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Seeking Sepsis in the Emergency Department- Identifying Barriers to Delivery of the Sepsis 6

James Bentley, Susan Henderson, Shobhan Thakore, Michael Donald, Weijie Wang
NHS Tayside

Abstract

The Sepsis 6 is an internationally accepted management bundle that, when initiated within one hour of identifying sepsis, can reduce morbidity and mortality. This management bundle was advocated by the Scottish Patient Safety Programme as part of its Acute Adult campaign launched in 2008 and adopted by NHS Tayside in 2012. Despite this, the Emergency Department (ED) of Ninewells Hospital, a tertiary referral centre and major teaching hospital in Scotland, was displaying poor success in the Sepsis 6.

We therefore set out to improve compliance by evaluating the application of all aspects of the NHS Tayside Sepsis 6 bundle within one hour of ED triage time, to identify what human factors may influence achieving the one hour The Sepsis 6 bundle. This allowed us to tailor a number of specific interventions including educational sessions, regular audit and personal feedback and check list Sepsis 6 sticker. These interventions promoted a steady increase in compliance from an initial rate of 51.0% to 74.3%.

The project highlighted that undifferentiated patients create a challenge in initiating the Sepsis 6. Pyrexia is a key human factor-trigger for recognising sepsis with initial nursing assessment being vital in recognition and identifying the best area (resus) of the department to manage severely septic patients. EDs need to recognise these challenges and develop educational and feedback plans for staff and utilise available resources to maximise the Sepsis 6 compliance.

Problem

The Sepsis 6 has facilitated Emergency Departments (EDs) to commence timely treatment and facilitate early patient transfer to inpatient departments for ongoing monitoring and management.[1-3] There still, however, may be a number of factors present in the ED which delay achieving these goals.

Background

Sepsis is a medical emergency where failure to initiate and continue effective management can proceed to acute organ dysfunction with hypotension resulting in death with mortality up to 50% in certain populations.[2,4-6] The Surviving Sepsis Campaign (SSC), initiated in 2002, has been performing ongoing reviews of sepsis management based on the benefit of early goal-directed therapy (EGDT) defined by Rivers et al.[7] Using the available evidence and relevant research they published advice in the form of guidelines and management bundles in 2004, 2008 and, 2013.[2] The evidence base supporting the SSC has been questioned and recent randomised controlled trials have shown no benefit to patient mortality with EGDT compared to standard care.[8-11] These compared EGDT dictated by parameters suggested by Rivers et al. with intervention at clinicians' discretion and do not account for the possibility that standard care may be more aggressive now than in the original Rivers et al. trial as a result of the large SSC. A recent meta-analyses of all goal-directed therapy (GDT) strategies for sepsis management compared to standard care concluded that any form of GDT reduced mortality and morbidity especially if initiated early.[12] Daniels et al. evaluated six interventions based on the SCC that when initiated within an hour of identifying sepsis reduced mortality and morbidity.[3] These elements are: administer high flow oxygen; take blood cultures; give broad spectrum antibiotics; give intravenous fluid challenges; measure serum lactate and haemoglobin; measure accurate hourly urine output. Completing this bundle allows the practitioner to make interventions to support early aggressive sepsis management either using GDT or non-protocolised care.

In 2008 the Scottish Patient Safety Programme (SPSP) launched its Acute Adult campaign which included the aim of reducing mortality and harm from sepsis, defined as a patient displaying two or more aspects of the Systemic Inflammatory Response Syndrome (SIRS) and a presumed infection. As part of this group, and in conjunction with the Scottish Antimicrobial Management Group, NHS Tayside adopted the Sepsis 6 bundle in January 2012 to attempt to reduce mortality in sepsis by 5% by December 2012 and by 10% by December 2014. Ninewells ED is a university-affiliated teaching hospital in Dundee, Scotland, which sees around 50,000 undifferentiated cases per annum with up to 40 patients admitted with sepsis per month. The department operates with 24-hour 'shop-floor' senior doctor (ST4 to Consultant) supervision and is split into three clinical areas comprising a minors area; majors area and a resuscitation area (resus) for the critically injured or unwell. Patients are triaged on arrival and streamed into one of the three areas. As first responders to undifferentiated patients, the ED plays a crucial role in the early identification and initiation of management for many of the septic patients admitted to hospital. The familiarity with time-critical management strategies for other disease processes places

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emergency physicians in an optimal position to initiate quick and effective interventions.[13] Studies have suggested a positive influence on the mortality in sepsis with structured clinical management approaches adopted by EDs.[3,14,15] Consistent management, however, was lacking in our department.

Baseline measurement

Data were collected retrospectively by searching the Symphony (EMISHealth, Leeds) patient information system from mid-April 2012 to the end of October 2012. This was approved by local Caldicott Guardian. For each week of the study period a list of all patients for whom 'Sepsis/SIRS2 criteria' had been selected as an admission category when released from the system, had their local identifying numbers (CHI) extracted to Microsoft® Excel. From each list five patients were selected using the Microsoft® Excel random number generator and recruited to the study. This followed guidance from the SPSP Sepsis Collaborative to audit 20 cases of sepsis per month. These patients had their ED Assessment Cards reviewed and the following information was collected; arrival time in ED; area of ED initially managed; time of first medical assessment (any doctor FY1 grade or above); time of first senior clinician involvement (ST4 and above); SIRS criteria present at triage; Scottish Early Warning Score (SEWS) at triage; element of the Sepsis 6 completed with timings.

Compliance was defined as all aspects of the Sepsis 6 completed within one hour of triage. The use of indwelling urinary catheters in septic patients is not routine in Tayside but only when oliguria has occurred despite fluid resuscitation, a patient is displaying severe sepsis or septic shock or there is another factor preventing the patient from easily passing urine. Prompt transfer to admitting wards often occurs locally before the patient has needed to pass urine and so the lack of urine output can be misleading. For this reason 'initiating a fluid bolus' and 'measure accurate hourly urine output' were combined as a single output measure. The time to completion of each individual element was recorded for analysis. Compliance was then analysed against factors stated previously. Arrival time was categorised as 'In-hours' (08:00hrs-18:00hrs Monday–Friday) and 'out-of-hours' (18:01-07:59hrs Monday-Friday and all weekend) and the area of the ED in which the patient was managed as: treatment bay; resus; treatment bay patients who were transferred to resus (treatment bay to resus).

STATISTICAL METHODS

SPSS version 21 (SPSS Inc., Chicago IL) was used to analyse data. Chi-squared test was used to compare the percentages between groups and the Mann-Whitney test used to compare the non-normally distributed data. Binary multivariate regression was used to determine the most influential factors on compliance.

RESULTS

A total of 155 patients were included in the survey with demographic data shown in Table 1 (Results Supplement). The main factors associated with compliance along with the mean and median times for medical assessment and SEWS scores are summarised in Table 2 (Results Supplement). There was no significant difference in overall compliance with the Sepsis 6. The bundle was achieved for 79 (51.0%) participants and in the remaining 76 (49.0%) patients at least one element was not delivered within one hour or at all (non-compliant). There was no difference in the compliance in-hours compared with out-of-hours. The area of the department in which the patient was managed, the presence of pyrexia and the time to first medical and senior assessment had significant influences on compliance. Regression analysis suggested that the time to 1st medical and senior doctor assessment and the presence of pyrexia had the greatest influence on compliance.

Initial management in resus was associated with increased compliance (p=0.009). Most patients (113, 72.9%) were managed initially in resus with 66 (58.4%) compliant. 31 (20.0%) were transferred to resus during their management. Management was compliant for 75 (52.1%) of patients ultimately managed in resus but only nine (29.0%) of the patients transferred during assessment were compliant. 11 patients (7.1%) were not managed in resus with four (36.4%) compliant. In the presence of pyrexia (temperature 38oC or over) 75 patients (57.7%) were compliant. Only four patients with (temperature less than 38oC (16.0%) were compliant. In the compliant group the mean time from triage to 1st medical assessment was 2.7 minutes, senior involvement 7.0 minutes compared with 16.6 minutes and 25 minutes respectively in the non-compliant group.

Almost twice as many patients involved (101 patients, 65.1%) had three SIRS criteria present rather than two (the minimum required for inclusion): with 56 patients (55.4%) compliant and 23 patients (42.6%) compliant with three and two SIRS present respectively. The median SEWS score was six for the compliant patients and five for the non-compliant.

Table 3 (Results Supplement) shows how often each element of the bundle was achieved. Administering antibiotics was the poorest achieved aspect of the Sepsis 6 bundle occurring in 103 patients (66.5%) and 24 (31.6%) of the non-compliant. Oxygen was administered in 148 patients (95.5%) and in 69 (90.8%) of the non-compliant.

Design

The following aim was created in order to address the problem: Ninewells ED will have 75% compliance with the Sepsis 6 management bundle, for patients displaying two or more SIRS criteria and a presumed infection, by the end of December 2014.

When creating this aim the local team considered a number of sources. The SPSP campaign had set a target of 95% compliance with the Sepsis 6 in order to achieve a 10% reduction in mortality. It was felt that achieving this target initially would be unrealistic and so a lower compliance rate should be considered. College of Emergency Medicine [since given Royal Charter] set clinical standard for EDs to have all Sepsis 6 aspects achieved before ED discharge but only set a target for antibiotics and fluid bolus initiation within one hour (50% and 75% respectively).[16] On the

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basis of this an initial target of 75% compliance with the complete Sepsis 6 bundle was set.

When considering how to address the problem, there appeared to be two main aspects to address: correct placement of the patient in the department and commencing early interventions to maximise the first hour after triage. The two main groups who could affect these were the initial assessment nurse who triages the patient to the most appropriate area of the department and the junior doctors who, most commonly, make the first medical assessment and initiate management under the guidance of the senior clinicians. Raising awareness of the clinical need for rapid assessment and completion of the Sepsis 6, in particular administering antibiotics and IV fluid, was essential to improve compliance. The most obvious system was through departmental education and target-driven clinical care. This was supported with ongoing audit of compliance with regular feedback to the clinical team.

The QI team comprised of a ST3 doctor, a Clinical Audit Facilitator, and two Emergency Medicine Consultants.

Strategy

In order to improve compliance with the Sepsis 6 bundle a series of Plan, Do, Study, Act (PDSA) cycles were conducted with 20 random cases per month reviewed to measure monthly compliance in accordance with the SPSP campaign. This gave continuous feedback as to the benefit of various interventions. The interventions have been grouped into the following general themes: engagement (PDSA 1-3); education (PDSA 4-5); surveillance and feedback (PDSA 6-7).

PDSA 1: Initial discussions occurred at senior staff meetings surrounding the evidence of EGDT in sepsis management, our compliance against the national target and the potential impact on patient care and department flow. This concluded with agreement that improving compliance with the Sepsis 6 bundle was important, would improve patient care and would not adversely affect patient flow through the department. This enrolment of senior clinical staff was essential to support further interventions by directing and supporting junior staff and emphasise the importance of early management and decision making in patients with signs of sepsis.

PDSA 2: Senior staff agreed that managing potential septic patients should be directed to resus for early aggressive management. This would prompt early medical assessment, senior involvement and decision making, and facilitate performing interventions as Level II or III (2:1 or 1:1) nursing care would be provided.

PDSA 3: This led to a department protocol being drawn up (Figure 1, Supplementary Material) and a lead sepsis consultant being appointed to oversee department education, compliance and dissemination of information.

PDSA 4: All junior doctors rotating through the department attended a mandatory induction course (held every four months). For this a short lecture, delivered by the lead sepsis consultant, was created to educate staff. This involved defining SIRS criteria and sepsis, explaining the diagnostic criteria for increasing levels of sepsis. The background evidence for EGDT was summarised, then the local aims for sepsis management which introduced the agreed local sepsis management protocol (Figure 1 Supplementary Material). The lecture also stressed the importance of early senior doctor involvement to aid early decision making.

PDSA 5: Morning drop-in educational sessions were organised for nursing and existing medical staff where the Induction Lecture was presented and informal discussions about the proposed project occurred. Information about these sessions as well as basic information about the local objectives in sepsis management was communicated at shift handovers and safety huddles.

PDSA 6: Continuing survey on sepsis compliance was undertaken, selecting 20 random cases each month for review by the lead sepsis clinician each month. This process involved case note review, discussion with the clinicians involved in non-compliant patients to clarify information surrounding the case and identifying any difficulties. This gave an opportunity to clinicians to reflect and feedback any factors they felt hindered sepsis management as well as to identify areas of improvement in their own practice.

PDSA 7: The results of the initial survey into Sepsis 6 compliance were displayed on a dedicated noticeboard in the central staff base of the department. This display was updated with the monthly compliance rates. This information was also disseminated to all staff through email detailing the proportion of patients compliant with the Sepsis 6 and the proportions achieved for each element. The email also highlighted any recurrent issues giving potential strategy.

PDSA 8: These processes led to the creation of a Sepsis 6 check-list sticker (Figure 2, Supplementary Material) to act as a prompt for both nurses and doctors for inclusion in the patient's notes. This was created at triage when clinical history and initial observation suggested the presence of sepsis.

See supplementary file: ds7774.docx - "Supplementary Material"

Results

Audit data were evaluated from 1st June to 31st December 2014 after interventions were put in place to assess any change to the Sepsis 6 compliance. A total of 140 patients were recruited to the follow-up survey through the same methods as the initial survey. Demographic data shown in Table 1 (Results Supplement).

Post-interventions there was a significant increase ($p<0.001$) in overall compliance with more patients (104, 74.3%, $p<0.01$) compliant with the Sepsis 6 bundle (Table 2, Results Supplement). This demonstrated a 45.7% improvement in compliance. Compliance improved across all factors measured in the primary survey. As with the initial survey earlier, 1st medical and senior doctor involvement were associated with increased compliance. The mean and median time to senior involvement, however, did not reduce post-intervention.

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Table 3 (Results Supplement) shows the percentage change in the proportion of patients receiving each element of the Sepsis 6 bundle. There was increase in the number of patients receiving each element of the Sepsis 6 bundle. In the non-compliant group fluid administration and blood culture collection were not achieved for a greater proportion of non-compliant patients. However, more patients received these interventions within the Sepsis 6 hour than had in the initial survey. Overall 40 (13.1%) of patients: 27, (17.4%) baseline survey; 13, (9.2%) post-intervention survey, had at least one element not performed in the ED.

See supplementary file: ds7622.docx - “Results Supplement”

Lessons and limitations

Our initial survey showed that there was room for improvement with Sepsis 6 compliance with and sepsis management in our ED. We rely on junior staff to perform the majority of initial medical assessments. A difficulty in improving and maintaining performance is the constant (every four months) change in junior staff who, depending on clinical experience and previous areas of work, may not approach patient assessment in the prompt manner required in Emergency Medicine. Without prompt senior involvement uncertainty in management decisions can cause delay in Sepsis 6 actions. Utilising the induction programme to educate and reinforce this swift approach and provide a standardised knowledge base empowered junior doctors to seek senior guidance and act promptly. Providing this standardised knowledge to nurses, through the drop in sessions, encouraged them to place the patient in the correct area of the department and involve the appropriate level of staff early. Managing patients in resus, which provides high level monitoring with 2:1 or 1:1 (level II or level III) nursing care, allows fast and effective intervention. Patients being managed in resus also alerts senior clinicians who can anticipate and push decision making when required. The educational sessions gave nurses the knowledge to identify and pre-empt interventions and encouraged them to prompt doctors in decision-making. Nurses could prepare fluid and antibiotics without delay which could be administered as soon as venous access was obtained. Although time to medical involvement did not improve, managing patients in resus along with the education encouraged decisions to be made earlier and acted upon without delay.

We also learned that this approach needed to be partnered with improvement methods that give continuous feedback to staff and identify knowledge gaps and system issues that might threaten compliance. This also allowed us to reinforce good clinical management.

In both surveys oxygen administration was well performed compared to other elements (Table 3, Results Supplement). This is a simple intervention which we found all members of the clinical team comfortable to perform. Also a large proportion of patients arrived already receiving oxygen administered by the ambulance service. Blood sampling and peripheral cannulation are performed by medical staff in our department so any delay in doctors’ involvement would reduce the length of time available to comply with this element. Fluid and antibiotic administration is dependent on venous access and so it is understandable that more people did not receive timely fluids and antibiotics than blood sampling. One way to address this issue would be to train nurses in venepuncture and cannulation. This is the case in other EDs. Doing this would have involved a large change in local policy and training for nursing staff. We believe it is important to have medical assessment and input early in these potentially critically unwell patients in order to provide other timely decision making and so we used education to ensure septic patients, who needed timely management, were managed in the appropriate area of the department.

Documentation led to some difficulties measuring Sepsis 6 performance with the timings or application of interventions or factors not always clearly stated in the notes. For most aspects this information could be gathered from other sources, such as: electronic records, laboratory requesting system, associated patient charts. Time to senior involvement could not, and so when it was not documented patients were omitted when calculating mean times to senior involvement and are likely to be too few to influence results significantly. Some information may only be recorded on a separate document such as a fluid and SEWS chart. If this chart goes missing it may not be possible to determine from the notes when the fluids were commenced, resulting in failure of that part of the bundle. For some patients alternative target oxygen saturations are assumed (such as COPD sufferers). If this alternative target or co-morbidities are not clearly documented then this patient group may have been recorded as non-compliant during data collection. The timings for the blood samples were taken from the hospital’s electronic test requesting system, and therefore relate to the time labels are printed for the sample bottles, which may have been taken earlier, or may even have been printed prior to obtaining the samples thus creating potential inaccuracies in these results. Recording urine output was not a specific measure in this study as the time in the department often prevents an accurate measurement. The time for initiating hourly urine output was recorded as the same time as when intravenous fluid was initiated and so failure in this element could not be differentiated, nor separated, for analysis. This element is now identified by the placement of a urinary catheter or signing the fluid balance chart acknowledging the desire for hourly urine output monitoring. We learned that using a quick prompt can empower the staff to act early and to alert others who are essential in this timely management. This, as well as attempting to address the documentation issues, led to the creation of the Sepsis 6 sticker which allowed us to record compliance more easily and acted as a prompt for both timely management and accurate documentation of these aspects in the notes.

During the QI period researchers from the SPSP Sepsis VTE Collaborative made two visits the department to observe practice and interview staff on sepsis management. Feedback suggested that ‘on the ground’ workforce engagement had occurred with increased awareness and understanding of the importance of sepsis management which was reflected in the improvement in compliance.(O’Donnel B, et al., 2014, Sepsis VTE Collaborative Evaluation: Feedback to participants)

Conclusion

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Despite falling short of our target this project shows a promising initial step in sepsis management. There was, however, a significant improvement in compliance with the Sepsis 6 bundle. This is greater than compliance rates and improvements evidenced by other projects.[17-19] These introduced similar educational interventions and addressed local management issues but did not provide the individual case-review and individual feedback or promote the need for managing patients in level II/III environment which triggers early assessment and senior involvement. Over this project time period Scotland saw a 19.9% reduction in mortality from sepsis with an 18.6% reduction in Ninewells. (SPSP 2015, Sepsis collaborative flash report) The improvements in sepsis management in our ED, as a result of this project, will have contributed to this impressive result which surpassed the SPSP target of a 10% reduction in mortality which prompted this project.

It is important to emphasise the need for a quick initial assessment by clinical staff that identifies deranged physiology and presence of infection and SIRS criteria. Undifferentiated patients and those with multiple co-morbidities present significant challenges with the absence of pyrexia being an important factor in our failure to identify sepsis at this early stage. Data showed a strong association between compliance with the sepsis protocol and being managed entirely in resus and so early triage by nursing staff to place the patient in the relevant area of the department is paramount. Early senior doctor involvement increased our compliance rate and is a key part of the management of sepsis as this increased experience allows more timely decision making maximising time to instigate management. The experience of senior clinicians is invaluable when assessing such patients in order to avoid pitfalls that hinder our ability to provide the sepsis bundle in an appropriate time frame. A rolling departmental educational programme focussing on pathophysiology, bundle awareness and the need for early senior clinician involvement supplemented by regular monthly audit on sepsis compliance has helped identify and reinforce these points. A Sepsis 6 check-list sticker aids data collection and acts as a prompt for clinicians. All these initiatives along with ongoing surveillance for areas of improvement have allowed us to improve sepsis management in our department.

Locally we have the challenge to continue to improve sepsis compliance and since the addition of the Sepsis 6 check-list sticker an element of competition within the department has developed with medical and nursing teams showing a desire to have a high personal compliance. Ongoing surveillance will continue to facilitate further interventions which may benefit compliance with the Sepsis 6. This project has also acted as a stepping stone to another QI project into blood culture contamination, where improving contamination rates will not only benefit patient care but also help support the overall importance of the appropriate, timely and high-quality management of septic patients.

Although there has been recent controversy in the benefit of EGDT, in the form suggested by the SSC (on which the Sepsis 6 is based) this is still the management advocated by the RCEM with GDT being of overall benefit.[9-12,16] This means most UK EDs are likely to be targeting and managing sepsis in a similar way with these factors likely to be apparent. As most will have similar a set-up with clinical area division, triage system and regular rotation of medical staff our simple, replicable interventions could be rolled out to other UK EDs and potentially improve compliance with the Sepsis 6 and decrease sepsis mortality.

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Declaration of interests

Nothing to declare.

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Ethical approval

Data collection and analysis was approved by local Caldicott Guardian.

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