Improving the management of sepsis in a district general hospital by implementing the 'Sepsis Six' recommendations

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Abstract

Sepsis is a common condition with a major global impact on healthcare resources and expenditure. The Surviving Sepsis Campaign has been vigorous in promoting internationally recognised pathways to improve the management of septic patients and decrease mortality. However, translating recommendations into practice is a challenging and complex task that requires a multi-faceted approach with sustained engagement from local stakeholders.

Whilst working at a district general hospital in New Zealand, we were concerned by the seemingly inconsistent management of septic patients, often leading to long delays in the initiation of life-saving measures such as antibiotic, fluid, and oxygen administration. In our hospital there were no clear systems, protocols or guidelines in place for identifying and managing septic patients.

We therefore launched the Sepsis Six resuscitation bundle of care in our hospital in an attempt to raise awareness amongst staff and improve the management of septic patients. We introduced a number of simple low-cost interventions that included educational sessions for junior doctors and nursing staff, as well as posters and modifications to phlebotomy trolleys that acted as visual reminders to implement the Sepsis Six bundle.

Overall, we found there to a be a steady improvement in the delivery of the Sepsis Six bundle in septic patients with 63% of patients receiving appropriate care within one hour, compared to 29% prior to our interventions. However this did not translate to an improvement in patient mortality.

This project forms part of an on going process to instigate a fundamental culture change among local healthcare professionals regarding the management of sepsis. Whilst we have demonstrated improved implementation of the Sepsis Six bundle, the key challenge remains to ensure that momentum of this project continues and forms a platform for sustainable clinical improvement in the long term.

Problem

Whilst working at a 130-bed district general hospital in New Zealand, we noted a high incidence of sepsis amongst patients both in the emergency department (ED) and general hospital wards. We were concerned by the seemingly inconsistent management of these patients, often leading to long delays in the initiation of life-saving measures such as antibiotic, fluid, and oxygen administration. As part of a global effect to reduce mortality from sepsis, New Zealand endorses the Surviving Sepsis Campaign International Guidelines for the management of sepsis.[1] However, in our hospital there was no clear system in place for identifying septic patients and triggering a co-ordinated clinician response. Furthermore there were no local protocols or guidelines in place to aid in the delivery of optimal management for septic patients and subsequently the administration of antibiotics, intravenous fluids, and oxygen within one hour was poorly executed.

On further inspection, we felt that there were a number of factors that contribute to suboptimal implementation of international sepsis guidelines.[1] One was the lack of awareness and understanding amongst nurses and junior doctors that time-critical interventions significantly improves survival rates in septic patients.[1-5]

Furthermore, the assessment of end-organ perfusion with relevant blood tests, including lactate, to help determine the severity of sepsis and requirement for escalation of care to high dependency or intensive care units (ICU) was not performed well. One contributing factor to this phenomenon was the lack of a readily accessible time critical resuscitation bundle. Another was a lack of awareness amongst junior doctors regarding the necessary blood tests. This meant antibiotics were frequently delayed, sometimes for many hours, with blood cultures often acquired following administration of antibiotics.

Background

Sepsis is a common condition with a major global impact on healthcare resources and expenditure.[2] It is defined as the presence (probable or documented) of infection together with evidence of associated systemic manifestations, also known as systemic inflammatory response syndrome (SIRS).[1] Severe sepsis is defined as sepsis combined with sepsis-induced organ dysfunction or tissue hypoperfusion, whilst septic shock is defined as continued sepsis-induced hypotension despite adequate fluid resuscitation.[1] Data from studies conducted in mainly developed countries suggests that in adults, the incidence of severe sepsis is...
Deliver high-flow oxygen
Heart rate >90bpm
Take blood cultures prior to antibiotics but do not delay
Other evidence of organ dysfunction: (creatinine >177
Administer empirical intravenous antibiotics
Mean arterial pressure <65mmHg
Respiratory rate >20/min or pCO2 < 4.3 kPa (<32mmHg)
White cell count <4 x10^9/L or > 12 x10^9/L
Systolic BP <90mmHg
Start intravenous fluid resuscitation with crystalloids
Measure serum lactate
Lactate >2mmol/L

The Sepsis Six is comprised of three diagnostic and monitoring steps and three therapeutic interventions:

1. Deliver high-flow oxygen
2. Take blood cultures prior to antibiotics but do not delay treatment
3. Administer empirical intravenous antibiotics
4. Measure serum lactate
5. Start intravenous fluid resuscitation with crystalloids
6. Commence urine output monitoring via either a catheter or chart[5]

Baseline measurement

Data was retrospectively collected over a six-month period for all hospitalised adult (over 18-years old) patients with confirmed sepsis. Initially, case notes were obtained via the medical records department, using a list of coded diagnoses that included infection, sepsis, pneumonia, lower and upper respiratory infection, urosepsis, urinary tract infection, pyrexia of unknown origin, meningitis, abdominal sepsis, biliary sepsis, sepsis, septicemia, endocarditis, pyelonephritis, septic arthritis, and cellulitis. 138 sets of notes were then scrutinised to identify patients that satisfied sepsis or severe sepsis criteria as defined by the international sepsis guidelines shown below.[1]

Sepsis- clinical evidence of infection and any two of the following present:

1. Temperature <36°C or >38°C
2. Respiratory rate >20/min or pCO2 < 4.3 kPa (<32mmHg)
3. White cell count <4 x10^9/L or > 12 x10^9/L
4. Heart rate >90bpm

Severe sepsis- patients with sepsis plus and any one of the following present:

1. Systolic BP <90mmHg
2. Mean arterial pressure <65mmHg
3. Lactate >2mmol/L
4. Other evidence of organ dysfunction: (creatinine >177 umol/L, bilirubin >34 umol/L, platelets <100 x10^9/L, INR >1.5, urine output <0.5mL/kg/hr, SpO2 <90%)

Those who met the criteria for sepsis or severe sepsis were subsequently included in the data collection. Our primary outcome measure was administration of antibiotics, intravenous fluids, and oxygen if appropriate within one hour of initial assessment. Secondary outcome measures focused on fulfilling the Sepsis Six bundle that included obtaining blood cultures prior to antibiotic administration, lactate levels, and documentation of urine output monitoring either via indwelling catheter or fluid balance chart. Furthermore we analysed data regarding time taken from initial nursing assessment to clinician review and all-cause in-hospital mortality.

A total of 55 patients (26 males, 29 females) were included in the baseline measurement. 22 patients met the criteria for severe...
sepsis. 16 out of 55 patients (29%) had appropriate management with antibiotics, intravenous fluids +/- oxygen commenced within 1 hour. Only 10 out of 55 patients (18%) had lactate measured. 18 (33%) had blood cultures taken and of this group 14 (78%) were taken prior to antibiotic administration. 15 out of 55 patients (27%) had urine output monitoring via either an indwelling catheter or designated fluid input/output chart. After initial assessment by nursing staff, the mean waiting time to clinician review was 47 minutes (range 0-270). One patient, who did not fit criteria for severe sepsis at initial assessment, died whilst in hospital (2%).

Overall, the numbers of patients receiving the equivalent of a sepsis bundle were as follows:

- Six parts: 2 (4%)
- Five parts: 6 (11%)
- Four parts: 11 (20%)
- Three parts: 11 (20%)
- Two parts: 13 (24%)
- One part: 10 (18%)
- Zero parts: 2 (4%)

**Design**

When considering the underlying causes of the problem, it became obvious that a multi-faceted set of interventions were necessary to improve the management of sepsis in our hospital. Firstly, since there was no readily available and accessible sepsis resuscitation bundle in place, we introduced a Sepsis Six resuscitation bundle algorithm which was reproduced in poster format and displayed in relevant areas of the hospital such as the ED, general ward care stations and doctors’ offices. They were intended to act as a visual reminder to staff to implement the six appropriate diagnostic and therapeutic steps of the algorithm, ideally within one hour of initial assessment. Secondly, we set out to engage key stakeholders to improve awareness of the implications of poor management of sepsis and the strategies we could employ to improve the situation. This was achieved through a variety of presentations, workshops, and informal discussions with both junior and senior medical and nursing staff. These were conducted over a two-week period and focused on ED and general ward staff. We presented the Sepsis Six resuscitation bundle and used data from our baseline measurement as a rationale for adopting these modifications to practice, thereby attempting to foster a fundamental culture change from the hospital staff who, up until this point, were not familiar with using resuscitation bundles as tools to improve the management of septic patients. These sessions focused on the recognition, investigation, monitoring, and management of septic patients and the importance of Sepsis Six implementation in improving patient outcomes and reducing mortality.

Finally, we designated a number of ‘sepsis assistants’ throughout the general wards and ED to ensure that education regarding the management of sepsis was reinforced on a day-to-day basis, and that the momentum of our project was sustained. These ‘assistants’ were able to aid staff and advise on appropriate initiation and escalation of treatment, finding equipment and requesting appropriate investigations.

As noted previously, sustainability of such projects is a difficult challenge, often due to the high turn around of staff, especially junior doctors who consistently rotate through different jobs in different hospitals.[18-19] We were especially keen to ensure that improvements we made in our hospital were sustainable in the long term. We therefore recruited junior doctors to the sepsis-management quality improvement team, who we knew would be working in the hospital for the next two years. This was to ensure that the momentum of the project was sustained, even once some members of the team moved on to different jobs. Recruitment of future members of the team will follow a similar practice to ensure that progress is continued.

**Strategy**

PDSA cycle 1: Meetings were held by the sepsis-management quality improvement team to review national and international sepsis guidelines and evaluate how they could be implemented within our hospital. A sepsis recognition and management pathway was then developed. Our aim was that this pathway, based on the Sepsis Six,[5] could be used to prompt the consideration of sepsis in unwell patients and to guide the user through the diagnostic and therapeutic steps required in the management of the septic patient (intravenous fluids, blood cultures, antibiotics, lactate, oxygen, monitor urine output).

PDSA cycle 2: To raise awareness of sepsis diagnostic criteria and the Sepsis Six pathway, we designed sepsis recognition and management algorithm posters for display in the ED and all ward-based doctors’ offices and nursing care stations. A first draft was displayed in the ED and received positive feedback from staff detailing that it was easy to understand and clearly highlighted the Sepsis Six resuscitation bundle. The design was bold and colourful with an easy-to-read font. After minor layout adjustments, the poster was distributed to the wards and received promising feedback from stakeholders.

PDSA cycle 3: We held an educational awareness workshop on sepsis with all ED staff and all hospital junior doctors invited to attend. 75% of ED staff and 30% of junior doctors attended the session. The session focused on the early recognition and management of sepsis and was designed to emphasise the importance of recognising sepsis and the timely initiation of the Sepsis Six bundle to improve patient outcomes. Examples of clinical scenarios were used to give realistic representations of septic patients and help contextualize background theory into clinical practice. Feedback from the session demonstrated that junior nurses and doctors, in particular, found the workshop extremely useful. We therefore repeated the workshop at one of the weekly junior doctor teaching sessions. This was attended by just...
Results
discuss the future direction of the project. Management quality improvement team will meet once more to
months time to re-evaluate our practice, following which the sepsis
appointed doctors. Further re-audit will be completed in three
previously been shown to improve implementation of the Sepsis Six
introducing ‘sepsis boxes’ in the general wards to centralise the
equipment needed to adequately manage septic patients. This has
further significant improvements in the
implementation of the Sepsis Six bundle. Nursing
staff commented how they would often forget to take lactate and
blood cultures from patients who whilst tachypnoeic and
tachycardic, were afebrile during the initial assessments. We
therefore tied a laminated photo of a set of blood cultures, a lactate
tube, nasal prongs, a 500ml bag of normal saline, a catheter, and
vial of antibiotic on each phlebotomy trolley in the department.
Feedback from the nurses was extremely positive, remarking that
this photo reminded them to draw the relevant blood samples and
consider escalating management of possibly septic patients by
triaing them higher for a more urgent clinician review.

PDSA cycle 5: We noted that there was no change in mean waiting
time to clinician review from initial nursing assessment. ED nursing
staff reported that even if patients were tachypnoeic, tachycardic,
and febrile, and therefore categorised as a higher triage priority,
due to staff shortages in the ED, there were still delays in clinician
reviews. This was highlighted as a critical incident, and brought up
in a series of departmental meetings. As a consequence, another
full-time consultant is being recruited to the ED, to help improve
timely reviews of all patients, including those who may be septic.

PDSA cycle 6: Following another three months, a re-audit
demonstrated further significant improvements in the
implementation of the Sepsis Six bundle. These results are due to
be presented at a hospital managers meeting, to gain formal
approval for the integration of the Sepsis Six bundle into hospital
guidelines. These will be placed on the trust intranet and be readily accessible to any healthcare professional in the hospital.
Furthermore, we are extending the sepsis management quality
improvement team to incorporate a wider range of stakeholders
including the antimicrobial pharmacist, the resident microbiologist
and the ED clinical nurse manager. We are also working on
introducing ‘sepsis boxes’ in the general wards to centralise the
equipment needed to adequately manage septic patients. This has
previously been shown to improve implementation of the Sepsis Six
bundle.[18] Finally, we are incorporating sepsis management
education sessions into the induction programme for newly
appointed doctors. Further re-audit will be completed in three
months time to re-evaluate our practice, following which the sepsis
management quality improvement team will meet once more to
discuss the future direction of the project.

Overall, the numbers of patients receiving the equivalent of a sepsis
bundle were as follows:

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6 months post baseline measurement: A total of 40 patients (23 males, 17 females) were included in the data collection. 17 patients
met the criteria for severe sepsis. 25 out of 40 patients (63%) had
appropriate management with antibiotics, intravenous fluids +/-
oxygen commenced within 1 hour. Only 10 out of 40 patients (25%)
had lactate measured. 25 (63%) had blood cultures taken and of
this group 24 (96%) were taken prior to antibiotic administration. 17
out of 40 patients (43%) had urine output monitoring via either an
indwelling catheter or designated fluid input/output chart. After initial assessment by nursing staff, the mean waiting time to clinician
review was 44 minutes (range 0-205). 4 out of 40 patients (10%)
died whilst in hospital, with all 4 patients fitting criteria for severe sepsis at initial assessment.

Overall, the numbers of patients receiving the equivalent of a sepsis
bundle were as follows:

<table>
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<td>Four</td>
<td>11 (28%)</td>
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<td>Three</td>
<td>7 (18%)</td>
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<tr>
<td>Two</td>
<td>4 (10%)</td>
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Baxter S, Hutchings S, & Barnes T. Timeliness of antibiotic.


Robson WP, & Daniels R. The Sepsis Six: helping patients.

Members of the multidisciplinary team may bring new ideas to the outcomes for our patients. Additionally, involvement of the other improvements that we have made so far can be consolidated and hope that with more of a multidisciplinary approach the running and there is greater awareness across the hospital, we highly motivated and dedicated team. Now the project is up and to kick-start the project it would be better to have a smaller but this, we needed to extend the number of stakeholders involved in ensuring the sustainability of this project for the future. To accomplish this, we wanted to be practical by department managers and we modified our intervention accordingly. The original concept however, may still help in managing septic patients on the general wards, and we are therefore implementing this idea during the next cycle of interventions.

Another key lesson is that a singular approach does not necessarily work in different situations or departments, and therefore flexibility is vital to achieving success. For example, we broached the idea of introducing a ‘sepsis box’ or ‘sepsis trolley’ into the ED. These have been successfully trialled in previous quality improvement projects.[18-20] However, due to limited space, this idea was thought to be impractical by department managers and we modified our intervention accordingly. The original concept however, may still help in managing septic patients on the general wards, and we are therefore implementing this idea during the next cycle of interventions.

Admittedly there are a number of limitations to this project. Firstly this study was conducted over a six-month period, and as such its sustainability is, as yet, untested. Therefore, the key challenge is to ensure the sustainability of this project for the future. To accomplish this, we were able to extend the number of stakeholders involved in the team. Initially this was a junior doctor-led initiative, as it was felt that to kick-start the project it would be better to have a smaller but highly motivated and dedicated team. Now the project is up and running and there is greater awareness across the hospital, we hope that with more of a multidisciplinary approach the improvements that we have made so far can be consolidated and further improved upon, and that these may in turn lead to better outcomes for our patients. Additionally, involvement of the other members of the multidisciplinary team may bring new ideas to the group that have not previously been considered.

Another key limitation of this study is that it does not examine the costs associated with managing sepsis according to the Sepsis Six bundle. Nor does it explore any savings that may occur by reducing the incidence of septic patients becoming more unwell. Whilst this would be difficult to incorporate into the study, it will be discussed at future meetings.

Finally, the lack of outcome measures in our data analysis is another limitation of this study. For example, we did not analyse ICU admission rates, use of vasoactive drugs, appropriate antibiotic stewardship, length of stay in hospital, or post-discharge morbidity and mortality. By increasing the stakeholders involved in the project, we hope to increase the content of the data we can collect which will provide us with more information to guide future practice.

**Conclusion**

As noted previously, sepsis is a serious condition with high mortality. The international community has been vigorous in promoting internationally recognised pathways to improve the management of septic patients in an attempt to improve their outcomes. However, translating recommendations into practice is a challenging and complex task that requires a multi-faceted approach with sustained engagement from local stakeholders. We have implemented a number of simple, low-cost interventions that have improved the implementation of the Sepsis Six resuscitation bundle in our hospital. However, this has not translated into better patient outcomes in terms of mortality. Whilst this quality improvement project has helped instigate a fundamental culture change among local healthcare professionals, there is more work to be done to improve the management of sepsis at our hospital. The key challenge remains to ensure that momentum of this project continues and forms a platform for sustainable clinical improvement in the long term.

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Declaration of interests
Nothing to declare

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Ethical approval
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