ORIGINAL ARTICLE

Status of Sepsis Care in European Hospitals
Results from an International Cross-Sectional Survey

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Abstract

Rationale: Early detection, standardized therapy, adequate infrastructure, and strategies for quality improvement should constitute essential components of every hospital's sepsis plan.

Objectives: To investigate the extent to which recommendations from the sepsis guidelines are implemented and the availability of infrastructure for the care of patients with sepsis in acute-care hospitals.

Methods: A multidisciplinary cross-sectional questionnaire was used to investigate sepsis care in hospitals. This included the use of sepsis definitions, the implementation of sepsis guideline recommendations, diagnostic and therapeutic infrastructure, antibiotic stewardship, and quality improvement initiatives (QIIs) in hospitals.

Measurements and Main Results: A total of 1,023 hospitals in 69 countries were included. Most of them, 835 (81.6%), were in Europe. Sepsis screening was used in 54.2% of emergency departments (EDs), 47.9% of wards, and 61.7% of ICUs. Sepsis management was standardized in 57.3% of EDs, 45.2% of wards, and 70.7% of ICUs. The implementation of comprehensive QIIs was associated with increased screening (EDs, +33.3%; wards, +44.4%; ICUs, +23.8% absolute difference) and increased standardized sepsis management (EDs, +33.6%; wards, +40.0%; ICUs, +17.7% absolute difference) compared with hospitals without QIIs. A total of 9.8% of hospitals had implemented ongoing QIIs, and 4.6% had invested in sepsis programs.

Conclusions: The findings indicate that there is considerable room for improvement in a large number of mainly European hospitals, particularly with regard to early identification and standardized management of sepsis, the availability of guidelines, diagnostic and therapeutic infrastructure, and the implementation of QIIs. Further efforts are required to implement a more comprehensive and appropriate quality of care.

Keywords: sepsis screening; sepsis management; standard of care; quality of care; sepsis programs

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The incidence of sepsis is high, with almost 49 million new cases and 11 million deaths worldwide per year (1). International guidelines strongly recommend routine sepsis screening in acutely ill patients at high risk and the application of standard operating procedures for sepsis treatment when indicated (2). In recent years, there has been international recognition of the need for hospital facilities to improve sepsis care. This is recognized by the seventh World Health Assembly resolution on "Improving the prevention, diagnosis, and management of sepsis" (Resolution 70.7) in 2017, which encouraged "Member States to define and implement standards and established guidelines, infrastructure, laboratory capacity, strategies, and tools for identifying, reducing incidence of, and morbidity and mortality due to sepsis" (3) and by the statement of the G7 Health Ministers in May 2022 to intensify efforts to strengthen early detection, diagnosis, and therapy of sepsis and to boost the implementation of the World Health Assembly 70.7 Resolution (4). One question is whether existing hospital facilities are ready to reach these goals. This would require the delivery to state authorities a real mapping of the existing facilities, including infrastructure, available personnel,

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Availability of data and materials: the data used for this analysis can be made available upon reasonable request for as long as 5 years. For further information, please contact the corresponding author.

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This article has a related editorial.

A data supplement for this article is available via the Supplements tab at the top of the online article.

At a Glance Commentary

Scientific Knowledge on the Subject: There are few data on the implementation of guideline recommendations and infrastructure for the care of patients with sepsis in hospitals, especially in Europe.

What This Study Adds to the Field: This study investigated for the first time the implementation of guideline recommendations and infrastructure for the care of patients with sepsis in a large sample of mainly European hospitals.

and bundles of sepsis management to increase awareness of the necessary corrective actions.

The objective of this study was to investigate the implementation of sepsis guideline recommendations and the availability of infrastructure for the care of patients with sepsis in pivotal hospital departments in Europe and other regions. Some of the results of this study have been previously reported in the form of abstracts or conference contributions (5–18). Some of the results of these studies have been previously reported in the form of a preprint (*Lancet*, 2023 Aug 15; http://dx.doi.org/10.2139/ssrn.4538229).

Methods

The European Sepsis Care Survey (ESCS) was conducted to investigate the current status of sepsis care in hospitals. The ESCS was addressed to healthcare professionals working in different hospital settings, mostly in Europe, and tried to investigate the implementation of basic principles of sepsis recognition and management in routine clinical practice.

Study Design, Harmonization, and Pretesting

The ESCS, a cross-sectional questionnaire, was designed and harmonized by a multiprofessional steering committee led by the European Sepsis Alliance and peer-reviewed by the scientific committees of four European professional scientific societies (Table E1 in the online supplement). The survey included 94 questions, including overarching questions and concerning separate sections for the emergency departments (EDs), wards, and ICUs (*see* online supplement for the full survey).

The main focus of interest was the use of sepsis definitions and the implementation of Surviving Sepsis campaign guidelines, including sepsis screening for early recognition and standardized sepsis management, including standard operating procedures for management and quality improvement programs (2). Quality improvement initiatives (QIIs) are programs that include meetings, case reviews, informational material, and peer reviews with the aim to improve the quality of sepsis care.

A second focus of interest was infrastructure and resources for the care of patients with sepsis. This included the presence of medical emergency teams for the identification and evaluation of critically ill patients, the availability of imaging for the detection of the source of infection, the accessibility of microbiological diagnostic services, and the availability of surgical procedures for source control. The use of fluids for hemodynamic resuscitation, the implementation of antimicrobial guidelines or recommendations for antiinfective treatment, and the establishment of antibiotic stewardship teams were also identified as essential therapeutic and structural features.

The survey was available in English, German, Polish, Romanian, Russian, and Turkish. Technical and content-related pretesting was conducted by steering committee members and national coordinators. The study protocol received ethical approval from the ethics committee of University Medicine Greifswald, Germany (BB 124/21), where data are stored and processed. In all other countries, the study was approved per national legislation. The study complies with the EQUATOR (Enhancing the Quality and Transparency of Health Research) network reporting guidelines, CHERRIES (Checklist for Reporting Results of Internet E-Surveys) (19), and CROSS (Checklist for Reporting of Survey Studies) (20) and was registered at clinicaltrials.gov (identifier NCT05059808).

Sampling Strategy, Technical Realization, and Statistical Analysis

The ESCS was conducted between August 2021 and June 2022. The steering committee of the ESCS invited national coordinators from 26 countries and 8 international scientific societies. The national coordinators were tasked to invite hospitals in their respective countries in a way that was as representative as possible, taking into account the distinction between teaching and nonteaching hospitals, as well as tertiary and nontertiary hospitals. Participation was encouraged by calls from the endorsing scientific societies (*see* online supplement for further details regarding the recruitment strategies in each country). Participants self-registered or were registered by the national coordinators. Following an initial verification of the hospital at which the participant was employed, an invitation email was sent to the individual, containing a unique link to enable web-based participation. To prevent the inclusion of redundant or duplicate data, a single authorized representative from each hospital was invited to respond to all queries. In the event that the designated individual was unable to address all queries, other personnel from relevant departments (e.g., ED, inpatient wards, ICU, or microbiological laboratory) were consulted and invited to respond. The survey was conducted online using the survey software LamaPoll (platin version; Lamano GmbH and Co KG), which meets the requirements of the European Union General Data Protection Regulation and is certified by the Deutsches Institut für Normung ISO 27001 standard.

Hospitals were grouped in five regions: Northern, Eastern, Southern, and Western Europe and the rest of the world (i.e., not Europe), including Asia, Africa, and Central and South America according to the definition of United Nations M49 standard regions (21). Because of the well-known differences between hospitals in terms of their numbers of beds and different types, hospitals were classified according to the number of beds available, differentiating between 0–250 beds, 251–500 beds, 501–750 beds, 751–1,000 beds, and more than 1,000 beds. Additionally, hospitals were grouped according to their type, based on the classification provided by the participants. This resulted in three main categories: university or training hospitals, general or community hospitals, and independent or private hospitals. These findings are presented in Table E6 and Figure E7. General measures and infrastructure were analyzed for the entire hospital. Given the distinct organizational structures observed in the EDs, wards, and ICUs, a separate analysis was performed for each of these units.

With regard to sepsis screening and standardized sepsis management, we explored the implementation (i.e., yes/no) and specified the individual criteria used for recognition and measures for treatment. As recommended in the Surviving Sepsis campaign guidelines, QIIs and programs were analyzed in terms of implementation, scope, and funding. In the area of essential infrastructure, we investigated whether: *1*) microbiological laboratories were able to incubate and analyze blood cultures and report the results, *2*) imaging (computed tomography or magnetic resonance imaging) was used to identify the source of infection, and *3*) surgery for source control was available on a 24/7 (i.e., service unlimited in time) basis. Data were analyzed using SPSS software (version 26.0; IBM). Only questionnaires with definitive or assignable answers (e.g., no/yes, specific criteria or measures) were included in the analysis. The results are presented as numbers and proportions with 95% CIs. The χ^2 test was used to calculate *P* values with a significance level (α) lower than 0.05. Because of the multiple comparisons, a Bonferroni correction was performed. Uncorrected and corrected *P* values are presented in the tables.

To date, there is a paucity of data regarding the optimal rates or levels of standardized screening and sepsis management in hospitals. Therefore, a comparative analysis was conducted between hospitals with hospital-wide QIIs across the ED, all wards, and ICUs and those within each of the regions. The performance gap between the two groups was calculated as the absolute difference.

Results

Participants from 1,294 hospitals registered for the survey. After excluding incomplete responses and duplicates ($n = 271$; 20.9%), 1,023 responses (response rate, 79.1%) from individual hospitals from 69 countries were included in this convenience sample. Hospitals included in the analyses were mainly from Western Europe ($n = 335$; 32.7%), Eastern Europe ($n = 215$; 21.0%), Southern Europe ($n = 185$; 18.1%), and Northern Europe ($n = 100$; 9.8%). A smaller group of hospitals outside Europe was also included (Figure 1 and Table E5). In total, general hospitals constituted 56.5% of the sample ($n = 578$), university hospitals 35.7% ($n = 365$), and private hospitals 7.8% ($n = 80$). The responses related to the wards were primarily from medical and surgical wards, and the statements relevant to ICUs stemmed primarily from interdisciplinary ICUs (Tables E8 and E9).

Use of Sepsis Definitions

Most hospitals (45.4%; 95% CI, 42.3%–48.5%) reported using the Sepsis-3 definition (Table 1). The Sepsis-3 criteria were used more often in Northern Europe (48.0%; 95% CI, 37.9%–58.2%) and Southern Europe (53.5%, 95% CI, 46.0%–60.9%) than in Eastern Europe (39.5%; 95% CI, 33.0%–46.4%) and Western Europe (43.0%; 95% CI, 37.6%–48.5%). Sepsis-1 was used in 24.5% (95% CI, 21.9%–27.3%) of hospitals and more commonly in Eastern Europe (37.7%; 95% CI, 31.2%–44.5%). Sepsis-1 and Sepsis-3 criteria were used together in 23.2% (95% CI, 20.6%–25.9%) of hospitals. A smaller proportion of hospitals (6.9%; 95% CI, 5.5%–8.7%) used other criteria or had no definition for sepsis. Sepsis-3 was more frequently used in university hospitals (51.0%; 95% CI, 45.7%–56.2%) than in general hospitals (42.0%; 95% CI, 38.0%–46.2%) and more often in hospitals with more than 750 beds (Table 1).

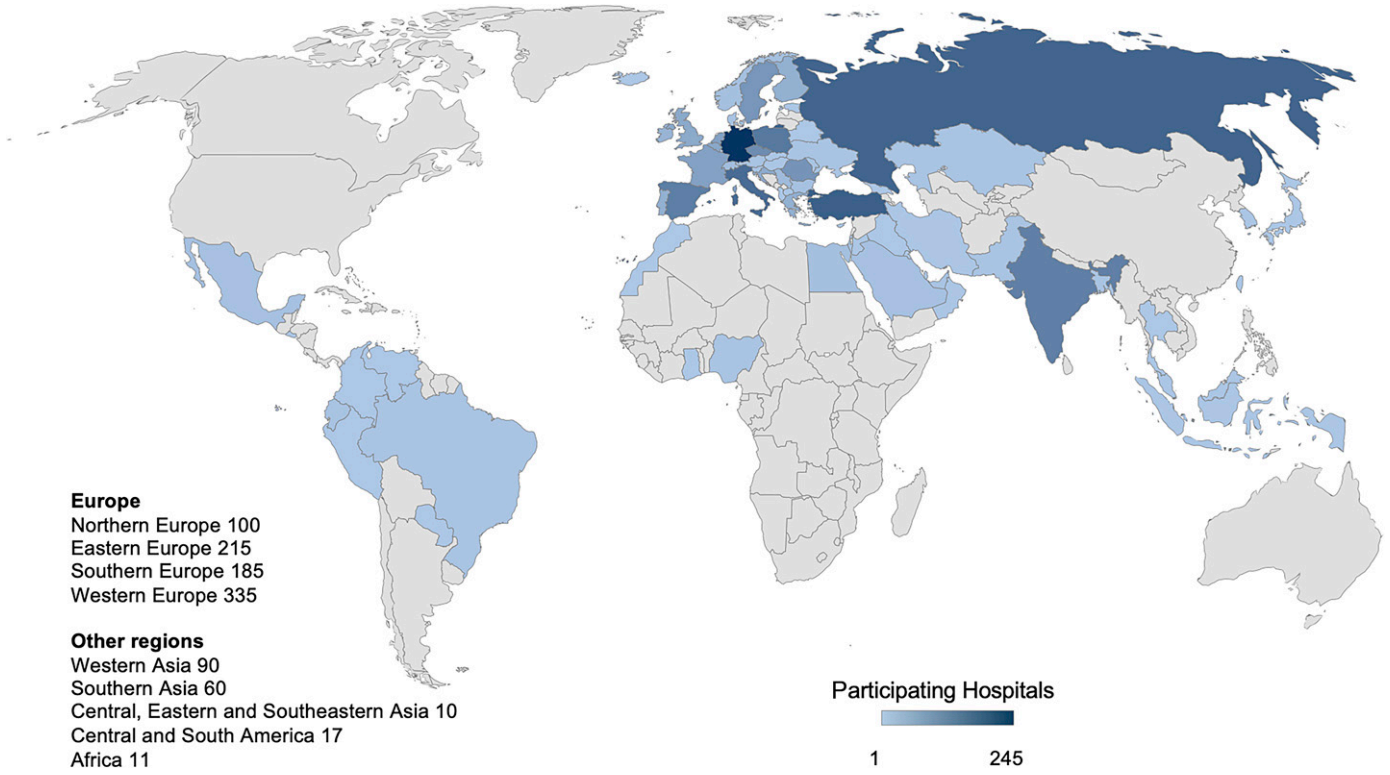


Figure 1. Participating countries and numbers of hospitals in the different regions sampled (*see* Table E5 for detailed information).

Table 1. Use of Sepsis Definitions in Different Regions and Hospital Sizes and Types

	No. of Hospitals	Sepsis-1 Used	Sepsis-3 Used	Sepsis-1 and Sepsis-3 Used	Any Other Definition or No Definition Used
All hospitals	1,023	24.5% (21.9%–27.3%)	45.4% (42.3%–48.5%)	23.2% (20.6%–25.9%)	6.9% (5.5%–8.7%)
Region					
Northern Europe	100	18.0% (11.0%–26.9%)	48.0% (37.9%–58.2%)	10.0% (4.9%–17.6%)	24.0% (16.0%–33.6%)
Eastern Europe	215	37.7% (31.2%–44.5%)	39.5% (33.0%–46.4%)	17.2% (12.4%–22.9%)	5.6% (2.9%–9.5%)
Southern Europe	185	22.7% (16.9%–29.4%)	53.5% (46.0%–60.9%)	20.0% (14.5%–26.5%)	3.8% (1.5%–7.6%)
Western Europe	335	18.2% (14.2%–22.8%)	43.0% (37.6%–48.5%)	33.4% (28.4%–38.8%)	5.4% (3.2%–8.4%)
Other regions	188	26.1% (19.9%–33.0%)	46.8% (39.5%–54.2%)	21.8% (16.1%–28.4%)	5.3% (2.6%–9.6%)
Hospital size					
0–250 beds	295	29.8% (24.7%–35.4%)	40.7% (35.0%–46.5%)	24.4% (19.6%–29.7%)	5.1% (2.9%–8.2%)
251–500 beds	298	25.8% (21.0%–31.2%)	43.0% (37.3%–48.8%)	22.8% (18.2%–28.0%)	8.4% (5.5%–12.1%)
501–750 beds	157	22.3% (16.0%–29.6%)	47.1% (39.1%–55.2%)	22.3% (16.0%–29.6%)	8.3% (4.5%–13.7%)
751–1,000 beds	133	17.3% (11.3%–24.8%)	54.1% (45.3%–62.8%)	21.8% (15.1%–29.8%)	6.8% (3.1%–12.5%)
>1,000 beds	140	20.0% (13.7%–27.6%)	50.0% (41.4%–58.6%)	23.6% (16.8%–31.5%)	6.4% (3.0%–11.9%)
Hospital type					
General hospitals	578	27.7% (24.1%–31.5%)	42.0% (38.0%–46.2%)	23.0% (19.6%–26.7%)	7.3% (5.3%–9.7%)
University hospitals	365	19.5% (15.5%–23.9%)	51.0% (45.7%–56.2%)	22.7% (18.5%–27.4%)	6.8% (4.5%–9.9%)
Independent hospitals	80	25.0% (16.0%–35.9%)	43.8% (32.7%–55.3%)	26.3% (17.0%–37.3%)	5.0% (1.4%–12.3%)

Data in parentheses are 95% CIs. "Sepsis-1" refers to the systemic inflammatory response syndrome criteria due to infection. "Sepsis-3" refers to new organ failure as evidenced by an increase in Sequential Organ Failure Assessment score by ⩾2 due to infection.

Adherence to the Surviving Sepsis Campaign Guideline Recommendations

Sepsis Screening. Standardized sepsis screening (*see* online supplement for definitions) as a measure for early sepsis identification was used in 54.2% (95% CI, 50.6%–57.7%) of EDs, 47.9% (95% CI, 44.5%–51.3%) of wards, and 61.7% (95% CI, 58.4%–65.0%) of ICUs. There were significant differences in sepsis screening between regions ($P < 0.001$). Screening occurred more frequently in EDs and wards in Northern Europe than in the rest of Europe (Figure 2). There were no statistically significant differences between hospitals of different sizes or between general, university, and private hospitals (Tables E10–E12). Screening was done daily in 51.0% (95% CI, 46.0%–55.9%) of wards and 75.8% (95% CI, 71.9%–79.4%) of ICUs and less frequently or only on demand in the remaining wards and ICUs (Table E13). In EDs and wards with standardized sepsis screening practices, the most common screening criteria were respiratory rate (EDs, 89.8%; wards, 85.0%), blood pressure (EDs, 88.6%; wards, 83.0%), temperature (EDs, 87.2%; wards, 87.2%), heart rate (EDs, 84.6%; wards, 83.5%), and mental alterations (EDs, 86.5%; wards, 81.0%). Lactate measurement was used for screening in 77.9% of EDs and 61.8% of wards. In ICUs, blood pressure (92.3%) temperature (91.9%), lactate (89.8%), respiratory rate (89.4%), and mental alterations (89.3%) were the most common criteria for sepsis, followed by heart rate (88.7%) and organ dysfunction (88.5%). *See* Table E13 for details about the criteria for sepsis screening including biomarkers and scores.

The complete set of four Systemic Inflammatory Response Syndrome criteria was used in 56.3% of EDs and 63.1% of ICUs in hospitals that applied the Sepsis-1 definition. A greater number of hospitals used a reduced set of Systemic Inflammatory Response Syndrome criteria. Hospitals that

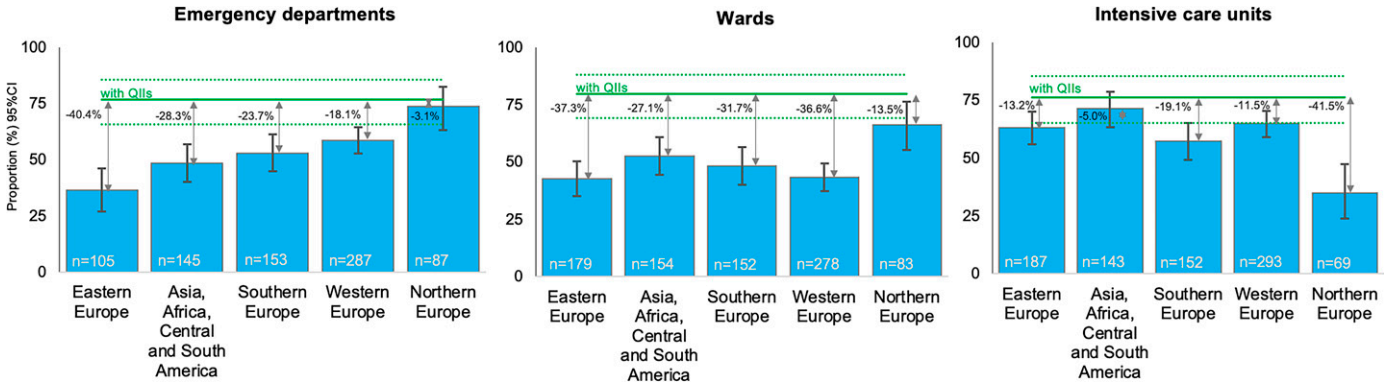


Figure 2. Screening for sepsis in different regions: proportions of screening in emergency departments, on wards, and in ICUs. The blue bars show the proportions of screening in the different regions. The green line represents the level of screening in emergency departments, wards, and ICUs in all hospitals that have a quality improvement initiative (QII) on a regular basis. The 95% CIs of hospitals with QIIs are displayed as green dotted lines. The absolute differences between hospitals with QIIs and hospitals in each region are displayed in gray (*see* Figure 5).

used the Sepsis-3 definition were more likely to use the quick Sequential Organ Failure Assessment and Sequential Organ Failure Assessment scores, particularly within the ICUs (82.5% vs. 51.4% in hospitals that used the Sepsis-1 definition) (*see* Table E13). Early warning scores such as the New Early Warning Score or Modified Early Warning Score were used in 31.1% of EDs, 38.2% of wards, and 19.6% of ICUs. A total of 79.6% (95% CI, 70.3%–87.1%) of respondents from hospitals in Northern Europe stated that medical emergency teams (METs) who help to identify critically ill patients early were implemented in their hospitals. In all other regions, the availability of METs was significantly lower (Table E14). In hospitals with 0–250 beds, METs were available in 43.3% (95% CI, 37.5%–49.2%), compared with 58.8% (95% CI, 49.8%–67.3%) in hospitals with more than 1,000 beds. University hospitals (58.6%; 95% CI, 53.3%–63.8%) had METs more often than general hospitals (47.5%; 95% CI, 43.3%–51.6%) (*see* Table E14).

Standardized Sepsis Management. Protocols for standardized sepsis management (*see* online supplement for definitions) were reported to be available in 57.3% (95% CI, 53.7%–60.8%) of EDs, 45.2% (95% CI, 41.7%–48.6%) of wards, and 70.7% (95% CI, 67.5%–73.8%) of ICUs. There were significant differences in standardized sepsis management in EDs in different regions (Figure 3) but not between hospitals of different sizes (Tables E15–E17). The actions in hospitals with standardized sepsis management are displayed in Table 2.

QIIs and Sepsis Programs. A total of 31.4% of respondents (95% CI, 28.3%–34.7%) had programs available to increase the quality of sepsis care. QIIs across the whole hospital (ED, wards, and ICUs) existed on a regular basis in only 9.8% (95% CI, 7.9%–12.0%) of hospitals, with significant differences between the regions ($P < 0.001$) (Figure 4 and Table E18). Hospitals with QIIs had greater implementation of sepsis screening and standardized sepsis management in EDs, wards, and ICUs. Implementation of antibiotic stewardship and antimicrobial guidelines for patients with sepsis were also more common (Figure 5). According to the respondents, only 4.6% (95% CI, 3.3%–6.1%) of hospitals invested extra money in sepsis programs (Figure 4 and Table E25). Physicians and nurses from ICUs were more often part of the programs than staff from the ED or wards (Figure E21). Sepsis prevalence and mortality were monitored in 54.3% (95% CI, 51.0%–57.5%) and 45.0% (95% CI, 41.7%–48.2%) of all participating hospitals. Sepsis bundle compliance was measured in 18.1% (95% CI, 15.7%–20.7%) of hospitals, time to antibiotic therapy in 21.1% (95% CI, 18.5%–23.9%), severity of sepsis cases in 25.0% (95% CI, 22.3%–28.0%) and frequency of blood culture ordering in 47.5% (95% CI, 44.2%–50.7%).

Infrastructure for Identification of the Source of Infection and Source Control

Imaging for Identification of the Source and Microbiological Diagnostic Service. Computed tomography or magnetic resonance imaging was available to identify the source of infection around the clock in 89.9% (95% CI, 87.8%–91.8%) of hospitals. The availability of an imaging service with computed tomography or magnetic resonance imaging with no time limitations was significantly higher in larger hospitals (Table E22). The microbiological diagnostic service was limited in time in 89.6% (95% CI, 87.6%–91.4%) of the hospitals. The limitations concerned a lack of the possibility to incubate blood cultures, identify pathogens, and communicate results outside the main working hours or during weekends and holidays. Services that were unlimited in time, including blood culture incubation, pathogen identification, and communication of results, were reported by only 106 of 1,023 (10.4%) hospitals.

Surgical and Interventional Source Control. Surgical service for source control that was unlimited in time was available in 87.0% (95% CI, 84.8%–89.0%) of the hospitals. The availability was highest in hospitals in Western Europe (95.5%; 95% CI, 92.7%–97.5%) and lowest in hospitals in Asia, Central and South America, and Africa (71.1%; 95% CI, 64.1%–77.5%). In hospitals with 0–250 beds, the availability was lower (79.9%; 95% CI, 74.9%–84.4%) than in hospitals with more than 250 beds (range, 88.9%–91.1%). There were no differences between general, university, and private hospitals (Table E23). The proportion of hospitals with services for interventional source control (e.g., by radiologists) that was unlimited in time was 31.7% (95% CI, 28.9%–34.7%). A small proportion of hospitals (5.3%; 95% CI, 4.0%–6.8%) had no

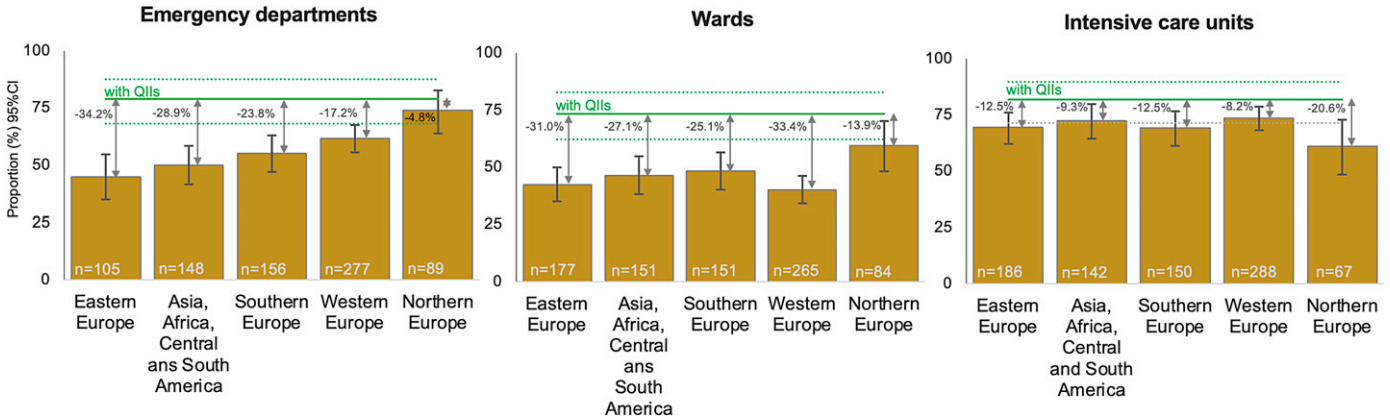


Figure 3. Standardized sepsis management in different regions: proportions of standardized sepsis management in emergency departments, on wards, and in ICUs. The brown bars show the proportions of standardized sepsis management in the different regions. The green line represents the level of standardized sepsis management in emergency departments, wards, and ICUs in all hospitals that have a quality improvement initiative (QII) on a regular basis. The 95% CIs of hospitals with QII are displayed as green dotted lines. The absolute differences between hospitals with QIIs and hospitals in each region are displayed in gray (*see* Figure 5).

Table 2. Actions in Hospitals with Standardized Sepsis Management

Action	Emergency Departments ($n = 444$)	Wards ($n = 374$)	ICUs ($n = 589$)
Surviving Sepsis campaign bundle			
Measuring lactate level	93.2% (90.5%–95.4%)	81.6% (77.2%–85.4%)	96.4% (94.6%–97.8%)
Obtaining blood cultures before administration of antibiotics	97.3% (95.3%–98.6%)	97.1% (94.8%–98.5%)	98.0% (96.5%–98.9%)
Administering broad-spectrum antibiotics	91.0% (87.9%–93.5%)	93.6% (90.6%–95.8%)	96.8% (95.0%–98.0%)
Beginning rapid administration of crystalloid*	91.2% (88.2%–93.7%)	88.8% (85.1%–91.8%)	94.2% (92.0%–96.0%)
Applying vasopressors to maintain MAP ⩾65 mm Hg†	81.8% (77.8%–85.2%)	65.8% (60.7%–70.6%)	96.9% (95.2%–98.2%)
Organ dysfunction			
Blood testing‡	93.7% (91.0%–95.8%)	91.4% (88.1%–94.1%)	96.9% (95.2%–98.2%)
Catheterization/urine output measurement	72.3% (67.9%–76.4%)	74.3% (69.6%–78.7%)	90.3% (87.6%–92.6%)
SOFA score	55.4% (50.6%–60.1%)	43.3% (38.2%–48.5%)	77.8% (74.2%–81.1%)
Identification of source			
Computed tomography	38.1% (33.5%–42.8%)	39.0% (34.1%–44.2%)	50.1% (46.0%–54.2%)
Ultrasound	51.4% (46.6%–56.1%)	43.0% (38.0%–48.2%)	57.9% (53.8%–61.9%)
Chest X-ray	65.1% (60.5%–69.5%)	59.4% (54.2%–64.4%)	71.1% (67.3%–74.8%)
Additional microbiological sampling§	85.4% (81.7%–88.5%)	85.8% (81.9%–89.2%)	90.7% (88.0%–92.9%)
Source control			
Initiation of rapid source control (surgical or interventional)	57.4% (52.7%–62.1%)	62.8% (57.7%–67.7%)	70.6% (66.8%–74.3%)
Source control within 1–6 h	33.8% (29.4%–38.4%)	29.9% (25.3%–34.9%)	40.2% (36.3%–44.3%)
Source control within 12 h	12.2% (9.3%–15.6%)	15.5% (12.0%–19.6%)	15.6% (12.8%–18.8%)
Source control within 24 h	2.5% (1.2%–4.4%)	4.8% (2.9%–7.5%)	3.9% (2.5%–5.8%)
No time frame	1.6% (0.6%–3.2%)	2.7% (1.3%–4.9%)	2.0% (1.1%–3.5%)
Not specified	7.4% (5.2%–10.3%)	9.9% (7.1%–13.4%)	8.8% (6.7%–11.4%)
Monitoring			
Central venous catheter	33.1% (28.7%–37.7%)	36.9% (32.0%–42.0%)	78.4% (74.9%–81.7%)
$ScvO_2$	24.8% (20.8%–29.1%)	27.5% (23.1%–32.4%)	53.1% (49.0%–57.2%)
Arterial catheter	30.2% (25.9%–34.7%)	28.3% (23.8%–33.2%)	74.9% (71.2%–78.3%)
Passive leg raising or fluid challenge	48.2% (43.5%–53.0%)	47.1% (41.9%–52.3%)	65.5% (61.5%–69.4%)
Hemodynamic measurement‖	28.2% (24.0%–32.6%)	33.2% (28.4%–38.2%)	55.5% (51.4%–59.6%)
Antibiotic stewardship			
Regular consultations with infectious diseases specialists	29.7% (25.5%–34.2%)	40.1% (35.1%–45.3%)	39.6% (35.6%–43.6%)
Procalcitonin guided antiinfective therapy	47.7% (43.0%–52.5%)	52.7% (47.5%–57.8%)	72.7% (68.9%–76.2%)
MRSA testing	19.4% (15.8%–23.4%)	26.5% (22.1%–31.3%)	36.7% (32.8%–40.7%)

Definition of abbreviations: MAP = mean arterial pressure; MRSA = methicillin-resistant *Staphylococcus aureus*; $ScvO_2$ = central venous O_2 saturation; SOFA = Sequential Organ Failure Assessment.
Data in parentheses are 95% CIs.
*Begin rapid administration of 30 ml/kg of crystalloid for hypotension or lactate level ⩾4 mmol/L.
†Apply vasopressors if patient is hypotensive during or after fluid resuscitation to maintain MAP ⩾65 mm Hg.
‡By clinical chemistry: white blood cells, coagulation, renal and liver function.
§Examples: urine, swabs, cerebrospinal fluid.
‖Cardiac output, stroke volume, pulse pressure measurement.

services for source control available, leading to patient transfers.

Specific Measures for Hemodynamic Resuscitation and Antiinfective Treatment

Fluids, Hemodynamic Evaluation, and Management. Participants from hospitals with and without standardized sepsis management reported that balanced crystalloids were used more commonly than 0.9% NaCl in their ICUs for patients with sepsis (89.0% [95% CI, 86.7%–90.9%] vs. 39.7% [95% CI, 36.5%–43.0%]). Albumin was used by 40.8% (95% CI, 37.6%–44.1%) of respondents. Gelatin (8.0%; 95% CI, 6.3%–10.0%), hydroxyethyl starch (2.8%; 95% CI, 1.8%–4.1%), and dextran (1.7%; 95% CI, 0.9%–2.7%) were still used in some hospitals. There were significant differences in the use of fluids between regions (Figure E24). Norepinephrine (93.1%; 95% CI, 91.2%–94.6%) was by far the most common first-line vasoactive agent in ICUs (*see* Table E25).

Blood pressure and heart rate response (92.5%; 95% CI, 90.6%–94.2%) and urine output (92.2%; 95% CI, 90.2%–93.9%) were the most common parameters guiding fluid resuscitation in ICUs. Lactate clearance was used by 79.3% (95% CI, 76.5%–81.9%) of respondents as a measure to guide fluid resuscitation. Passive leg raising or fluid challenges were used for guidance more frequently than hemodynamic measurements like cardiac output, stroke volume, or pulse pressure variation (Table E26). Point-of-care lactate testing was available in 83.0% (95% CI, 80.2%–85.4%) of EDs, 44.8% (95% CI, 41.5%–48.1%) of wards, and 91.5% (95% CI, 89.5%–93.3%) of ICUs. It was more commonly available in EDs and ICUs in Northern and Western Europe than in other regions, but there were no significant differences between hospitals

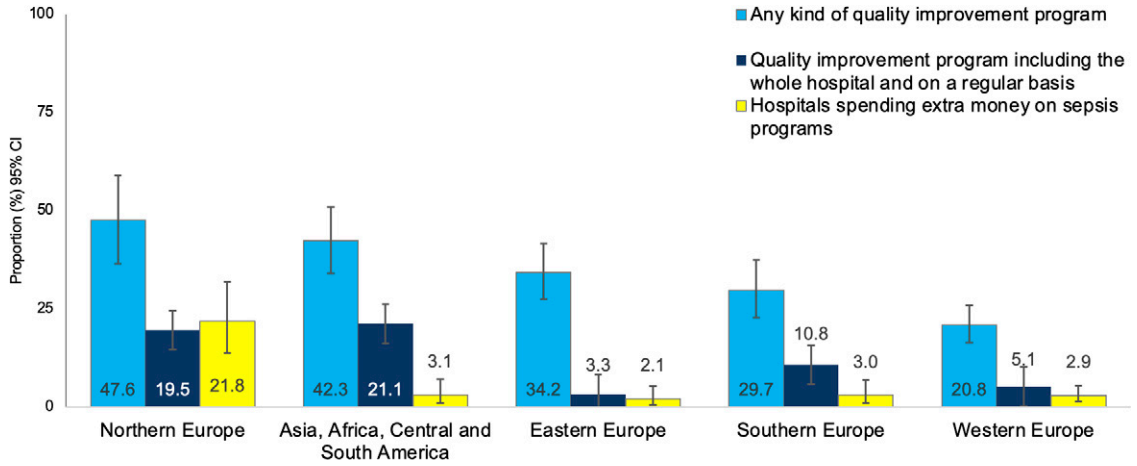


Figure 4. Quality improvement initiatives for sepsis in hospitals ($n = 859$).

of different sizes or general and university hospitals (Table E27).

Antimicrobial Guidelines and Antibiotic Stewardship. The use of standard operating procedures or hospital guidelines for antimicrobial therapy for patients with sepsis was reported by 74.0% (95% CI, 71.1%–76.7%) of hospital representatives. The rate was higher in Northern Europe (92.8%; 95% CI, 85.7%–97.0%) and Western Europe (89.2%; 95% CI, 85.4%–92.3%) and lower in other regions: Southern Europe (63.9%; 95% CI, 56.4%–70.9%); Asia, Central and South America, and Africa (62.2%; 95% CI, 54.7%–69.3%); and Eastern Europe (59.6%; 95% CI, 52.6%–66.3%). There were no significant differences between hospitals of different sizes or types (Table E28). Antibiotic stewardship teams were most often implemented in Western Europe (80.4%; 95% CI, 75.7%–84.5%) and Northern Europe (77.4%; 95% CI, 67.6%–85.4%). In the wards, patients with sepsis were usually treated by the ward clinical teams (89.6%; 95% CI, 87.5%–91.4%), but 24.5% (95% CI, 21.8%–27.3%) of respondents stated that the treatment was regularly supported by infectious diseases specialists, and 18.1% (95% CI, 15.8%–20.7%) of participants indicated regular support by antibiotic stewardship teams (Table E29). Respondents stated that advice on antimicrobial treatment was available to ward clinicians in 83.3% (95% CI, 80.7%–85.7%) of hospitals and 84.3% (95% CI, 81.7%–86.7%) of ICUs (Table E30). To guide antiinfective management, procalcitonin was used widely in ICUs (72.7%; 95% CI, 68.9%–76.2%) and less frequently in wards (52.7%; 95% CI, 47.5%–57.8%) (Table 2).

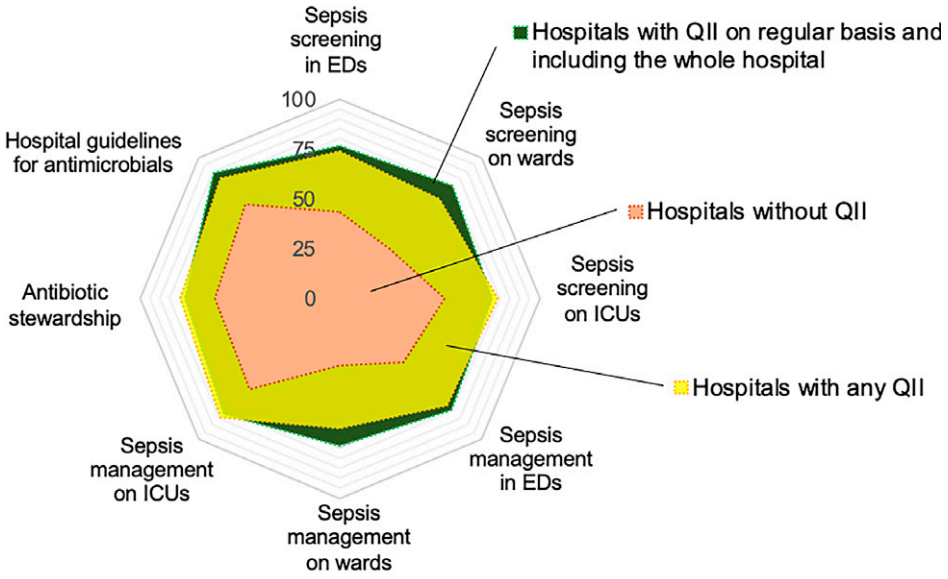
Discussion

The results of this survey provide insight into sepsis care in 1,023 hospitals in 69 countries. Hospitals in the European Union included in the survey had a total of 388,000 acute-care beds, which corresponds to 23% of all acute-care beds in the European Union. Outside of Europe, only a limited number of hospitals were included in the study. Results suggest that, at a European level, we are a distance away from what the "golden goal" for a deadly disease should be.

Screening for sepsis has been recommended in international guidelines for more than 10 years (22, 23). In fact, the current international sepsis guidelines highlight screening for sepsis and the use of standard operating procedures for the management of sepsis as recommendation number one (2). Nevertheless, respondents stated that sepsis screening was implemented in only 62% of ICUs overall and even less often in EDs (54%) and wards (48%). In addition, screening was often not undertaken daily or available only on demand, resulting in potentially missed cases of sepsis. In contrast, hospitals with QIIs reached sepsis screening levels of >70%. The pattern for standardized sepsis management was similar, with substantially higher rates of standardized management in hospitals with QIIs. Implementation of antibiotic stewardship and hospital guidelines for antimicrobial therapy were also significantly higher in hospitals with QIIs (Figure 5). However, only 31.4% of hospitals had any QIIs, and few hospitals (9.8%) had implemented a regular QII across the whole hospital. The rate was lowest in Western Europe (5% for regular trainings), and university hospitals were not performing better than general hospitals.

A recent report of data from the National Healthcare Safety Network in the United States revealed that <10% of U.S. hospitals lacked a standardized screening process. Furthermore, >70% of U.S. hospitals had established guidelines or care pathways for the management of sepsis, and sepsis programs were reported in 73% of U.S. hospitals (24, 25).

In light of our findings and the data from the United States, we propose that participation in QIIs and sepsis programs should be regarded as best practice for achieving the World Health Organization recommendations (26), the Surviving Sepsis campaign guidelines (2), or national recommendations such as the National Institute for Health and Care Excellence guidelines (27) in the United Kingdom. Beneficial effects of QIIs were demonstrated in numerous studies (28–35), and there are also studies showing that such initiatives can be cost effective (32, 36–38). The U.S. Hospital Sepsis Program (39, 40) suggested seven core elements, including actions for identification and management but also for tracking outcomes and reporting. In our study, only 54% of respondents confirmed that sepsis prevalence was monitored and 45% stated that sepsis mortality was recorded. Also, the core element of "hospital



	Hospitals without QII		Hospitals with any kind of QIIs			Hospitals with QIIs on regular basis and hospital-wide		
	baseline				absolute difference			absolute difference
	n	%	n	%	%	n	%	%
Screening in EDs	462	43.3	211	73.9	+30.6	77	76.6	+33.3
Screening on wards	524	35.5	244	70.5	+35.0	79	79.7	+44.3
Screening on ICUs	545	52.5	247	78.9	+26.5	76	76.3	+23.8
Management in EDs	461	45.3	209	76.1	+30.7	76	78.9	+33.6
Management on wards	515	33.4	241	65.1	+31.7	79	73.4	+40.0
Management on ICUs	543	64.1	245	84.1	+20.0	77	81.8	+17.7
Antibiotic stewardship	578	62.3	259	79.5	+17.3	76	77.6	+15.3
Hospital guideline for antimicrobials	577	67.1	269	84.8	+17.7	83	89.2	+22.1

Figure 5. Implementation of screening and standardized management, antibiotic stewardship, and antimicrobial guidelines in hospitals with and without QIIs. The spider chart presents implementation of measures as proportions (percentages). ED = emergency department; QII = quality improvement initiative.

leadership commitment" that demands the provision of necessary financial resources was hardly fulfilled. Respondents in our study indicated that financial support for sepsis programs was very low in their respective hospitals, with only 4.6% of hospitals investing in sepsis programs. The findings in our study are in stark contrast to those from the United States, where executive sponsors were reported by 55% of hospitals and sepsis was identified as a priority and communicated to staff in 72% of hospitals (24, 25).

Radiological imaging and general surgery are included in the standard infrastructure of hospitals, but their availability is also essential to identify the source of infection in a timely fashion and provide early source control (41–44). Furthermore, imaging and surgical and/or interventional source control are guideline recommendations (2, 26, 27, 45). In our study, imaging and surgical services were time-limited, especially in small hospitals (i.e., fewer than 250 beds). In addition, source control was often not an goal within the first 6 hours after the recognition of sepsis, necessitating patient transfer in some cases. These limitations may delay care and increase the risk of mortality (46). Another area of concern was the lack of microbiological diagnostics available on a 24-hour basis. In 90% of hospitals, blood culture diagnostics, which represent a critical component of sepsis treatment, was not accessible outside regular working hours. This can result in delays in the identification of pathogens, which in turn may impede the adaptation and optimization of antiinfective therapy. Negative consequences can include unnecessary or inadequate treatment, unnecessary selection pressure, and development of antimicrobial resistance and antimicrobial harm (47).

Based on these results, increased efforts are needed to improve sepsis care in hospitals,

including: *1*) amplified implementation of tools for the early identification of sepsis and *2*) implementation of local treatment protocols based on international guidelines and local ecology and availability of resources.

Limitations

This survey has some limitations that need to be considered when interpreting the results. Most respondents and responses were from European hospitals, and only a very small number were from Asia, Africa, and Central and South America. Information from hospitals outside these regions was not collected. Therefore, the results reflect the situation in Europe. The study represents a convenience sample because participants contributed on a voluntary basis and may not have been representative. A potential selection bias cannot be excluded. A Hawthorne effect might have also influenced the results, whereby individuals modify an aspect of their behavior in response to being observed. It is independent of whether participants are selected randomly or nonrandomly (48). With every survey, the responses may be more positive or negative than in reality. However, it is likely that many of the hospitals where respondents worked have at least a basic interest in sepsis and quality of care. Given that >90% of respondents were hospital directors, heads of departments, or consultants, it can be assumed that they had a comprehensive understanding of the processes within their respective hospitals. However, it is important to acknowledge the inherent limitations of not conducting audits to validate the responses. In large hospitals, there may be significant discrepancies between different wards and departments. The intention of this study was to be exploratory, and generalization would not be appropriate. The results can only give an impression of the status in the 1,023 sampled hospitals. Finally, we acknowledge that we did not investigate adherence or compliance with existing screening programs.

Conclusions

The present study offers insights into sepsis care in hospitals across diverse geographical regions but mainly in Europe. The findings suggest that there is considerable room for improvement, particularly in a large number of European hospitals. This is especially true with regard to the early identification and standardized management of sepsis, the availability of guidelines, existence of diagnostic and therapeutic infrastructure, and the implementation of QIIs. These results underscore the necessity for more robust and comprehensive strategies to establish and implement comprehensive measures for sepsis identification, diagnostics, and evidence-based treatment, with the aim of establishing uniform quality standards. ■

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