

# Internal medicine residents' knowledge about sepsis: effects of a teaching intervention

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## ABSTRACT

The short- and long-term effects of a single teaching intervention for internal medicine residents are not known. Since sepsis is a prevalent and important disease and both therapeutic and diagnostic interventions have been protocolised, we investigated the effects of a sepsis-based single teaching intervention.

A prospective before-and-after education study was performed among residents who attended a regional professional training for internal medicine. All residents who participated were invited to complete a questionnaire about the assessment of symptoms and the diagnosis and treatment of sepsis. The questionnaire was filled out before, directly after, and four to six months after the teaching intervention. The overall questionnaire score was expressed on a 0 to 10 scale.

A total of 253 questionnaires from 109 training-grade doctors were collected. At baseline, the 'assessment of symptoms of sepsis' score was significantly lower than the 'diagnosis and treatment' score. Following the education session, training-grade doctors' knowledge about sepsis definitions and diagnosis and treatment of sepsis increased from (mean  $\pm$  SD) 6.1  $\pm$  1.6 to 8.2  $\pm$  1.2 ( $p < 0.0001$ ). Moreover, four to six months after the teaching intervention, this effect was sustained ( $p < 0.0001$  compared with test 1), resulting in a mean score of 7.6  $\pm$  1.1.

Our single teaching intervention resulted in improved and sustained knowledge on the assessment of symptoms, diagnosis and treatment of sepsis.

## KEYWORDS

Education, internal medicine residents, knowledge, surviving sepsis campaign

## INTRODUCTION

In 2004, the Central College of Medical Specialities (CCMS) of the Royal Dutch Medical Association presented guidelines for modernisation of all postgraduate speciality training programmes and since 2006 all these programmes should be based on these guidelines. To assess residents' competencies, several methods of evaluation can be applied.<sup>1</sup> Although the organised education for internal medicine residents is substantial, still little is known about its short- and long-term benefits.<sup>2</sup>

Over the last few years, several studies have shown that rapid diagnosis and management of sepsis is critical for successful treatment.<sup>3-6</sup> The Surviving Sepsis Campaign (SSC) provides helpful tools to improve the diagnosis and management of sepsis, especially for patients with severe sepsis and septic shock. However, implementation of these guidelines in daily practice appears to be troublesome.<sup>7-9</sup> As a result, about 30 to 40% of patients do not receive care according to the present scientific evidence and about 20 to 25% of the care provided is not needed or potentially harmful.<sup>10,11</sup>

Use of the SSC tools may be hindered by a variety of barriers to guideline adherence: lack of familiarity, lack of awareness, lack of agreement, lack of outcome expectancy, lack of self-efficacy, lack of motivation/inertia of previous practice and external barriers.<sup>12</sup> Previous studies have demonstrated that an important reason for not following the SSC guidelines is that the identification of patients with sepsis can be difficult, resulting in treatment delay.<sup>13,14</sup> Only about 30% of physicians correctly identified the diagnostic criteria for Systemic Inflammatory Response Syndrome (SIRS).<sup>15</sup> Even after active implementation of a sepsis teaching programme, only 48 and 67% of the training-grade doctors could define severe sepsis and septic shock, respectively.<sup>16</sup>

Another reason for not following the SSC guidelines is the lack of knowledge about the management of patients with sepsis.<sup>13,14</sup> Therefore, extensive knowledge about sepsis is an important condition for early identification and management of patients with sepsis. In addition, none of the previous studies have evaluated the knowledge deficiency for different sepsis topics and the short- and long-term effectiveness of a teaching intervention aimed at improving physicians' knowledge about sepsis. We performed the present study in which the potential variety in residents' knowledge about the identification and management of sepsis and the short- and long-term effectiveness of a brief and single teaching intervention were examined.

## MATERIALS AND METHODS

### Study design and population

We performed a prospective before-and-after education study among internal medicine residents who visited the regional professional training for internal medicine (RODIN) about sepsis. RODIN is part of the training programme for internal medicine residents<sup>17</sup> and is organised five times a year at the Radboud University Nijmegen Medical Centre (RUNMC). RODIN is attended by residents from the RUNMC or one of the six affiliated regional community hospitals.

During a brief educational intervention based on the SSC guidelines, an internist-intensivist (PP) gave a lecture about the SSC, diagnosis and the management of sepsis.

### Development of the questionnaire

The questionnaire was based on the two topics of the SSC-based teaching intervention and included ten multiple choice questions: five questions covering assessment of the symptoms of sepsis (topic 1) and five questions about diagnosis and treatment of sepsis (topic 2). In the questionnaire, respondents were presented with short case descriptions. Examples of two questions are shown in *table 1* (the complete questionnaire is available on request).

### Data collection and variables

All data were collected in three periods: immediately before, three hours after the education session about sepsis, and four to six months following the teaching intervention. Before and directly after the lecture, the residents were asked to fill out the first two questionnaires. All respondents were approached by mail and asked to fill out the third questionnaire. Non-responders received two reminders, including the questionnaire, by e-mail. Relevant respondent characteristics included gender, and year of training.

**Table 1.** Questionnaire with five questions covering assessment of the symptoms of sepsis (topic 1) and five questions about diagnosis and treatment of sepsis (topic 2), examples of two questions

#### Topic 1: Assessment of symptoms

Which of the following criteria are SIRS criteria?

- Temperature  $>38^{\circ}\text{C}$  or  $<36^{\circ}\text{C}$ , cold chills, heart rate  $>90$  beats/min, respiratory rate  $>20$  breaths/min, altered mental status,  $\text{PaCO}_2 <4.3$  kPa (32 mmHg), white blood cell count  $>12 \times 10^9/\text{l}$ ,  $<4 \times 10^9/\text{l}$  or  $>10\%$  immature (band)forms.
- Temperature  $>38^{\circ}\text{C}$  or  $<36^{\circ}\text{C}$ , heart rate  $>90$  beats/min, respiratory rate  $>20$  breaths/min,  $\text{PaCO}_2 <4.3$  kPa (32 mmHg) or respiration, white blood cell count  $>12 \times 10^9/\text{l}$ ,  $<4 \times 10^9/\text{l}$  or  $>10\%$  immature (band)forms.
- Temperature  $>38^{\circ}\text{C}$  or  $<36^{\circ}\text{C}$ , heart rate  $>90$  beats/min, respiratory rate  $>20$  breaths/min,  $\text{PaCO}_2 <4.3$  kPa (32 mmHg), white blood cell count  $>12 \times 10^9/\text{l}$ ,  $<4 \times 10^9/\text{l}$  or  $>10\%$  immature (band)forms, hyperglycaemia in the absence of diabetes (glucose  $>6.8$  mmol/l)

#### Topic 2: Diagnosis and treatment of sepsis

When patient's blood pressure and/or organ perfusion does not respond to fluid challenges, you have to start with vasopressor therapy. Which proposition(s) is/are correct?

Proposition I: In case of hypotension in patients with septic shock, norepinephrine or dopamine is first choice vasopressor therapy.

Proposition II: To offer protection to the kidneys, a low dose of dopamine can be used in the treatment of severe sepsis.

- Proposition I as well as proposition II are correct
- Proposition I is correct, proposition II is incorrect
- Proposition I is incorrect, proposition II is correct
- Proposition I and proposition II are both incorrect

### Statistical analysis

Descriptive statistics included frequencies, percentages, means and standard deviations. All questions were given an equal weight of one point per question. The overall questionnaire score was expressed on a 0-10 scale. Potential differences in the total questionnaire scores between the three tests were analysed using a random-effects model with random-factor respondent and fixed-factor test. In a secondary analysis, gender and year of experience were added as covariates to investigate whether gender and experience had an impact on the scores. Finally, we investigated whether these factors influenced the learning, by adding the interaction terms with the test to the model.

## RESULTS

A total of 253 questionnaires were collected. Seven of these questionnaires were excluded: four questionnaires could not be linked to follow-up tests and three residents only filled out the questionnaire before or immediately after the education. We used 246 questionnaires for further analysis.

### Respondents

A total of 109 internal medicine residents participated, 91 of whom (84%) completed the questionnaire before and

immediately after the education. Of these participants 39% were male and 45% had more than two years training experience. The set of all three questionnaires was completed by 64 participants (70%), 33% were male and 42% had a training experience of more than two years.

### Questionnaire data

Figure 1 illustrates the mean overall questionnaire scores and the mean scores per topic for all participants in the study. At test I and test II the mean overall questionnaire scores are comparable with the mean scores of the 64 respondents who filled out all three questionnaires:  $6.1 \pm 1.5$  for test I and  $8.3 \pm 1.1$  for test II.

In the subgroup of residents who filled out all three questionnaires, the baseline score of  $6.1 \pm 1.6$  increased to  $8.2 \pm 1.2$  after the lecture ( $p < 0.0001$ ). Moreover, four to six months after the teaching intervention this improvement was sustained ( $p < 0.0001$  compared with test I), resulting in a mean score of  $7.6 \pm 1.1$ .

At baseline, questions concerning 'diagnosis and treatment' scored significantly better than 'assessment of symptoms' (table 1). As a result, only the score of 'assessment of symptoms' improved significantly ( $p < 0.0001$ ).

There were no significant differences between male and female residents in baseline score (data not shown). The mean scores for the years of training experience are summarised in figure 2. After adding gender and experience as covariates to the analysis, we found that there was no significant difference between scores or increase in score per gender or year of training (all  $p > 0.05$ ).

Figure 1. Overall score per test and topic

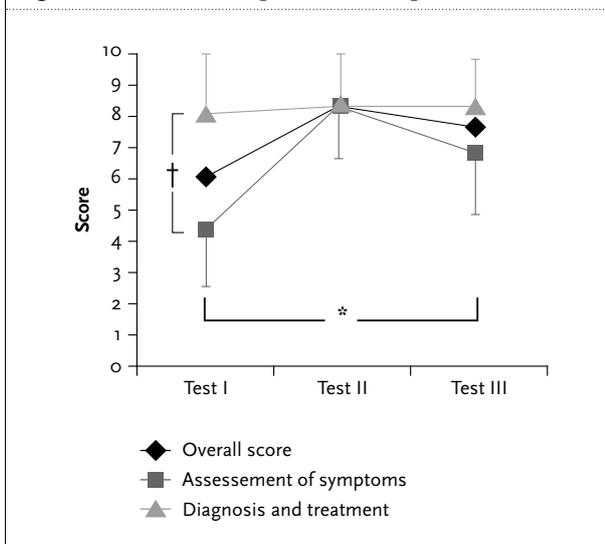
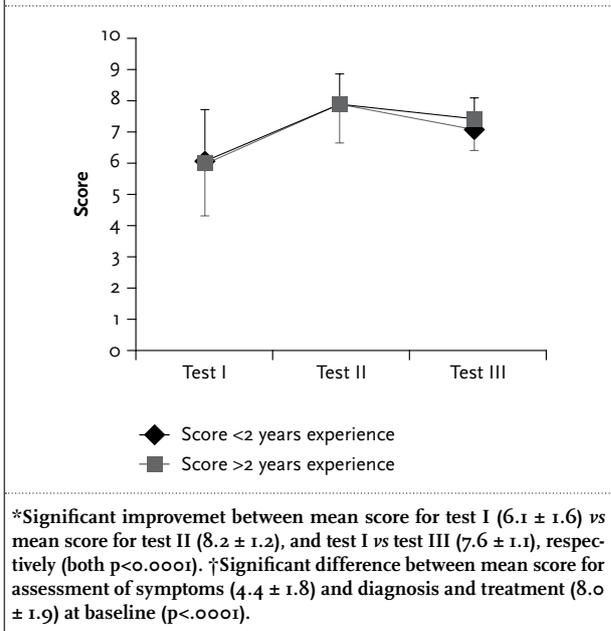


Figure 2. Scores per years of training experience



## DISCUSSION

Identification of patients with sepsis is essential for early diagnosis and treatment. In managing sepsis, delays can be life-threatening.<sup>3,5</sup> Lack of adherence to recommended SSC guidelines is in part caused by lack of knowledge of these guidelines. Through the education of residents about the SSC guidelines, both diagnosis and treatment of sepsis may improve.<sup>18</sup>

We demonstrated that following an educational intervention about sepsis, residents' knowledge about assessment of symptoms of sepsis improved significantly. One of the main findings of this study is that apart from the short-term effects, the improved test results were sustained after four to six months. In the first (baseline) questionnaire, the issues relating to the symptoms of sepsis scored significantly lower than those related to the diagnosis and treatment. This might be related to the fact that the SIRS criteria described by Bone<sup>19</sup> demonstrate a high sensitivity, but low specificity for sepsis and may not equal the residents' clinical perception of a septic patient. Interestingly, a previous study showed that a majority of physicians believe that other physicians within their speciality define sepsis differently from themselves: not more than 17% agreed on any one definition.<sup>20</sup> This may explain why we found no association between years of experience and knowledge level at baseline or increase following an education session. Importantly, only the Bone criteria are acknowledged and it remains important that everyone uses these sepsis definitions correctly. In addition, this finding emphasises our view that the effectiveness of educational activities and progression

of knowledge during the training of residents should be monitored more frequently and more closely.

The issues concerning the treatment of sepsis scored significantly higher at baseline, resulting in the fact that a further increase did not reach statistical significance.

Only a few previous studies have described physicians' and nurses' knowledge about sepsis.<sup>14-16,20</sup> In accordance with our study, these studies showed an inadequate level of knowledge of the signs and symptoms of sepsis. It was demonstrated in one study that knowledge levels increased over time, when a group of residents in 1999 were compared with a different group of residents in 2003.<sup>16</sup> However, it is unclear whether or not this effect is linked to an unidentified more active teaching programme as mentioned by the authors, or by other unknown time-dependent factors.

A possible limitation of our study is the fact that we used a questionnaire that, although based on the SSC guidelines, was not formally validated. In addition, repeated use of the same questionnaire may have positively influenced the overall questionnaire score. However, this does not seem likely on account of the decreased overall score four to six months after the teaching intervention. Interestingly, compliance to the SSC guidelines in the emergency department significantly improved from 3.0 to 4.2 on a 0-6 scale (number of recommendations that were correctly performed). However, several other implementation strategies were conducted at the same time, and these results cannot be associated with the education of the residents alone.

## CONCLUSION

Our teaching intervention resulted in a sustained improved knowledge on symptoms, diagnosis and treatment of sepsis. Short- and long-term quantitative determinations concerning the efficiency of educational activities should be performed more often.

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