

Initial, successful implementation of sepsis guidelines in an emergency department

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ABSTRACT

INTRODUCTION: Early screening and treatment of sepsis can reduce mortality. Region Zealand established guidelines for the diagnosis and treatment of sepsis. We assess an interdisciplinary intervention for implementation of these guidelines at the Department of Emergency Medicine at Nykøbing Falster Hospital from July 2009 to August 2010.

MATERIAL AND METHODS: Structured training was imparted to personnel during the first 18 weeks. Electronically accessible guidelines, posters with diagnostic and treatment algorithms, pocket references and checklists were made available to encourage adherence to the guidelines. Key nurses and doctors encouraged compliance. Journal audits (at baseline, 18 weeks and one year) were undertaken to measure adherence to six elements of the sepsis guidelines: lactate measurement, oxygen and fluid treatment, timely antibiotic treatment, blood culture and planning of treatment monitoring.

RESULTS: A total of 27 (baseline), 29 (18 weeks) and 48 (one year) patients were included for analysis. Adherence to 3-5 of the elements of the sepsis guidelines' six elements increased from 37% to 65% from baseline to the first follow-up at 18 weeks ($p = 0.03$). Adherence to 3-5 of the elements decreased from the first to the second follow-up at one year. Lactate measurement, blood culture and antibiotic administration increased from baseline to the one-year follow-up.

CONCLUSION: The intervention had a positive effect on the implementation of guidelines. This effect was reduced one year after the baseline audit, possibly due to a decline in the focus on the intervention and/or personnel turnover in the department.

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International studies have shown that sepsis survival can be improved through early recognition and treatment. This can be accomplished by introducing a package for screening and treatment [1-5]. In 2009, The Danish National Board of Health has published a report regarding clinical incidents in the treatment of patients with sepsis, which indicated problems with early detection and treatment of sepsis in Danish hospitals [6]. The National Board of Health recommended that all hospital departments implemented guidelines for the observation and

treatment of sepsis patients, and that these guidelines should be implemented in practice. The national Operation Life Campaign, which included evidence-based sepsis guidelines, was conducted during the same period. The campaign was primarily implemented in intensive departments. In conjunction with the conclusion of the campaign, it was decided in Region Zealand that all clinical departments should use a regionally established clinical guideline entitled »Diagnostic and treatment of severe sepsis/septic shock.« This guideline includes recommendations based on those made by the international Surviving Sepsis Campaign (SSC) [7].

There is growing evidence that protocol implementation with education and performance feedback changes clinician behaviour and may improve outcome in severe sepsis [8].

Our study investigated the effectiveness of the establishment of an early sepsis detection and treatment guideline in a newly established emergency department. The implementation was made as a multidisciplinary endeavour involving personnel from the departments of anaesthesiology, surgery and emergency medicine at Nykøbing Falster Hospital during the period from July 2009 to August 2010. Admitting physicians were primarily interns from the medical and surgical departments working under the supervision of senior doctors from these departments and from the emergency department. The senior physicians of the emergency department were specialists in anaesthesiology, general practice and an unspecialized doctor with extensive surgical experience.

We analyzed the effect of decision-supporting aids and 18 weeks of formalized training on adherence to our regional clinical sepsis guideline.

MATERIAL AND METHODS

This was a prospective interventional study with a baseline and two follow-up audits. The original protocol was designed to measure compliance to the sepsis package elements at 18 weeks and six months after baseline. Interventions were determined prior to the initiation of the study period at baseline and were scheduled to last six months.

The six-month audit was not completed and formalized training ceased at 18 weeks due to lack of re-

ORIGINAL ARTICLE

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sources during the establishment of the new emergency department at Nykøbing Falster Hospital. A new protocol was subsequently written to include a follow-up at one year in order to measure the effect of the interventions.

Interventions

Implementation of each intervention utilized the breakthrough series including the Plan-Do-Study-Act (PDSA) cycle. The breakthrough series is a method for implementation of best practice procedures in a given field and in a setting where they are not already in place [9]. The interventions were tested using PDSA cycles prior to the study period and optimized according to feedback from departmental personnel.

The interventions included: electronically accessible guidelines, posters with diagnostic and treatment algorithms, pocket references (**Figure 1**), checklists, and support from key nurses and doctors. Physician-developed training in sepsis diagnostics and treatment, was given by a leading physician to doctor and nursing staff in the

emergency department. This formalized training was given as two-hour sessions. Structured training was only given from baseline to the initial follow-up at week 18. The effectiveness of the implementation process was monitored using graphic checklists covering the sepsis elements and reported to personnel on bulletin boards in the department.

Audits

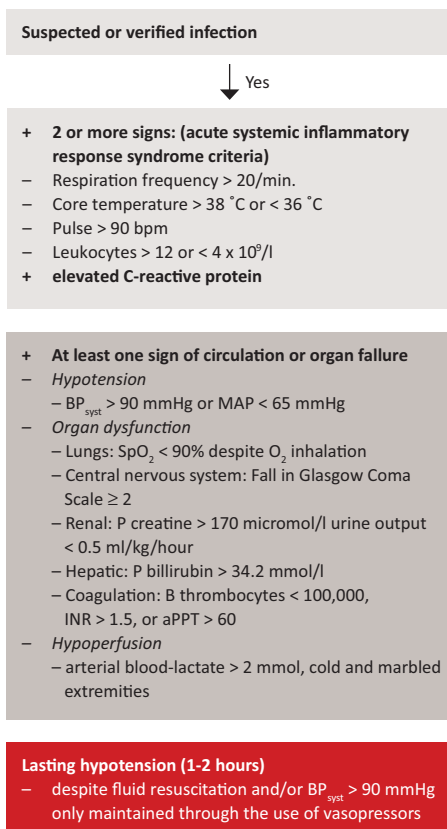
Patients over 15 years of age with sepsis were included for audit. We defined sepsis as the presence of two systemic inflammatory response syndrome (SIRS) criteria and suspected or verified infection. Suspected or verified infection was defined as elevated C-reactive protein (CRP) and abnormal leukocyte titers and an initial diagnosis suggesting infection.

Data from these patients were collected for week-long periods: four weeks before the intervention (baseline), at 18 weeks (initial follow-up) and at one year (second follow-up). All patients were recruited using triage and observation charts from the emergency depart-

FIGURE 1

Front and back of the pocket reference translated from the original Danish version. This reference is given to all new nurses and doctors at Nykøbing Falster Hospital.

Sepsis diagnostics



Sepsis treatment

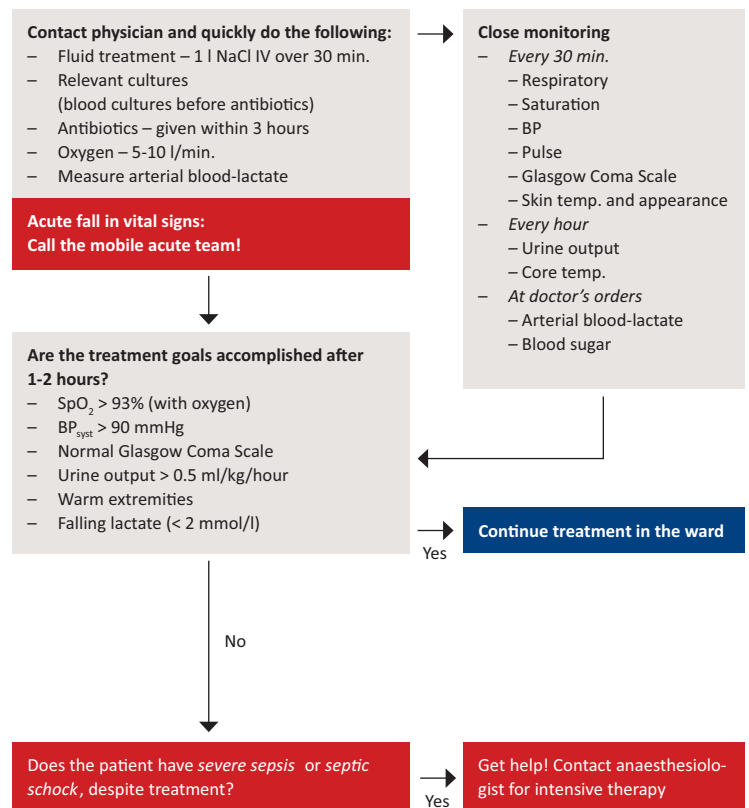




TABLE 1

Patient flow through the emergency department in one-week periods at baseline, after 18 weeks and one year – showing patients included in the study (two systemic inflammatory response syndrome (SIRS) and verified infection). The values are n.

	Baseline	18 weeks	1 year	Total
Admissions	244	290	311	845
2 SIRS criteria	42	43	64	149
2 SIRS and suspected or verified infection	27	29	48	104

ment. Patients with two SIRS criteria and suspected or verified infection were regarded as an unsorted group having clinical sepsis.

Journal audits were conducted at baseline, after 18 weeks and one year after the intervention. Indicators for SIRS criteria were respiration frequency > 20/min., temperature > 38 or < 36 °C, pulse > 90/min., leukocytes > 12 and/or < 4 × 10⁹/l in addition to elevated CRP.

Audits were conducted by quantifying the following parameters: lactate measurements taken within one hour of admittance, oxygen administration, fluid administration, blood culture before antibiotic administration, relevant antibiotic administration and establishment of a treatment plan.

Data and statistics

Data were obtained from physical and electronic journal material, triage records and basic observation charts. Data from the three audits were verified by two independent observers. Data were grouped as adherence to 0-2, 3-5 and all of the sepsis package elements (full package) at data analysis in order to better determine the degree of overall compliance. Statistical significance was confirmed by use of Fisher's exact probability test.

Ethical considerations

Permission to use patient data for this project was obtained from the Danish Data Protection Agency based on two protocols outlining the study. We report no conflicts of interest.

Trial registration: Danish Data Protection Agency SN-30-2011.

RESULTS

A total of 845 patients were reviewed (baseline, n = 244; 18 weeks, n = 290; one year, n = 311). A total of 149 patients had two SIRS criteria (baseline, n = 42; 18-week follow-up, n = 43; one year, n = 64). In all, 104 patients had sepsis (baseline, n = 27; 18 weeks, n = 29; one year, n = 48) (Table 1).



TABLE 2

Effects of interventions on the six elements of the sepsis package from baseline to one year. There was a positive effect from baseline to 18 weeks, which then decreased. This is in accordance with the increased focus on interventions during the first 18 weeks. Apart from the p-values the values are n (%).

	Baseline (n = 27)	18 weeks (n = 29)	1 year (n = 48)	p-value	
				baseline-18 weeks	baseline-1 year
Oxygen	14 (52)	17 (59)	24 (50)	0.4	0.53
Fluids	20 (74)	21 (72)	36 (75)	0.5	0.57
Lactate	6 (22)	8 (28)	16 (33)	0.4	0.23
Blood culture	13 (48)	21 (72)	28 (58)	0.056	0.27
Antibiotics	10 (37)	23 (79)	25 (52)	0.001	0.16
Plan	4 (15)	5 (17)	6 (13)	0.5	0.52

Formalized training ceased after 18 weeks due to lack of resources. 73% of the departmental personnel (57 of a total of 78 doctors and nurses) participated during this period. There was an increase in the percentage of patients who received correct oxygen treatment, blood culture and correct antibiotic administration from baseline to the 18-week follow-up. These improvements were not sustained at the one-year follow-up, i.e. at the second follow-up. Proper lactate measurement increased from 22% at baseline to 27% after 18 weeks and further to 33% after one year. There was improvement in the administration of antibiotics and in the frequency of blood culture during the same period. The intervention did not successfully encourage the introduction of a written treatment plan as standard practice (Table 2). Our intervention had a positive effect of on the adherence to 3-5 elements of the sepsis package from baseline to the 18-week follow-up, but very few received the full treatment package (Table 3).

DISCUSSION

We have shown a positive effect of our interventions on adherence to the sepsis guidelines. It is disappointing that many patients did not receive the full sepsis package despite a massive multidisciplinary intervention. Many patients were treated with oxygen and fluids. This is standard procedure for the emergency department upon patient admission and was not affected by the intervention. The increase in correct antibiotic use and blood culture from baseline to 18 weeks was the primary contributor to the overall increase in adherence to the sepsis package during this period.

Not all departmental nurses and doctors received formalized training during the first 18 weeks. This was, in part, due the changing shifts, and the fact that many, primarily younger doctors are only employed in the emergency department for short periods. We attempted to make our intervention more robust through the utilization of a wide range of media and the appointment of

 TABLE 3

Effect of interventions on adherence to 0-6 of the elements of the sepsis package from baseline to one year. The values are n (%).

Elements of package	Baseline (n = 27)	18 weeks (n = 29)	1 year (n = 48)
0	2 (7)	0 (0)	2 (4)
1	8 (30)	3 (10)	7 (15)
2	5 (19)	6 (21)	14 (29)
3	5 (19)	7 (24)	8 (17)
4	3 (11)	7 (24)	11 (23)
5	2 (7)	5 (17)	4 (8)
6	2 (7)	1 (3)	2 (4)

key personal to encourage proper guideline usage. Our study shows a good effect of these initiatives from baseline to 18 weeks where formalized education was encouraged and readily available, but this effect disappeared from the 18-week to the one-year follow-up. A similar result was seen in a recent Spanish study [10]. Formalized training was downgraded during this time period, partly due to restructuring in the department. This indicates that formalized training in addition to other media is vital for guideline introduction and maintenance. Proper utilization of such interventions could reduce the negative effects of personnel turnover on sepsis package compliance.

There is always a risk of bias in studies relying on retrospective journal material, and we expect that this has an effect on our results. Improper record keeping can entail discrepancies between the treatment given and what is actually recorded. During the first weeks of the implementation process, nurses used checklists to ensure proper implementation. These checklists showed that 90% of patients had lactate measured promptly after admission, a percentage that could not be found during the journal audit completed only a few weeks later. Nonetheless, this study design has the advantage of being relatively easy to utilize in a clinical setting.



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A larger, but similar study was undertaken in a Dutch emergency department where nurses were in charge of the implementation of a sepsis protocol. This study showed a significant improvement in the early detection and treatment of sepsis [11]. This indicates that maintaining the positive results observed from baseline to the 18-week follow-up in the present study may be dependent on the degree of involvement of nurses, who are typically employed for longer periods in our emergency department.

The recommended guidelines from the SSC cannot replace the clinician's decision-making capability when he or she is provided with a patient's unique set of clinical variables [1]. The schism between the knowledge and proper use of clinical guidelines is a challenge for healthcare. Our study found that whereas the sepsis guideline dictates that all patients with two SIRS criteria and suspected infection should be treated as sepsis patients, 45 of the 149 patients included did not have an infection. This is, of course, a retrospective finding, but it raises the question of overtreatment risk. Screening for sepsis in this fashion has a high sensitivity, but a low specificity. Many patients received broad spectrum antibiotics without necessarily having any benefit of such treatment. This risk of guideline-specific overtreatment could partly explain why many patients did not receive more of six elements of the sepsis guidelines. The initial diagnosis could have been sufficiently clear to the admitting doctor to allow him or her to determine that one or more of the six elements of the guidelines were not necessary. Treatment could also have been given without proper documentation. Regardless of this, any divergence from guidelines should be clinically defensible and documented in patient charts. In cases of divergence from the guidelines, senior doctors should be consulted.

CONCLUSION

We have shown a positive effect on adherence to the sepsis package which unfortunately could not be maintained after one year, probably due to a reduced focus on the intervention and/or departmental personnel turnover.

Our results indicate that adherence to guidelines in an emergency department can be increased through targeted training and a daily focus on guidelines.

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LITERATURE

1. Surviving Sepsis Campaign: international guidelines for management of severe sepsis and septic shock: 2008. *Intens Care Med* 2008;34:17-60.

2. Gao F, Melody T, Daniels D et al. The impact of compliance with 6-hour and 24-hour sepsis bundles on hospital mortality in patients with severe sepsis: a prospective observational study. *Crit Care* 2005;9:R764-R70.
3. Schierbeck J, Poulsen LM, Larsen et al. Sepsiskampagnen – øget overlevelse med sepsispakker. *Ugeskr Læger* 2008;170:1034.
4. Nguyen HB, Rivers EP, Abrahamian FM et al. Severe sepsis and septic shock: review of the literature and emergency department management guidelines. *Ann Emerg Med* 2006;48:28-54.
5. Rivers E, Nguyen B, Havstad S et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. *N Eng J Med* 2001;345:1368-77.
6. National Board of Health. Utsigtede hændelser hos patienter med sepsis. www.sst.dk/~media/3E327FBBC6B9438C85FAF3FBB2432ED0.ashx (23 Aug 2012).
7. The Surviving Sepsis Campaign results of an international guideline-based performance improvement program targeting severe sepsis. *Intens Care Med* 2010;36:222-31.
8. Nguyen HB, Corbett SW, Steele R et al. Implementation of a bundle of quality indicators for the early management of severe sepsis and septic shock is associated with decreased mortality. *Crit Care Med* 2007;35:1105-12.
9. The breakthrough series: IHI's collaborative model for achieving breakthrough improvement. www.ihl.org/knowledge/Pages/IHIWhitePapers/TheBreakthroughSeriesIHICollaborativeModelforAchievingBreakthroughImprovement.aspx (23 Aug 2012).
10. Ferrer R, Artigas A, Levy M et al. Improvement in process of care and outcome after a multicenter severe sepsis educational program in Spain. *JAMA* 2008;299:2294-303.
11. Tromp M, Hulscher M, Bleeker-Rovers CP et al. The role of nurses in the recognition and treatment of patients with sepsis in the emergency department: A prospective before-and-after intervention study. *Int J Nurs Stud* 2010;47:1464-73.