# Septic patients arriving with emergency medical services: a seriously ill population

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**Objective** Sepsis is a serious condition with high mortality. Early treatment improves outcome and can be initiated by emergency medical services (EMS) personnel. The primary aim of our study was to investigate how many sepsis patients are transported by EMS to the internist at the emergency department (ED). The secondary aims were to compare these EMS patients with patients who arrived at the ED otherwise and to investigate how these patients were managed. We further investigated how often the diagnosis sepsis/infection was documented by EMS.

**Patients and methods** We retrospectively retrieved all ED and EMS data of patients with sepsis who were assessed by the internist between March 2011 and March 2012.

**Results** Half (48.0%) of 654 sepsis patients were transported by EMS. These patients were more seriously ill (more severe grades of sepsis, more admittances to the hospital/ICU) than patients who were transported otherwise. Mortality within 28 days was 19.4% compared with 6.5% in the other patients. Nevertheless, half of the EMS transports were considered not urgent, even in 34.6% of the patients with septic shock. Assessment of vital signs was not routinely performed and treatment was started in only 43.6%. The diagnosis sepsis/infection was documented in 63.4% of patients.

**Conclusion** Half of the patients with sepsis arrive at the ED by EMS. These patients are seriously ill, and although these patients are likely to benefit from early treatment, they are often transported with nonurgent rides and both assessment of vital signs and early start of treatment are not routinely performed. *European Journal of Emergency Medicine* 00:000–000 © 2013 Wolters Kluwer Health | Lippincott Williams & Wilkins.

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## Introduction

Sepsis is a serious condition, leading to considerable morbidity and mortality [1]. Although increasing the awareness of the high prevalence and serious nature of sepsis has received considerable attention, this issue is still a challenge. After the introduction of the Surviving Sepsis Campaign, which aims to improve the awareness of doctors dealing with sepsis and to provide treatment protocols, mortality decreased up to 17% [2,3].

The guidelines for treatment provided by the Surviving Sepsis Campaign address the treatment of the septic patient after arrival at the hospital and not during the prehospital phase [4]. This focus on the hospital phase leaves room to improve the recognition and initiation of treatment of the septic patient in the prehospital phase. In the Dutch treatment guideline of the emergency medical services (EMS), a protocol for sepsis exists (Supplemental data, Supplemental digital content 1, *http://links.lww.com/EJEM/A58*) [5]. This guideline prescribes the administration of oxygen and intravenous fluids by the paramedic if systolic blood pressure is below 90 mmHg.

There are a few studies on the care of sepsis patients by EMS personnel. In the USA, patients with sepsis who were transported by ambulances were more seriously ill and had a higher risk of dying than patients who arrived at the emergency department (ED) otherwise [6–8]. Interestingly, these EMS patients were treated earlier, not only by EMS personnel but also during stay at the ED [6]. Thus, transportation by EMS not only offers an opportunity to treat septic patients early in the ambulance but also accelerates the treatment after arrival at the hospital. These advantages for ambulance patients can, however, only be achieved when these patients are transported by EMS and when sepsis is identified in the ambulance.

The primary aim of our retrospective study is to investigate how many patients with sepsis, severe sepsis, and septic shock, who are assessed and treated at the

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ED by internists, are transported by EMS. The secondary aim is to compare these EMS patients with those who are transported otherwise in terms of demographic data, hospitalization rate, sepsis severity, management, and outcome. We further aim to investigate whether sepsis is documented by EMS personnel and to investigate whether assessment, treatment, and outcome differ between the patients who were documented to have sepsis by EMS personnel and those who were not.

## Patients and methods
### Design and setting
This retrospective cohort study was carried out in the Maastricht University Medical Centre (MUMC). This hospital is a secondary and tertiary teaching hospital in the Netherlands. Yearly, ~22 750 patients visit our ED, of whom ~5000 are assessed and treated by acute internists and their residents. At our ED, there are no emergency physicians and residents of clinical specialties; in our study, acute internists assess all patients who are referred to the ED. Most patients are referred by a general practitioner and almost all acute admissions originate from the ED.

EMS is provided by 'regionale ambulancevoorziening Zuid-Limburg' (RAV-ZL). The EMS team consists of a trained EMS driver and a highly trained paramedic. As the Netherlands is a densely populated country, the EMS can transport (almost) all urgent patients to an ED within 45 min and nonurgent patients within 60 min. This study was approved by the medical ethics committee of MUMC.

### Population and data
All adult patients who were assessed by the internist at the ED between March 2011 and March 2012 were evaluated by the researchers. The diagnosis of sepsis and its severity was made at the ED using data from the electronic ED and hospital chart by one investigator and were confirmed by a second. In case of doubt, a third investigator decided on this issue. Sepsis was defined using international criteria: suspicion of infection and two or more of four systemic inflammatory response syndrome (SIRS) criteria: (i) heart rate more than 90/min, (ii) respiratory rate more than 20/min or $pCO_2$ less than 4.3 kPa, (iii) temperature less than 36.0°C or more than 38.3°C, (iv) leukocytes less than $4 \times 10^9$/l or more than $12 \times 10^9$/l or more than 10% leukocyte bands [9]. The severity of sepsis was divided into three categories: (i) sepsis, (ii) severe sepsis, and (iii) septic shock. Sepsis was defined as a suspected infection and at least two SIRS criteria; severe sepsis as sepsis with organ dysfunction (e.g. lactic acidosis, oliguria, or acute alternation of mental status) or sepsis-induced hypotension; and septic shock as severe sepsis with persistent hypotension despite adequate fluid administration [9–11]. If a patient presented twice at our ED within 28 days, the second visit was excluded as we assumed that the second visit was related to the same disease episode. In addition, we excluded patients for whom we could not retrieve the means of transportation or data on 28-day mortality.

From the patients' charts, demographic data, vital signs at arrival at the hospital, laboratory values, diagnosis, and focus of infection at admittance were retrieved. All-cause mortality within 28 days, both in-hospital and out-hospital, was retrieved from the patient charts, and if necessary by contacting the general practitioner.

Of all patients, who were assessed by the internist for sepsis, we retrieved whether they were transported by EMS. From the electronic database of the EMS, we retrieved data on the urgency and reason for the ride, the vital signs, and treatments started in the ambulance. We excluded patients with insufficient EMS data (e.g. when a patient was transported by an EMS from outside our own region). The assessment of urgency is made by the emergency medical dispatch center of the EMS. The urgency can change during the ride; these data were not evaluated in our study. Urgency category A1 is the highest urgency category (life-threatening situation), whereas A2 is ascribed to an urgent, but not immediately life-threatening situation, and category B to nonurgent situations [12].

### Outcomes and analysis
We assessed the number of patients with sepsis who were transported by EMS. In addition, we compared those who were transported by EMS with those who were transported otherwise in terms of demographic data, admission rates to both general wards and medium care/ICUs, length of hospital stay, all-cause mortality within 28 days, and focus of infection.

We analyzed whether the EMS paramedic assessed and treated patients more frequently with increasing sepsis severity. Further, we analyzed whether the EMS paramedic had documented whether the patients had sepsis or an infection or not. We further compared the number of assessments and treatments performed and started during the EMS ride and compared 28-day mortality between the patients who were documented to have sepsis/infection and those who were not.

Using SPSS 20.0. (IBM, Armont, New York, USA) for Windows, the independent samples $T$-test and the Mann–Whitney $U$-test was used to compare continuous data in two groups. Categorical data were analyzed using the $\chi^2$ and Fisher's exact test to compare proportions of groups, when appropriate. Kaplan–Meier survival curves were created and differences between curves were tested using the log-rank test. $P$ values of less than 0.05 were considered significant.

## Results
In the study period, 704 patients were assessed by the internist at the ED and diagnosed with sepsis (Fig. 1). Forty patients who were readmitted within 28 days were

Fig. 1
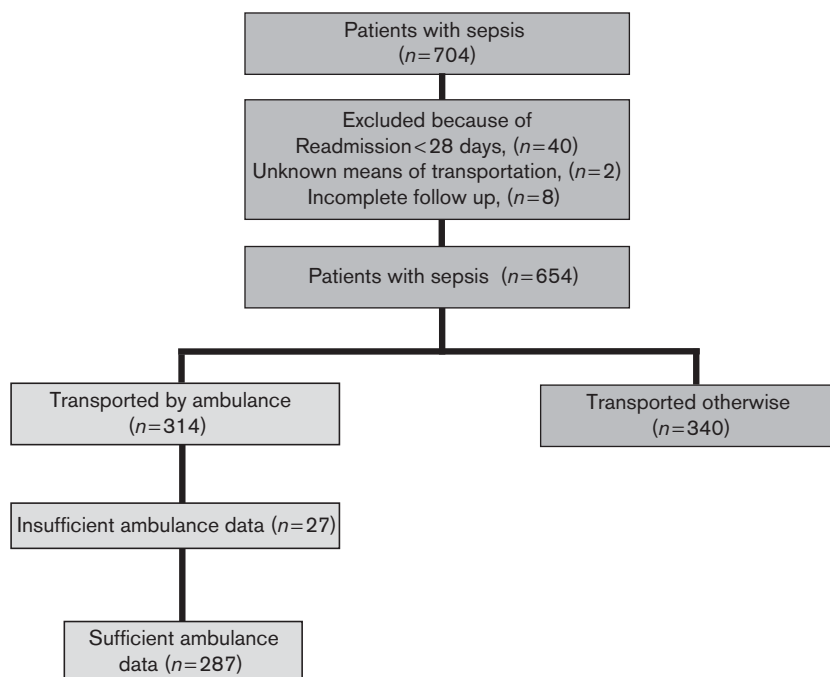


Flow chart showing the study population.

excluded. Two patients were excluded because of unknown means of transportation and eight because of incomplete follow-up. Of the remaining 654 patients, 314 patients (48.0%) were transported by ambulance. Data on outcome were available for all EMS patients and data on the EMS ride were available for 287 of these EMS patients (91.4%).

Table 1 shows the differences between the patients who were transported by EMS and those who were transported otherwise. The EMS patients were not only older (mean 71 vs. 56 years, $P < 0.0001$) but also more seriously ill. The EMS patients were admitted more frequently to the hospital and more specifically to the ICU ($P < 0.0001$ for both comparisons). They also had more respiratory tract ($P < 0.0001$) and less hepatobiliary ($P = 0.006$) infections. EMS patients more frequently had severe sepsis or septic shock ($P < 0.0001$) and 28-day mortality was higher (19.4 vs. 6.5%, $P < 0.0001$) in this group.

### Urgency of emergency medical services transports
Most EMS transports were judged as nonurgent (B category, 50.5%), followed by A2 (32.4%), and A1 (17.1%) (Table 2). With increasing severity of sepsis, the transports were not judged as more urgent ($P = 0.42$). More than one-third (34.6%) of the patients with septic shock were transported with a B-ride. There was no significant difference in mortality between the EMS urgency categories (data not shown, $P = 0.66$).

**Table 1  Patient characteristics**

| | n (%) | |
|---|---|---|
| | Transported by ambulance ($n=314$) | Transported otherwise ($n=340$) |
| Demographics | | |
| Male | 149 (47.5) | 155 (45.6) |
| Mean age (SD)[a] | 71±15 | 56±16 |
| Outcome | | |
| Admittance to the hospital[a] | 307 (97.8) | 292 (85.9) |
| Length of hospital stay (median, IQR) (days)[a] | 7 (4–12) | 5 (3–10) |
| MCU-admittance | 6 (1.9) | 5 (1.5) |
| ICU-admittance[a] | 22 (7.0) | 2 (0.6) |
| Mortality within 28 days[a] | 61 (19.4) | 22 (6.5) |
| Severity of sepsis[b] | | |
| Sepsis | 136 (43.3) | 263 (77.4) |
| Severe sepsis | 150 (47.8) | 68 (20.0) |
| Septic shock | 28 (8.9) | 9 (2.6) |
| Focus of infection | | |
| Respiratory[a] | 108 (34.4) | 73 (21.5) |
| Urinary | 74 (23.6) | 61 (17.9) |
| Gastrointestinal | 30 (9.6) | 39 (11.5) |
| Hepatobiliary[a] | 11 (3.5) | 29 (8.5) |
| Skin/joint | 25 (8.0) | 22 (6.5) |
| Other/unknown | 66 (21.0) | 116 (34.1) |

IQR, interquartile range; MCU, medium care unit.
[a]Significant difference between the two groups.
[b]Significant difference between the two groups in the three grades of sepsis severity.

### Assessments and treatment during emergency medical services transport
Table 2 shows the assessments that were performed during the EMS transport. The five most important vital

Table 2   Urgency of and assessment and treatment during the emergency medical services ride in relation to sepsis severity

| | n (%) | | | |
|---|---|---|---|---|
| | All patients (n=287) | Sepsis (n=118) | Severe sepsis (n=143) | Septic shock (n=26) |
| Urgency | | | | |
| A1-ride | 49 (17.1) | 17 (14.4) | 26 (18.2) | 6 (23.1) |
| A2-ride | 93 (32.4) | 36 (30.5) | 46 (32.2) | 11 (42.3) |
| B-ride | 145 (50.5) | 65 (55.1) | 71 (49.7) | 9 (34.6) |
| Assessments | | | | |
| Blood pressure[a] | 192 (66.9) | 75 (63.6) | 93 (65.0) | 24 (92.3)[b] |
| Heart rate | 116 (40.4) | 48 (40.7) | 52 (36.4) | 16 (61.5) |
| Oxygen saturation | 119 (41.5) | 46 (39.0) | 59 (41.3) | 14 (53.8) |
| Respiratory rate | 196 (68.3) | 76 (64.4) | 98 (68.5) | 22 (84.6) |
| Mental state | 157 (54.7) | 63 (53.4) | 74 (51.7) | 20 (76.9) |
| Temperature | 68 (23.7) | 29 (24.6) | 32 (22.4) | 7 (26.9) |
| Five vital signs | 60 (20.9) | 23 (19.5) | 28 (19.6) | 9 (34.6) |
| Treatment | | | | |
| Oxygen[a] | 102 (35.5) | 29 (24.6)[c,d] | 60 (42.0) | 13 (50.0) |
| Intravenous fluids[a] | 68 (23.7) | 24 (20.3)[c] | 31 (21.7)[e] | 13 (50.0) |
| Oxygen and intravenous fluids[a] | 45 (15.7) | 12 (10.2)[c] | 23 (16.1)[e] | 10 (38.5) |

A1-ride, highly urgent, life-threatening situation; A2-ride, urgent situation; B-ride, nonurgent situation.
[a]Significant difference between the three groups.
[b]Significant difference vs. sepsis and severe sepsis.
[c]Significant difference vs. septic shock.
[d]Significant difference vs. severe sepsis.
[e]Significant difference vs. septic shock.

signs (blood pressure, heart rate, oxygen saturation, respiratory rate, and mental state) were assessed in 20.9% of all ambulance patients, whereas in 23.7% no vital signs were assessed.

Blood pressure was assessed more frequently in the septic shock group than in the sepsis and the severe sepsis group ($P = 0.015$). Treatment was started by the EMS paramedic in 43.6% of the patients, whereas 45 (15.7%) patients received both oxygen and intravenous fluids (Table 2). Patients with septic shock were treated more frequently with oxygen ($P = 0.01$), intravenous fluids ($P = 0.004$), or both ($P < 0.0001$) than patients with sepsis. Similarly, patients with septic shock received intravenous fluids ($P = 0.002$) and both oxygen and intravenous fluids ($P = 0.008$) more frequently than patients with severe sepsis. Patients with severe sepsis received more oxygen than those with sepsis ($P = 0.003$).

### Documentation of sepsis by the emergency medical services personnel
Of the 287 EMS patients, 182 (63.4%) were documented to have an infection, including the exact diagnosis of sepsis in 31 (10.8%) (Table 3). The same percentages of documented infections (67.9%) and sepsis (13.6%) were found in the 162 patients who were referred by a general practitioner as in the other patients ($P = 0.34$ and $0.38$, respectively).

Blood pressure and mental state were assessed less frequently and temperature was measured more frequently in the group with documented infection/sepsis ($P < 0.05$ for the three comparisons). Treatment was similar as was mortality within 28 days in the two groups ($P = 0.17$, data not shown).

Table 3   Assessments, treatment, and outcome in relation to documentation of sepsis and infection by emergency medical services personnel

| | n (%) | |
|---|---|---|
| | Documentation of infection/sepsis (n=182) | No documentation of infection/sepsis (n=105) |
| Assessments | | |
| Blood pressure[a] | 114 (62.6) | 78 (74.3) |
| Heart rate | 72 (39.6) | 44 (41.9) |
| Oxygen saturation | 75 (41.2) | 44 (41.9) |
| Respiratory rate | 117 (64.3) | 79 (75.2) |
| Mental state[a] | 91 (50.0) | 66 (62.9) |
| Temperature[a] | 50 (27.5) | 18 (17.1) |
| Five vital signs[b] | 39 (21.4) | 21 (20.0) |
| Treatment | | |
| Oxygen | 63 (34.6) | 39 (37.1) |
| Intravenous fluids | 40 (22.0) | 28 (26.7) |
| Oxygen and intravenous fluids | 28 (15.4) | 17 (16.2) |
| Outcome | | |
| Mortality within 28 days | 31 (17.0) | 26 (24.8) |

[a]Significant difference between the two groups.
[b]The five vital signs were blood pressure, heart rate, oxygen saturation, respiratory rate, and mental state.

## Discussion
Almost half of the patients with sepsis who are treated by internists at the ED are transported by EMS. These EMS patients are more seriously ill than those who are transported otherwise. The mortality rate of the septic EMS patients of 19.4% is high and much higher than those who are not transported by EMS (6.5%).

The high mortality rate of sepsis we found was also reported in studies from the USA [8]. It is important to note again that the mortality rate of our sepsis patients is

higher than of many other diseases that are generally considered extremely threatening. For instance, the mortality rate of acute myocardial infarction in men admitted to the hospital is 6.3% [13].

The vital signs of these sepsis patients were not routinely assessed and treatment was started in less than half (43.6%) of the patients during the ambulance ride. Even with increasing sepsis severity, the number of patients in whom vital signs were assessed did not increase, except for the blood pressure. It is remarkable that these assessments were not performed routinely. It is possible that the assessments were performed but not registered correctly, that the paramedic depended on the assessments made by the general practitioner or a quick general assessment. It is not only important to assess vital signs to tailor and optimize treatment but also to diagnose sepsis as three of the vital signs are SIRS criteria (heart rate, respiratory rate, temperature). Measurement of these vital signs will probably improve the recognition of sepsis.

We further found that our sepsis patients were not treated aggressively in the ambulance as only 15.7% of the patients were treated with both oxygen and intravenous fluids and almost half of the patients received neither of these treatments, which has also been reported in other studies [6,8]. However, treatment was more frequently initiated with increasing sepsis severity. The registration of started treatments was probably rather reliable as this registration is used for feedback on skills maintenance. Mortality was not significantly different between the patients who were documented to have infection or sepsis and those who were not. As treatment was similar between the documented and the nondocumented groups, a difference in outcome cannot be expected. Early treatment in the ambulance could improve outcome if the results of early hospital treatment can be extrapolated to the prehospital phase. Further, improving treatment in the ambulance improves the care at the ED as patients who were treated with intravenous fluids during EMS transport received twice the volume of fluids in the first hour of ED stay [7,8] and antibiotics were administered earlier if patients had been identified as septic by the paramedic [6].

The diagnosis of sepsis was documented in a minority (10.8%) of the patients. Even if fever or infection were considered as documented sepsis, many cases of sepsis were not documented (36.6%). Of course, we cannot conclude on the exact number of patients in whom the diagnosis of sepsis was made by the EMS staff for several reasons. First, we could only assess the cases of sepsis/infection that were documented in the electronic chart; it is possible that sepsis was recognized by the EMS paramedic more frequently. However, vital signs were not routinely assessed and most patients did not receive treatment, even those who turned out to have septic shock. Second, the diagnosis of sepsis was established at the ED. It may be possible that sepsis was less serious or absent during the EMS transport and therefore difficult to recognize. Third, one of the four SIRS criteria (leukocytes or leukocyte bands) can only be assessed at the ED; thus, it is possible that sepsis could not have been diagnosed in patients with only one other positive SIRS criterion. Although we cannot be precise on the exact number of missed diagnoses, we can at least conclude that the exact diagnosis of sepsis was not documented in a majority of the EMS charts that were handed over to the ED.

There are several reasons why the diagnosis of sepsis was not documented by EMS personnel. It is possible that documentation of the diagnosis has no priority for the paramedic as safe transportation of patients is more important. It is possible that because information is handed over verbally, the diagnosis is not written down as well, although this is obligatory. It is also possible that EMS personnel missed the diagnosis as the paramedic used a global assessment instead of an exact assessment of the vital signs. The paramedic may not aim to diagnose sepsis specifically because the treatment of life-threatening symptoms is more important. It is also possible that the general practitioner missed the diagnosis as we found the same percentage of documented sepsis (13.6%) and suspected infections (67.9%) in the group of patients who were referred by the general practitioner. The dispatcher at the emergency medical dispatch center may also have failed to recognize/document sepsis and thereby misled the paramedic as almost half of the transports were considered nonurgent (50.5%).

Sepsis is a frequently missed diagnosis. EMS personnel missed up to 69% of those with a serious infection [14] and 52.2% of patients with severe sepsis [15]. Hospital doctors in Brazil did not identify severe sepsis in 43% of patients [16] and in the UK, only 17% of the admitted patients with sepsis were documented to have sepsis [17]. Sepsis is apparently difficult to diagnose for more groups of health care professionals than EMS personnel [18], possibly resulting from a lack of knowledge, skills, tools, or unclear rules and procedures.

Why is timely recognition of sepsis so important? First, the severity of sepsis tends to increase rapidly. More than 20% of patients with uncomplicated sepsis develop severe sepsis or septic shock within 72 h [18]. Second, each hour of delay in the administration of antibiotics at the ED increased mortality by 7.6% in patients with severe sepsis [19]. Since the introduction of the Surviving Sepsis Campaign that advocates early treatment, absolute mortality in an international study has decreased by 6.2% [2] and in the Netherlands by 17% [3]. These data concern the care from the moment the patient has reached the hospital.

Timely recognition and initiation of treatment remains a major challenge for professionals in the hospital, but

apparently also for the entire chain of emergency care. Further prospective research on early recognition and treatment of sepsis by EMS personnel is necessary.

## Conclusion

Almost half of the patients with sepsis who are assessed at the ED by the internist are transported by EMS. These patients are seriously ill as they are admitted more frequently to the hospital and the ICU and have more severe grades of sepsis than those who are transported otherwise. Mortality in the EMS patients is very high (19.4%). However, assessment of vital signs and initiation of treatment are performed in only a minority of the patients and sepsis is not documented in a huge proportion of patients. Therefore, assessment of vital signs and acknowledgement of the serious nature of sepsis must be improved.

## Acknowledgements

### Conflicts of interests
There are no conflicts of interest.

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