when considering whether a sign of symptom of an infection is present.

(Mohammed, 2011)