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If you don't take a temperature, you can't find a fever

Awareness in out-of-hospital vital signs in cases of suspected sepsis

Introduction

Sepsis and septic shock are frequent diseases with high mortality rates [1–3]; the survival probability decreases with every hour that adequate therapy is delayed [4, 5]. The first contact between patients with sepsis or septic shock and emergency medical services (EMS) is associated with improved in-hospital processes for the care of these critically ill patients, provided that early diagnosis is made and that the EMS initiated adequate organizational and therapeutic consequences [6, 7].

In 1991, the clinical definition of sepsis emerged from the consensus conference sponsored by the American College of Chest Physicians and the Society of Critical Care Medicine. This definition included the systemic inflammatory response syndrome (SIRS) criteria (Table 1) as the basis for the clinical diagnosis of sepsis. However, in pre-hospital emergency management, SIRS criteria cannot be completely recorded.

Recently, new definitions were published in February 2016 by the Sepsis-3 taskforce within the framework of the third international consensus definitions for sepsis and septic shock [8]. In general, sepsis is defined as life-threatening

organ dysfunction caused by a dysregulated host response to infection. To detect organ dysfunction, vital signs still play a key role in the emergency management. In the prehospital setting, the quick Sepsis Organ Failure Assessment (qSOFA) score is a new screening tool to detect sepsis, raising the alarm if two of the three criteria are present in case of a suspected infection (Table 2).

Alternative scores and screening tools are also used in the prehospital emergency setting (e.g., the Robson Prehospital Severe Sepsis Screening Tool, the Prehospital Early Sepsis Detection Score [PRESEP], and the Modified Early Warning Score [9–11]). All of these use vital signs, such as body temperature, heart, and respiratory rates or blood pressure to evaluate the patients' condition. Remarkably, body temperature is not part of the qSOFA criteria, since temperature is a sign of infection but not organ dysfunction.

Regardless of discussions about the best sepsis screening tool in the prehospital

emergency medicine setting, the best sepsis score will not be helpful if the applied single criteria are not measured regularly and completely in case of suspected sepsis, thereby initiating immediate treatment in prehospital sepsis care [12]. Recently, sepsis has been included as one of the six time-critical tracer diagnoses, thus requiring EMS to foster stronger awareness in the prehospital setting [13].

This retrospective study was initiated to analyze whether EMS regularly document vital signs associated with organ dysfunction in the presence of suspected infection.

Methods

During the analyzed period from January 1, 2013, to December 31, 2014, no specific prehospital infection or sepsis protocol was established. The analyzed data were derived from an EMS district in Hesse (Germany). This EMS district provided five rescue stations and three

Table 1 Systemic inflammatory response syndrome (SIRS) criteria. In addition to vital signs, there is a laboratory parameter (white blood cell count). Two or more SIRS criteria need to be positive to diagnose sepsis

Temperature	<36 °C (97 °F) or >38 °C (100 °F)
Heart rate	>90 beats/min
Respiratory rate	>20 breaths/min or PaCO ₂ <32 mm Hg
White blood cell count	<4000/mm ³ , >12,000/mm ³ or >10% band neutrophilia

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Table 2 Quick Sepsis Organ Failure Assessment (qSOFA): Two or more criteria need to be positive to suspect sepsis

Parameter	Limits
Respiratory rate	≥22 breaths/min
Systolic blood pressure	≤100 mm Hg
Mental status	Altered

Table 3 Number of measurements between the different diagnoses. Caution is required in the interpretation due to the small sample size

Number of measurements	Overall	Pneumonia/ Bronchitis	Meningitis	Septic shock	p-value
Respiratory rate, n (%)	437 (31.5)	424 (31.7)	9 (24.3)	4 (30.8)	0.635
Heart rate, n (%)	1349 (97.2)	1304 (97.4)	32 (86.5)	13 (100.0)	<0.001
Temperature, n (%)	364 (26.2)	353 (26.4)	6 (16.2)	5 (38.5)	0.230
GCS, n (%)	1092 (78.7)	1052 (78.6)	31 (83.8)	9 (69.2)	0.530
Blood pressure systolic, n (%)	1325 (95.5)	1281 (95.7)	31 (83.8)	13 (100.0)	0.002
SpO ₂ , n (%)	1231 (88.7)	1197 (89.5)	23 (62.2)	11 (84.6)	<0.001

SpO₂ Saturation of peripheral oxygen, GCS Glasgow Coma Scale

Table 4 Vital signs in the different diagnostic groups. Values are mean ± standard deviation (SD with min–max)

	Pneumonia/ Bronchitis	Meningitis	Septic shock	p-value
Respiratory rate, /min	18 ± 6 (9–47)	19 ± 8 (12–40)	24 ± 12 (12–38)	0.603
GCS	14 ± 2 (3–15)	14 ± 2 (7–15)	10 ± 4 (3–15)	<0.001
SpO ₂ , %	90 ± 8 (31–100)	95 ± 5 (78–99)	78 ± 23 (12–98)	<0.001
Heart rate, /min	94 ± 24 (15–227)	87 ± 28 (43–170)	118 ± 34 (67–160)	0.004
Systolic blood pressure, mm Hg	136 ± 31 (50–270)	135 ± 24 (90–190)	94 ± 43 (40–194)	0.001
Temperature, °C	37.9 ± 1.2 (34.4–41.8)	36.9 ± 0.9 (36.1–38.0)	38.3 ± 1.6 (36.5–40.0)	0.075

SpO₂ Saturation of peripheral oxygen, GCS Glasgow Coma Scale

emergency physician stations in a suburban setting with a population of 1000 people per km² and a total number of 230,000 inhabitants.

Under the supervision of a medical director, EMS is performed by different agencies pursuant to the legal mission. All EMS operations must be documented by the EMS and stored in a central register of the dispatching centers of the districts. For the present study, only

pseudonymized data were made available, so that no traceability was possible through the patient's name, address, location, or date of birth. To determine age, the date of birth was given as month and year. The investigation was approved by the Ethics Committee of the Faculty of Medicine at the Goethe University in Frankfurt/Main. The pseudonymized data usage is also permitted by law by the Hessian Rescue Services Act (HRDG)

§ 17 (Privacy) and § 19 (quality assurance); those responsible are even encouraged by law to analyze the data for medical quality assurance so that analysis can lead to improvements in emergency service law.

The diagnoses pneumonia, meningitis, and septic shock with unknown focus were chosen as representative for prehospital suspected infections in the prehospital setting. In total, 68,798 operation protocols from the years 2013 and 2014 were analyzed. Any missing data for nonvital parameters were interpreted as not evaluated. For statistical analysis, because the data were not normally distributed, we used the Mann–Whitney U-test for continuous variables and the χ^2 test for categorical variables. The Kruskal–Wallis test was used to compare the three independent groups. A two-tailed *p*-value < 0.05 was considered statistically significant. All data were analyzed using SPSS statistical software (Version 24.0, IBM Inc.). For continuous variables, data are shown as the mean ± standard deviation. For categorical variables, percentages are presented.

Results

In total, 1390 of 68,798 protocols were identified with prehospital diagnoses of pneumonia, meningitis or septic shock without known focus. The average age of patients was 73 ± 18 years, 59.0% (*n* = 820) were female. Most (96.4%, *n* = 1338) had suspected pneumonia, 2.7% (*n* = 37) had suspected meningitis, and 0.9% (*n* = 13) had septic shock with an unknown focus.

Table 3 shows the number of measurements in the different groups. Body temperature (26.2%) and respiratory rate (31.5%) were least documented. When comparing the documentation of different vital signs, the rates of measurement of respiratory rate, temperature, and Glasgow Coma Scale (GCS) did not differ significantly.

The points on the Glasgow Coma Scale, saturation of peripheral oxygen (SpO₂), heart rate and systolic blood pressure did differ significantly between groups, as shown in Table 4.

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If you don't take a temperature, you can't find a fever. Awareness in out-of-hospital vital signs in cases of suspected sepsis

Abstract

Background. Sepsis and septic shock are common diseases with high mortality rates and a survival rate that decreases with every hour of delayed therapy. While definitions are valid and published, even the best sepsis score is not helpful if the criteria are not measured regularly in case of suspected sepsis.

Objectives and Methods. The objective of this retrospective study was to evaluate the documentation addressing vital signs in case of severe infection, which can be measured by emergency medical services (EMS) to detect suspected sepsis or septic shock during prehospital management. We screened 68,798 prehospital operation protocols of

a German EMS district from January 1, 2013, to December 31, 2014. Tracer diagnoses were prehospital diagnoses of pneumonia, meningitis or septic shock.

Results. Those protocols ($n = 1390$) with severe infections as the leading diagnosis were identified. Respiratory rate was documented in 31.5% and temperature in 26.2%. The best documentation was found for heart rate (97.2%). There were significant differences in the documentation of vital signs between the different diagnoses ($p < 0.001$).

Conclusions. The results show a lack of documentation in patients with infection. This finding is obvious from the data on

respiratory rate and temperature. Considering that defined vital signs are among the criteria to diagnose sepsis, EMS personnel should be trained to measure and document fundamental vital signs and to search for signs of impending sepsis.

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Keywords

Awareness · Sepsis · Screening tool · Emergency medical services · SIRS · QSOFA

„If you don't take a temperature, you can't find a fever“. Wahrnehmung von prähospitalen Vitalparametern bei vermuteter Sepsis

Zusammenfassung

Hintergrund. Die Sepsis und der septische Schock sind häufige Erkrankungsbilder, die mit einer hohen Sterblichkeit vergesellschaftet sind. Die Überlebensrate sinkt mit jeder Stunde der verzögerten Therapie. Wenngleich gültige Definitionen für die Sepsis und entsprechende Scores publiziert wurden, sind auch die besten Definitionen nicht hilfreich, wenn bei vermuteter Infektion oder Sepsis die wesentlichen Vitalparameter als wichtiger Bestandteil für die Diagnosefindung nicht regelhaft erhoben werden.

Ziel der Arbeit und Methoden. Ziel dieser retrospektiven Untersuchung war zu überprüfen, wie regelhaft in der präklinischen Notfallversorgung die relevanten Vitalparameter im Falle vermuteter Infektionen erhoben werden, um eine Sepsis oder einen septischen Schock frühzeitig erkennen zu können.

Insgesamt wurden 68.798 präklinische Notfallprotokolle eines Rettungsdienstbereichs in Deutschland von 1. Januar 2013 bis 31. Dezember 2014 untersucht.

Ergebnisse. Insgesamt konnten 1390 Protokolle mit den Indikatoridiagnosen Pneumonie, Meningitis und primärer Sepsis eingeschlossen werden. Die Atemfrequenz war in 31,5% und die Körpertemperatur in 26,2% der Fälle dokumentiert. Am häufigsten wurde die Herzfrequenz (97,2%) erfasst. Signifikante Unterschiede in der Dokumentation von Vitalparametern konnten in Abhängigkeit der verschiedenen Diagnosen gezeigt werden ($p < 0,001$).

Diskussion. Zusammenfassend zeigen die Ergebnisse dieser Arbeit Mängel in der Dokumentation von Vitalparametern im Rahmen der Versorgung von Patienten mit

vermuteter Pneumonie, Meningitis oder primärer Sepsis. Dies zeigt sich insbesondere bei der Erfassung der Atemfrequenz sowie der Körpertemperatur. Beachtet man, dass zum Zeitpunkt der Datenerhebung diese Vitalparameter fester Bestandteil für die Verdachtsdiagnose der Sepsis waren, sollte das in der Präklinik tätige medizinische Personal daraufhin geschult werden, die wesentlichen Vitalparameter zu erheben, zu dokumentieren und nach Anzeichen einer drohenden Sepsis zu suchen.

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Schlüsselwörter

Wahrnehmung · Sepsis · Sepsis Scores · Rettungsdienst · SIRS · QSOFA

In this study, 28.8% ($n = 401$) of the patients were transported only by paramedics. As shown in **Fig. 1**, there seem to be differences in measurements between emergency physicians and paramedics. In particular, for paramedics, the respiratory rate was documented in 38% of cases, which is significantly more often than by emergency physicians (16%, $p < 0.001$). However, the measured values for heart rate (99.4%

versus 95.5%, $p = 0.001$) and blood pressure (98.2% versus 94.8%, $p = 0.013$) were significantly better documented by the emergency physicians.

Discussion

The SIRS criteria were fundamental for the diagnosis of sepsis and septic shock at the time of data collection [14]. Today, the Sepsis-3 definition qSOFA should be

used to screen for suspected sepsis and septic shock [8].

This study shows that documentation of the vital parameter in case of severe infection and possible sepsis in the pre-hospital setting is low, primarily because the respiratory rate and temperature are rarely measured.

In Germany, every ambulance can use thermometers so that body temperature can be evaluated as a standard vital pa-

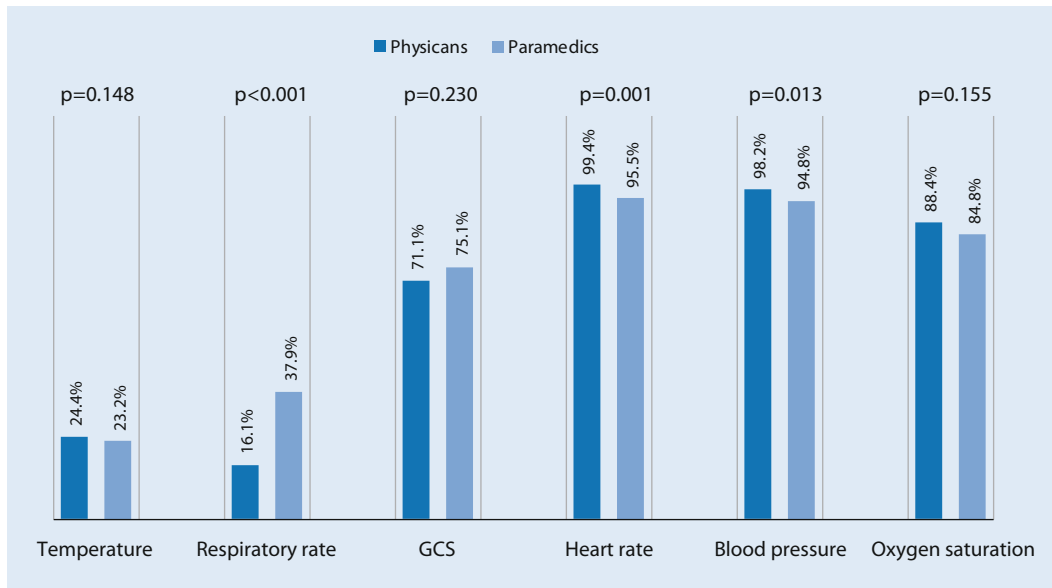


Fig. 1 ◀ Measurement behavior of emergency physicians and paramedics. P-value indicates significance between both groups in measuring the vital sign. GCS Glasgow Coma Scale

parameter. Considering this, it is surprising that body temperature and respiration rate were so poorly documented. This might be because heart rate is measured automatically with ECG, which is usually used for every emergency patient and further action is unnecessary to evaluate heart rate, in contrast to using a thermometer to measure body temperature or manually counting the respiration rate.

There is a need to demonstrate whether a gapless measurement of respiratory rate and temperature would have relevant consequences for the pre-hospital management of patients with sepsis and septic shock. There could be a change in management with oxygen, infusion therapy, and transportation management and handover procedure in relation to time management and destination hospital. However, in Germany, there are only a few rescue districts with rescue vehicles carrying antibiotics with them in the prehospital setting, so the therapeutic consequence in prehospital antibiotic treatment does not seem to be realistic, at least not yet [12].

The differences in stringencies in the collection of relevant measurements by paramedics versus emergency physicians were most pronounced in the respiratory rate. However, why these deviations existed cannot be explained.

In conclusion, our results show a lack of documentation of body temperature and respiratory rate in case of suspected

sepsis. Only the heart rate was evaluated regularly. EMS personnel have to be trained to document these parameters in case of severe infections.

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Compliance with ethical guidelines

Conflict of interest. S. Casu, J. Blau, B. Schempf and D. Häske declare that they have no competing interests.

This article does not contain any studies with human participants or animals performed by any of the authors.

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Ankündigung

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Plattform für Wissenstransfer und Erfahrungsaustausch: Jetzt zum DIVI-Kongress anmelden!

Der wichtigste Kongress für alle Berufsgruppen der Intensiv- und Notfallmedizin

Vom 4. bis 6. Dezember lädt die Deutsche Interdisziplinäre Vereinigung für Intensiv- und Notfallmedizin (DIVI) zum Jahreskongress nach Hamburg ein. Rund 6.000 Teilnehmer werden erwartet. Der „DIVI2019“ bietet zahlreiche Symposien, Hands-on-Kurse, mehrere Speakers' Corner sowie hochkarätige Keynote-Speaker und ist damit ein wichtiger Termin im Kalender von Beschäftigten und Entscheidern im Gesundheitswesen. Auch Bundesgesundheitsminister Jens Spahn wird vor Ort sein.

Das Kongress-Motto „Kooperation führt zu Entwicklung“ soll die zahlreichen wissenschaftlichen Themen verbinden. „Organisationen, Strukturen und Kongresse sind immer dann spannend, wenn Menschen aus unterschiedlichen Gruppen zusammenkommen. Wir in der DIVI sind unterschiedliche Menschen, Gruppen, Energien, Meinungen, auch Dogmen, und wir sprechen miteinander, wir arbeiten zusammen, wir entwickeln – uns und unsere Strukturen – zum Wohle unserer Patientinnen und Patienten“, sagt Kongress-Präsident Professor Bernd Böttiger, Direktor der Klinik für Anesthesiologie und Operative Intensivmedizin der Universität zu Köln. „Wir brauchen dabei auch die Unterstützung aus der Politik, genügend Personal, genügend Ressourcen.“

>> **Kooperation auch mit den Jüngsten der Gesellschaft: Schüler können leben retten**

Erstmals findet beim Kongress das Event „KIDS SAVE LIVES“ im Rahmen der „World Restart a Heart“-Initiative statt. Der DIVI-Kongress richtet sich an Intensivmediziner aller Fachgebiete, Pflegekräfte und Ärzte, aber auch an Rettungsassistenten, Atmungstherapeuten, Physiotherapeuten, Pharmazeuten, Juristen, Ethiker, IT-Spezialisten, Medizintechniker, Phoniater, Schlucktherapeuten und Seelsorger.

>> **Neue Methoden und Technologien im Fokus**

„Gerade in den vergangenen Jahren hat die interdisziplinäre Zusammenarbeit in der Intensiv- und Notfallmedizin große Fortschritte gemacht. Der Kongress in Hamburg ist jetzt die beste Plattform zum Wissenstransfer und Erfahrungsaustausch“, so Professor Stefan Kluge, DIVI-Präsidiumsmitglied und Direktor der Klinik für Intensivmedizin am Universitätsklinikum Hamburg-Eppendorf. Er ist verantwortlich für das wissenschaftliche Programm.

>> **Bis 30. September bewerben: Förderstipendien über 15.000 Euro**

Wichtiger Hinweis: Im Rahmen des Kongresses verleiht die DIVI-Stiftung Stipendien über insgesamt 15.000 Euro. Damit werden klinische und wissenschaftliche Projekte sowie Gesundheitsfachberufe unterstützt. Einsendeschluss für die Förderprogramme ist der 30. September 2019.

Mehr Informationen unter www.divi.de und www.divi2019.de