Sepsis Awareness at the University Hospital Level: A Survey-Based Cross-Sectional Study

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Research

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Abstract

Background: Sepsis is a leading cause of morbidity and mortality. Prompt recognition and management are critical to improved outcomes. In 2019, the Lausanne University Hospital (LUH) launched a quality of care project aiming to improve sepsis management. As part of this effort, we aimed to assess sepsis awareness among nurses and physicians of the LUH and among the local paramedics.

Methods: We conducted a survey on nurses and physicians at our institution and local paramedics between January and October 2020 representing over 1,000 professionals distributed over all hospital departments. The survey assessed professionals' knowledge of sepsis epidemiology, definition, recognition and initial evaluation (nurses and paramedics) or sepsis epidemiology, diagnosis, and management (physicians). Pediatrics and the neonatal unit were excluded.

Results: A total of 1,116 of 1,216 contacted persons among the 4417 targeted population participated and completed the survey (participation rate 91.8%). This included 619 of 2,463 (25.1%) of hospital nurses, 348 of 1,664 (20.9 %) of physicians and 149 of 290 (51.4%) of canton paramedics. Our nurse and physician sample was slightly imbalanced for sex and age. Thirteen percent of participants (28.4% of physicians, 5.9% of nurses, 6.8% of paramedics) correctly identified the Sepsis-3 consensus definition. Similarly, 48.6% of physicians and 10.0% of nurses identified the SOFA (sequential organ failure assessment) score as a sepsis defining score for infected patients. Furthermore, 24% of participants identified the Quick Sepsis-related Organ Failure Assessment (qSOFA) score as a predictor of increased mortality; 6% identified correctly the components of the score. For a patient with suspected sepsis, 96.1%, 91.6% and 75.8% of physicians respectively identified blood cultures, broad-spectrum antibiotics and fluid resuscitation as required interventions; 76.4% and 18.2% of physicians requested these initial measures within 1 and 3 hours, respectively. For physicians, recent training correlated with awareness regarding definitions, SOFA score and qSOFA score use and components: ORs (95%CI) 2.2 (1.4-3.6), 4.3 (2.7-6.7), 3.4 (2.2-5.2), and 2.6 (1.5-4.6), respectively).

Conclusions: We identify a deficit of awareness among physicians, nurses and paramedics at LUH correlating with a lack of sepsis-specific training. Enhanced sepsis-specific educational efforts could significantly improve early identification and treatment of affected patients.

Background

Sepsis is a syndrome defined as a dysregulation of the host response to an infection.[1] Its incidence has increased over the past decades and accounted in 2017 for an estimated 48.9 million cases and 11 million deaths globally, more deadly than stroke and myocardial infarction combined.[2] Sepsis is also associated with significant long-term morbidity, including cognitive impairment, recurrent septic episodes and increased mortality amongst survivors.[3,4] In the absence of specific targeted therapy blunting the dysregulated host response to infection, optimal sepsis management relies on rapid recognition, initiation of antimicrobial therapy and intensive supportive care. Since 2002, the Surviving Sepsis Campaign (SSC)

has aimed to reduce sepsis-related mortality and morbidity by increasing sepsis awareness among professionals and providing consensus management guidelines structured into bundles.[5–7]

Sepsis awareness and prompt recognition by healthcare professionals (HCPs) are critical components of the management of septic patients. Sepsis awareness includes basic notion of epidemiology, definition of sepsis, and the familiarity with the implementation of bedside scoring tools.[8] In the last three decades, sepsis definitions have been reviewed twice since the initial round of 1991 with the last iteration being the 2016 Sepsis-3 consensus definitions.[1] These changes in definitions have been accompanied by changes in the clinical score and diagnostic criteria. As an example, Systemic Inflammatory Response Syndrome (SIRS) is now replaced by the sequential [Sepsis-related] organ failure assessment (SOFA) score. Despite being introduced more than four years ago, there is a dearth of article on the degree of actual knowledge about the actual content of the definition among various HCPs. We identified only three studies on sepsis awareness amongst HCPs, limited in size and scope of HCPs which tested Sepsis-3 consensus definitions knowledge.[9–11] Studies of previous sepsis definitions have revealed gaps in sepsis recognition and management amongst medical and paramedical staff.[8,10,12–18] Most studies, however, focus on a single HCP subset, have limited participation (50-200 participants) and are restricted to a single department. Further, few studies have been conducted in wards despite nosocomial sepsis representing 20-30% of all cases.[19–21]

Methods

Study aim, design and setting

In 2019, the Lausanne University Hospital (LUH) launched a quality of care program to improve sepsis management. As a part of the effort, this study aims to quantify Sepsis-3 consensus awareness amongst nurses and physicians of various clinical units at LUH and local paramedics and identify potential deficits that should be addressed in continuing education.

This cross-sectional study was conducted through an anonymous, on-line survey measuring the awareness, knowledge, and attitudes about sepsis among nurses and physicians of the LUH and local paramedics. The LUH is a 1568-bed tertiary care university hospital, serving the city of Lausanne (population circa 300,000 inhabitants) and the tertiary care reference medical centre for the Canton de Vaud (799,145 inhabitants) in Switzerland. Participants were identified through random visits on the work place or at continuing education seminars.

Measures

The research team designed a survey inspired from previously published surveys assessing knowledge and awareness of sepsis.[22,23]

The questions were tailored to the profession (clinical scenario adapted activity sector - medicine, surgery, emergency department or gynecology). The survey was written and completed in French. Each section of the survey (paramedics', nurses' and physicians' section) was submitted to three focus groups consisting of 3 to 6 participants of each profession, commonly involved in care of patients with sepsis. These focus groups assessed the applicability and appropriateness (validity) of the survey. The questionnaire was revised using feedback from the groups. Surveys of nursing staff and paramedics were more focused on screening and initial evaluation whereas physicians were also tested on diagnosis and management. Responses options included Likert-type scales, binary (e.g. "yes/no") or multiple choices. Each question was locked upon answering, which prevented post hoc changes that could be influenced by information provided at a later stage of the survey. The final survey contained questions on participants' demographic characteristics (5/7/6 questions for nurses/paramedics/physicians), sepsis continuous education (3/3/3 questions), self-evaluation of sepsis knowledge and clinical management (2/2/2 questions), definitions, scores and epidemiology (11/12/14 questions), and sepsis management (4/4/5 questions). The survey was developed in REDCap (Research Electronic Data Capture) software so as to automatically export participants' responses to a database.[24,25] Surveys are provided as supplementary material (supp. meth. survey).

Data collection and recruitement

Participants were recruited between January 20 and October 10, 2020. We aimed for a large and representative sample size of 1,000 persons distributed over all departments (Emergency department (ED), intensive care unit (ICU), Medicine, Paramedic, Psychiatry, or Surgery) and professions (paramedics, nurses and physicians) to reach 25% of LUH staff considered HCPs. Pediatrics and neonatology staff (not covered by Sepsis-3 consensus definitions) as well as nurses and physicians not in daily contact with patients (i.e., who were working in research team or in administration) were excluded. Thus, participants were screened amongst the medical (n=1664) and nursing staff (n=2463) in daily contact with patients of LUH and amongst paramedics of the Canton of Vaud (n=290) during the screening period. Participation was voluntary and anonymous. In order to maximize data reliability, participants answered the online survey under investigator supervision so as to avoid biased responses (internet queries, discussions between colleagues). Participants were screened during scheduled patient hand-offs, seminars or group meetings, as permitted by heads of units. Participants completed the online survey using tablets or smartphones (participants' or provided by the investigators).

Statistical analysis

We described participants characteristics and survey responses across professions: 1) paramedic, 2) nurses, and 3) physicians. Continuous variables were summarised as means and standard deviations [SD] and categorical variables as frequencies and proportions. We also evalutated study participants representativeness of the LUH population of nurses and physicians using Student t-test and Pearson chi2 test for comparing mean ages and proportions of female professionals. In order to assess associations between sepsis awareness and proxies of prior medical and sepsis training, we used univariate logistic regression models with age, continuing education (yes vs. no or last training < 3 years), professional

experience (> 5 years vs. ≤ 5 years), knowledge self-evatuation of sepsis knowledge (good-very or good vs. others) and field of practice (ED, ICU, Medicine, Paramedic, Psychiatry, or Surgery) as explanatory variables. For each model, we estimated the odds ratio (OR) of correct vs. incorrect answer as well as is 95% confidence interval (95%CI). All tests for statistical significance were two tailed ($p<0.05$). We performed statistical analyses using the computing environment R version 4.0.2 (R Development Core Team, 2005) and Prism version 9.0.0 (Graphpad Software).

Results

Participants

Of the 4,417 eligible health-care professionals (HCPs) comprising 290 paramedics, 2,463 nurses and 1,664 physicians, 1,216 were screened (see methods) for participation. Among the 1,216 selected HCPs, 1,116 completed the survey while 46 refused to participate and 54 were excluded because of incomplete answer (91.7% of screened HCPs and 25.2% of total HCPs) (Figure 1A). All clinical areas were represented, though representation of profession and specialty varied (Figure 1B). Table 1 shows the characteristics of the participants. Participating nurses's mean age was not different from the institutional nurses mean age ($p = 0.1$), while participating physicians' mean age was lower than the institutional mean ($p = 0.001$). Gender distribution revealed an overrepresentation of male participants for nurses ($p = 0.03$) but was balanced for physicians ($p = 0.1$).

Table 1

	Overall	Paramedics	Nurses	Physicians
n participants	1116	149	619	348
Age (mean [SD]) in years participants/ Institution		41 (9.5) /NA	38.0 (10.2)/ 39.1 (10.3)	35.2 (7.6)/ 36.4 (9.4)
T-test comparison (Sample vs. overall)			*p=0.01*	*p<0.01*
Female gender (%) sample/ Institution		27.5/NA	75.8/79.7	46.8/51.7
Distribution difference (c^2) (Sample vs. overall)			*p=0.03*	*p=0.1*
Medical experience (%)				
< 1 year	79.7	2 (1.3)	43 (6.9)	29 (8.3)
1-3 years	117 (10.5)	16 (10.7)	58 (9.4)	43 (12.4)
3-5 years	126 (11.3)	8 (5.4)	51 (8.2)	67 (19.3)
5-10 years	284 (25.4)	24 (16.1)	137 (22.1)	123 (35.3)
10-15 years	183 (16.4)	27 (18.1)	123 (19.9)	33 (9.5)
> 15 years	332 (29.7)	72 (48.3)	207 (33.4)	53 (15.2)

Participant's demographical characteristics. Abbreviation: N/A: Not applicable.

T-test comparison for sample age distribution and (c^2) for sex difference analysis in order to assess representativity. Data from paramedics companies not available for representativity analyse N/A s.

Participant's training and perceptions

We next assessed sepsis training. In general 69.4% of HCPs reported a prior training on sepsis. Because our study launched in January 2020, we looked at the 2017-2019 as the period for training including the 3rd draft of consensus definitions. The majority of participants (73.7%) reported no sepsis-specific training in the last 3 years and 31.6% reported never having attended a sepsis-specific (Table 2). Conversely, 26.3% of participants reported a training within the last three years respectively. Nurses (82.9%) and paramedics (75.8%) reported more often no training or a training more than 3 years prior compared to physicians (56.6%). Next, participants were asked to evaluate their knowledge and management skills on sepsis using a 5-category (very good/good/average/fair/poor) Likert scale (Figure 2). Overall, 26.3 % of participants graded their knowledge as very good and good (Figure 2A). Similarly, 35.8% graded their management skills as very good and good. An analysis by category of health care professionals revealed similar trends (Figure 2B) although statistically significant differences between

professions were noted with physicians selfevaluating best and paramedics selfevaluating worst, whether regarding knowledge or management. We then asked participants to provide answers regarding their perception of sepsis (medical emergency, morbidity/mortality, evaluation, its link to organ dysfunction/propensity to develop under antimicrobial thearpy). Participants were cognizant of the severity and the necessity for emergent management of sepsis (87.4 and 95.6%, respectively, strongly agree or agree) (Figure 3). They estimated sepsis and septic shock mortality to be 40% and 50%, respectively. They recognized the association between organ dysfunction and infection for sepsis can arise under antimicrobial therapy (Figure 3). A majority of participants (74.9%, 67.7% and 96.1% respectively) identified age, active cancer and immunosuppression as risk factors but only half (52.8%) recognized a prior septic event as such.

Table 2

Timing of last sepsis training	Overall	Paramedics	Nurses	Physicians
< 1 year ago	109 (9.8)	9 (6.0)	30 (4.8)	70 (20.1)
1-2 years ago	97 (8.7)	14 (9.4)	29 (4.7)	54 (15.5)
2-3 years ago	87 (7.8)	13 (8.7)	47 (7.6)	27 (7.8)
> 3 years ago	470 (42.1)	77 (51.7)	241 (38.9)	152 (43.7)
Never	353 (31.6)	272 (43.9)	45 (12.9)	36 (24.2)
Specific sepsis training among study participants				

Definition, detection and diagnosis of sepsis

The fraction of participants defining sepsis according to the Sepsis-3 definitions was 12.9% (28.4%, 5.9% and 6.8% of physicians, nurses and paramedics respectively) (Figure 4A). Near half (43.5%) of participants defined sepsis as infection in combination a systemic inflammatory response syndrome (SIRS) (38.2%, 46.2% and 49.7% of physicians, nurses and paramedics respectively) and a quarter (26.9%) as an infection with hemodynamic instability (17.2%, 33.0% and 24.2% of physicians, nurses and paramedics respectively). A minority of participants defined sepsis as a bacteremia (14.4%) or infection not responding to antimicrobial therapy (2.2%). Awarenes of Sepsis-3 definitions was 40.0% amongst ED physicians, 34.8% amongst ICU physicians, 36.3% among internal medicine ward physicians, 13.3% among surgeons and 5.6% among psychiatrists. When asked to define by choosing items defining septic shock amongst five components (hemodynamic instability requiring vasopressors despite adequate volume resuscitation/SIRS score > 2 points/ bacteremia / blood lactate > 2 mmol/l / SOFA score > 10 points), 17.0% of physicians defined septic shock according to Sepsis-3 (hemodynamic instability requiring vasopressors despite adequate volume resuscitation and serum lactate of more than 2 mmol/l). Finally, nearly 50% of the physicians associated the qSOFA (Figure 4B) and SOFA (Figure 4C) scores with sepsis. Yet, only 42.1% of physicians reported having computed the SOFA score previously and 17.0% correctly identified the components of the qSOFA score.

Management

Participants were next asked what recommended timing for intervention was (choice: within 1h/3h/6h/12/24h), the vast majority of participants (88.5%) chose interventions within one to three hours of sepsis recognition. Figure 5 is a clinical vignette of a patient with suspected sepsis and a qSOFA score of 2 assessing the use of diagnostic tools and management skills show by the participants according to profession. Nearly all paramedics (90.6%) recognized the need for a rapid transfer to ED (Figure 5A). However, 42.3% considered vital signs monitoring as warranted. The vast majority of nurses recognized the need for immediate medical assessment (93.1%), monitoring of vital signs (82.3%), most requested blood cultures (70.1%) and half requested drawing blood for laboratory analysis (51.2%) (Figure 5B). Physicians identified vital signs monitoring (92.0%), blood culture draw (96.0%), lactate measurement (89.1%) and imaging (77.9%) as critical diagnostic steps (Figure 5C, diagnostic tests). Once sepsis was confirmed (presence of infection plus a SOFA score of 3), the majority of physicians chose the assessment for intravenous access (87.1%), administration of broad-spectrum antibiotics (91.7%) and fluid resuscitation (76.1%) as immediate therapeutic interventions (Figure 5C therapeutic interventions).

Factors associated with sepsis awareness

We then analyzed the factors associated with sepsis awareness. For nurses, sepsis training within the last 3 years was associated with SOFA and qSOFA score proficiencies (OR (95%CI) 5.3 (3.0-9.2), OR (95%CI) 5.6 (3.3-9.4)) and use of Sepsis-3 definition (OR (95%CI) 5.6 (3.3-9.4)). Likewise, for physicians sepsis training within the last 3 years was significantly associated with use of Sepsis-3 definition (OR (95%CI) 2.2 (1.4-3.6)), SOFA score (OR (95%CI) 4.3 (2.7-6.7)), qSOFA use (OR (95%CI) 3.4 (2.2-5.2)) and qSOFA computation skills (OR (95%CI) 2.6 (1.5-4.6)). Physicians' self-evaluation correlated with proficiency in SOFA score purpose (OR (95%CI) 2.4 (1.6-3.8)), qSOFA score purpose (OR (95%CI) 1.9 (1.2-2.9)) and qSOFA score computation ability (OR (95%CI) 4.1 (2.3-7.4)). Conversely, physicians with a clinical experience of more than 5 years was associated negative impact on SOFA and qSOFA score proficiencies (ORs (95%CI) 0.4 (0.3-0.63), and 0.4 (0.2-0.6)).

Discussion

Our study is a foundational analysis of the sepsis quality of care improvement project at LUH for the strategic development plan of the 2019-2023 period. We identified significant deficiencies in sepsis awareness amongst nurses and physicians of our university tertiary care center and local paramedics. A minority of healthcare professionals in our institution are aware Sepsis-3 consensus definitions for sepsis. Similarly, a minority of staff are aware SOFA and qSOFA scores. Correspondingly, a minority of paramedics, nurses, and physicians self-evaluated as good or very good for sepsis knowledge and management. Importantly, these findings are associated with a lack of continuing education.

Despite the fact that Sepsis-3 consensus was released more than four years ago,[1] despite its incorporation in the core of the Lausanne medical school curriculum or in institutional tools such as the

LUH's guide for empirical antimicrobial therapy, our results show a lack of penetrance of the latest sepsis definition.[26,27] The lack of specific continuing education accounts primarily for this. Only 18.5% of participants reported having attended sepsis-specific training in the previous three years. Thus, the vast majority of participants have not been exposed to training on the new sepsis definitions and are not familiar with the qSOFA score. This was striking for both paramedics and nurses that are at the front line of sepsis recognition. Nurses spend comparatively more time than physicians at the patient bedside[28] and early recognition of nosocomial sepsis by nurses increases 30-days survival.[29]

Similarly, only one-third of physicians are aware of the current sepsis definition. One-fifth of physicians using the definition of hemodynamic instability in addition to infection, may lead to delays in the recognition of septic patients. Furthermore, the low rate of calculation of a SOFA score by physicians implies that documentation of sepsis in discharge summaries and electronic medical records is also compromised. We are accumulating evidence in the context of our quality of care project (data not shown). As a consequence, sepsis epidemiology at the institutional level may be severely affected.

These observations support further - and regular - training incorporating Sepsis-3 consensus definitions in our institution as studies support continuous training to improve sepsis awareness amongst participants.[30,31] Because a minority of participants, whether nurses, paramedics or physicians rated their knowledge and management skills as good or very good, there is a major opportunity for continuing education.

To the best of our knowledge, the present study is the first assessing sepsis-3 knowledge surveying large sample size, multiple professions across all adult departments of a tertiary care center, thus representing all persons implicated in adult sepsis care. Multiple studies have assessed sepsis awareness,[8,10,12–18] however, only three probed Sepsis-3, all of which were limited in scope: Nucera and coworkers assessed Sepsis-3 awareness among nurses and physicians and found similar deficiencies, however the study was limited to 181 persons and excluded oncology wards. Consistent with our study, they identified major deficiencies in awareness particularly pertaining to scores and definitions. However, the large sampling in our study enables a better resolution of deficiencies. As an example, the capacity to define sepsis according to sepsis significantly better in ICU, ED and internal medicine compared to surgery and psychiatry. Mulders and co-workers assessed a very different setting, interviewing general practitioners, but found similar observations with very low penetrance of SOFA score-based sepsis definitions and qSOFA score-based assessment. Finally, a survey limited to ICU physicians in China revealed a limited familiarity with only 16% of 366 physicians using Sepsis-3 consensus definitions.[11] Studies relating to Sepsis-2 definitions had already identified significant deficiencies: Seymour and co-workers found paramedical staff struggling to define sepsis.[8] Abdul Rahman and colleagues identified deficiencies among nurses and physicians in the ED.[12] However, sepsis-specific training is associated with significant improvement in such deficiencies.[18]

This study's strengths include the number of participants, the participation rate, the combined assessment of nurses, physicians and paramedics and the breadth departments of adult medicine assessed. Furthermore, methodology with direct supervision of participants taking the survey ensures high-quality data collection. It also has limitations: The survey was built on knowledge, attitude and practice of health care professionals towards sepsis based on literature review and focus groups of experts clinicians.[32] It was tested in iterative pilots and revisions among intended respondents. However, we did not perform subsequent reliability (internal consistency, test-retest reliability, or inter-rater reliability) or construct validity assessment through a Crohnbach's alpha test due to the various formats of questions. Second, it is limited to a single center and results may not be generalizable, although they are consistent with previous studies. Third, we have a slight imbalance towards younger age for participants and male sex for nurses. The exclusion of staff not having daily contact with patients likely accounts in part for the age bias. The propensity of male nurses to take the test is more difficult to explain; it might reflect a more prevalent part-time activity amongst females compared to males (average full time equivalent 0.73 vs. 0.82). Fourth, we had significant discrepancies in the various hospital departments. This was strongly influenced by differences in availability (seminars, availability on the ward).

Conclusion

Our study reveals significant deficiencies in sepsis awareness at an institutional level, in all professions and departments four years after the introduction of Sepsis-3 consensus definitions. Their penetrance is limited and bedside tools are not mastered. It is associated with a lack of specific training, setting the roadmap for sepsis-education, targeting all professions tailored to their activity. The improved recognition and monitoring among nurses and paramedics and definition implementation among physicians with sustained continuing education is a critical step to our quality of sepsis care improvement program.

Abbreviations

CI
Confidence interval
ED
Emergency department
HCP
Healthcare professionals
ICU
Intensive care unit
LUH
Lausanne University Hospital
NEWS
National early warning score

OR
Odds ratio
qSOFA
quick sepsis-related organ failure assessment
SIRS
Systemic Inflammatory Response Syndrome
SOFA
Sepsis-related organ failure assessment
SSC
Surviving Sepsis Campaign

Declarations

Ethics approval

The local institutional review board (CER-VD, Lausanne, Switzerland) waived written consent for this research project.

Consent for publication

All participants, upon taking the survey, were asked to consent for publication (e-consent within the survey).

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests:

The authors declare that they have no competing interests.

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Contributions:

SM, JR, MALP, and TC conceived the study. JR, TC and SM drafted the first version of the manuscript. MALP and TN contributed to drafting sections of the manuscript. SM and JR took part in data collection. JR, SM, TN and MALP performed data analyses. RA, JBW, IL participated in the study design.

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References

1. Singer, M. *et al.* The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *Jama* **315**, 801–810 (2016).
2. Rudd, K. E. *et al.* Global, regional, and national sepsis incidence and mortality, 1990–2017: analysis for the Global Burden of Disease Study. *Lancet* **395**, 200–211 (2020).
3. Iwashyna, T. J., Cooke, C. R., Wunsch, H. & Kahn, J. M. Population Burden of Long-Term Survivorship After Severe Sepsis in Older Americans. *J Am Geriatr Soc* **60**, 1070–1077 (2012).
4. Prescott, H. C., Osterholzer, J. J., Langa, K. M., Angus, D. C. & Iwashyna, T. J. Late mortality after sepsis: propensity matched cohort study. *Bmj* **353**, i2375 (2016).
5. Townsend, S. R., Schorr, C., Levy, M. M. & Dellinger, R. P. Reducing Mortality in Severe Sepsis: The Surviving Sepsis Campaign. *Clin Chest Med* **29**, 721–733 (2008).
6. Dellinger, R. P. *et al.* Surviving Sepsis Campaign. *Crit Care Med* **41**, 580–637 (2013).
7. Slade, E., Tamber, P. S. & Vincent, J.-L. The Surviving Sepsis Campaign: raising awareness to reduce mortality. *Crit Care* **7**, 1 (2003).
8. Seymour, C. W. *et al.* Understanding of Sepsis among Emergency Medical Services: A Survey Study. *J Emerg Medicine* **42**, 666–677 (2012).
9. Mulders, M. C. F., Loots, F. J., Nieuwenhoven, J. van, Maaten, J. C. ter & Bouma, H. R. Use of sepsis-related diagnostic criteria in primary care: a survey among general practitioners. *Fam Pract* (2021) doi:10.1093/fampra/cmab020.
10. Nucera, G., Esposito, A., Tagliani, N., Baticos, C. J. & Marino, P. Physicians and nurses knowledge and attitudes in management of sepsis: An Italian study. *Journal of Health and Social Sciences* **1**, 13–26 (n.d.).
11. Dong, L.-H., Zhang, Q.-Y., Di, N.-N., Xue, Q.-L. & Liu, Y.-J. Are you using the third definition to diagnose sepsis in clinic?—A survey among Chinese intensivists. *Ann Palliat Medicine* **0**, 48–48 (2020).
12. Rahman, N. 'Inayati A., Chan, C. M., Zakaria, M. I. & Jaafar, M. J. Knowledge and attitude towards identification of systemic inflammatory response syndrome (SIRS) and sepsis among emergency personnel in tertiary teaching hospital. *Australas Emerg Care* **22**, 13–21 (2019).
13. Shime, N. A Survey of the Competency of Ambulance Service Personnel in the Diagnosis and Management of Sepsis. *J Emerg Medicine* **49**, 147–151 (2015).

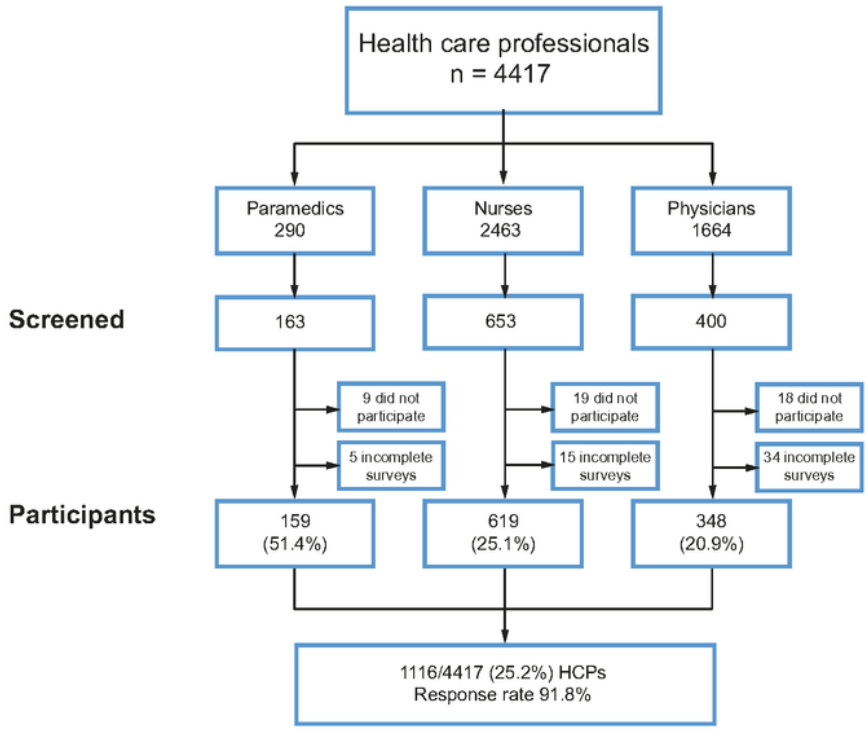
14. Tufan, Z. K. *et al.* The Knowledge of the Physicians about Sepsis Bundles is Suboptimal: A Multicenter Survey. *J Clin Diagnostic Res* **9**, OC13-6 (2015).
15. Jeffery, A. D., Mutsch, K. S. & Knapp, L. Knowledge and recognition of SIRS and sepsis among pediatric nurses. *Pediatric Nurs* **40**, 271–8 (2014).
16. Stamataki, P. *et al.* Knowledge regarding assessment of sepsis among Greek nurses. *J Infect Prev* **15**, 58–63 (2013).
17. Robson, W., Beavis, S. & Spittle, N. An audit of ward nurses' knowledge of sepsis. *Nurs Crit Care* **12**, 86–92 (2007).
18. Ziglam, H. M., Morales, D., Webb, K. & Nathwani, D. Knowledge about sepsis among training-grade doctors. *J Antimicrob Chemoth* **57**, 963–965 (2006).
19. Szakmany, T. *et al.* Sepsis Prevalence and Outcome on the General Wards and Emergency Departments in Wales: Results of a Multi-Centre, Observational, Point Prevalence Study. *Plos One* **11**, e0167230 (2016).
20. Rohde, J. M. *et al.* The epidemiology of acute organ system dysfunction from severe sepsis outside of the intensive care unit. *J Hosp Med* **8**, 243–247 (2013).
21. *et al.* Sepsis incidence and outcome: Contrasting the intensive care unit with the hospital ward* *Crit Care Med* **35**, 1284–1289 (2007).
22. Poeze, M., Ramsay, G., Gerlach, H., Rubulotta, F. & Levy, M. An international sepsis survey: a study of doctors' knowledge and perception about sepsis. *Crit Care* **8**, R409 (2004).
23. Rubulotta, F. M. *et al.* An international survey: Public awareness and perception of sepsis*. *Crit Care Med* **37**, 167–170 (2009).
24. Harris, P. A. *et al.* Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* **42**, 377–381 (2009).
25. Harris, P. A. *et al.* The REDCap Consortium: Building an International Community of Software Platform Partners. *J Biomed Inform* **95**, 103208 (2019).
26. Levy, M. M. *et al.* 2001 SCCM/ESICM/ACCP/ATS/SIS International Sepsis Definitions Conference. *Intens Care Med* **29**, 530–538 (2003).
27. Bone, R. C. *et al.* Definitions for Sepsis and Organ Failure and Guidelines for the Use of Innovative Therapies in Sepsis. *Chest* **101**, 1644–1655 (1992).
28. Wenger, N. *et al.* Allocation of Internal Medicine Resident Time in a Swiss Hospital: A Time and Motion Study of Day and Evening Shifts. *Ann Intern Med* **166**, 579 (2017).
29. Torsvik, M. *et al.* Early identification of sepsis in hospital inpatients by ward nurses increases 30-day survival. *Crit Care* **20**, 244 (2016).
30. Tromp, M. *et al.* Internal medicine residents' knowledge about sepsis: effects of a teaching intervention. *Neth J Medicine* **67**, 312–5 (2009).

31. Yousefi, H., Nahidian, M. & Sabouhi, F. Reviewing the effects of an educational program about sepsis care on knowledge, attitude, and practice of nurses in intensive care units. *Iranian J Nurs Midwifery Res* **17**, S91-5 (2012).
32. Boynton, P. M. & Greenhalgh, T. Selecting, designing, and developing your questionnaire. *Bmj* **328**, 1312 (2004).

Figures

Figure 1

A



B **HCPs distribution in the tertiary center**

	Nurses	Physicians
ED	73/132 (55.3%)	30/91 (33.0%)
ICU	73/210 (34.8%)	23/43 (53.5%)
MEDICINE	234/756 (30.9%)	179/612 (29.2%)
SURGERY	208/808 (25.7%)	98/332 (29.5%)
PSYCHIATRY	31/236 (13.1%)	18/418 (4.3%)
TOTAL	619/2142 (28.9%)	438/1260 (34.8%)

Figure 1

Study population: Flowchart (A) and HCP distribution according to specialty (ED: Emergency Department; ICU: Intensive Care Unit). Surgery encompasses visceral, thoracic and vascular surgery, neurosurgery, Gynecology, ENT and orthopedics. RR response rate of participants screened.

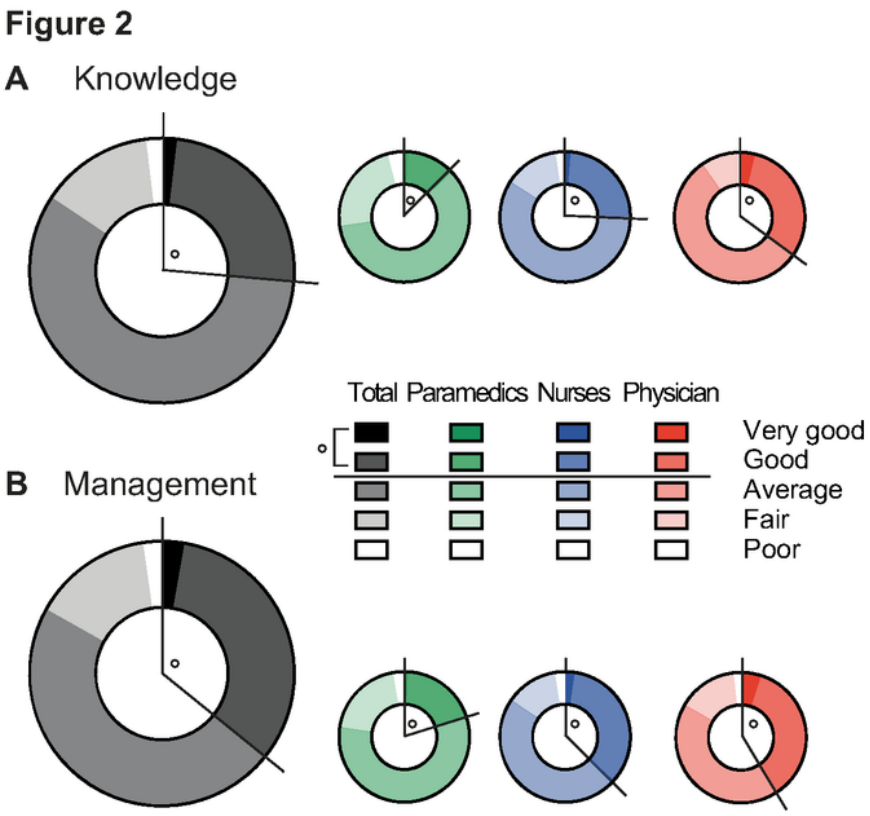


Figure 2

Assessment of sepsis knowledge and management skills. Pie chart representation of responses of participants/respondents according to a five-category Likert scale. Assessment of baseline sepsis knowledge and management skills by either the entire study group (A) or by each category of health care professionals (B). Number of participants/respondents: 619 nurses, 358 physicians and 149 paramedics.

Figure 3

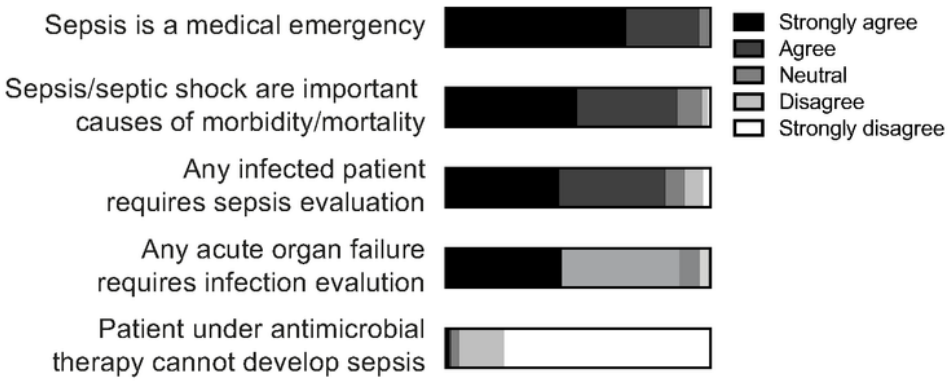


Figure 3

Sepsis awareness. Assessment of sepsis characteristics or features (i.e. urgency of care, severity, need for prompt evaluation and context of appearance) according to a 5-category Likert scale by study participants.

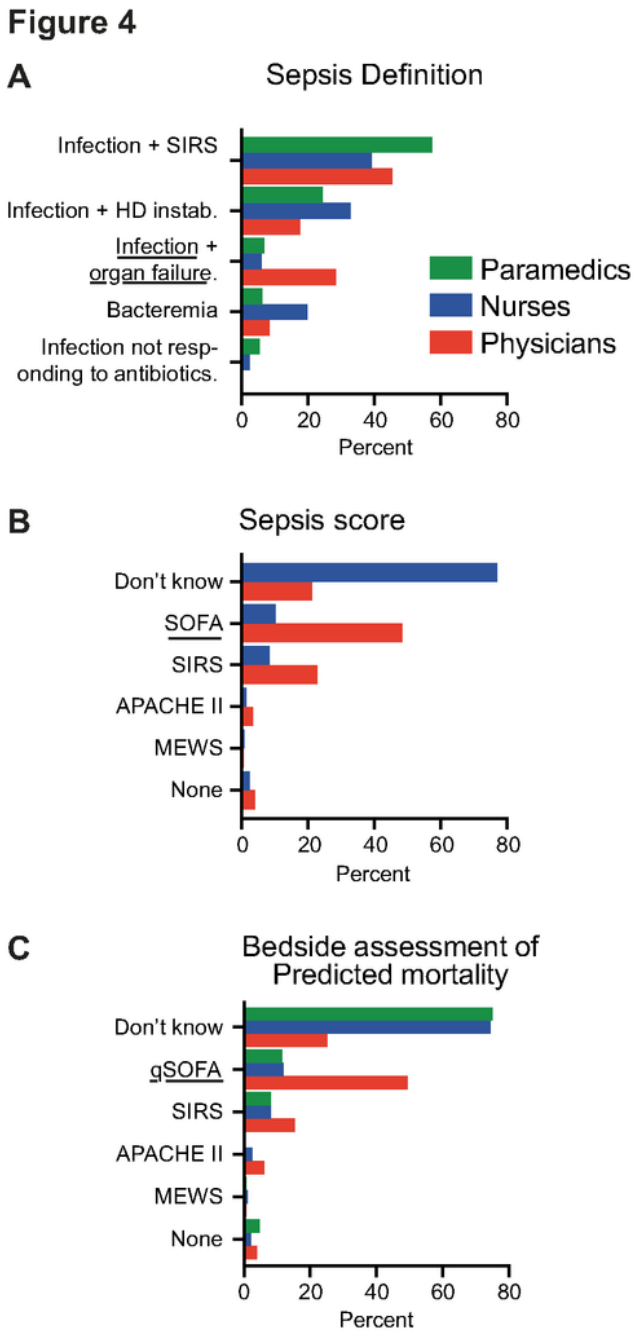


Figure 4

Sepsis definitions and sepsis scores. Evaluation of the definition of sepsis (A) and of scores (SOFA, SIRS, qSOFA, MEWS and APACHE II) as a sepsis defining tool (B) or a bedside predictor of sepsis mortality (C). Abbreviations: MEWS (modified early warning score), APACHE II (acute physiology and chronic health evaluation II).

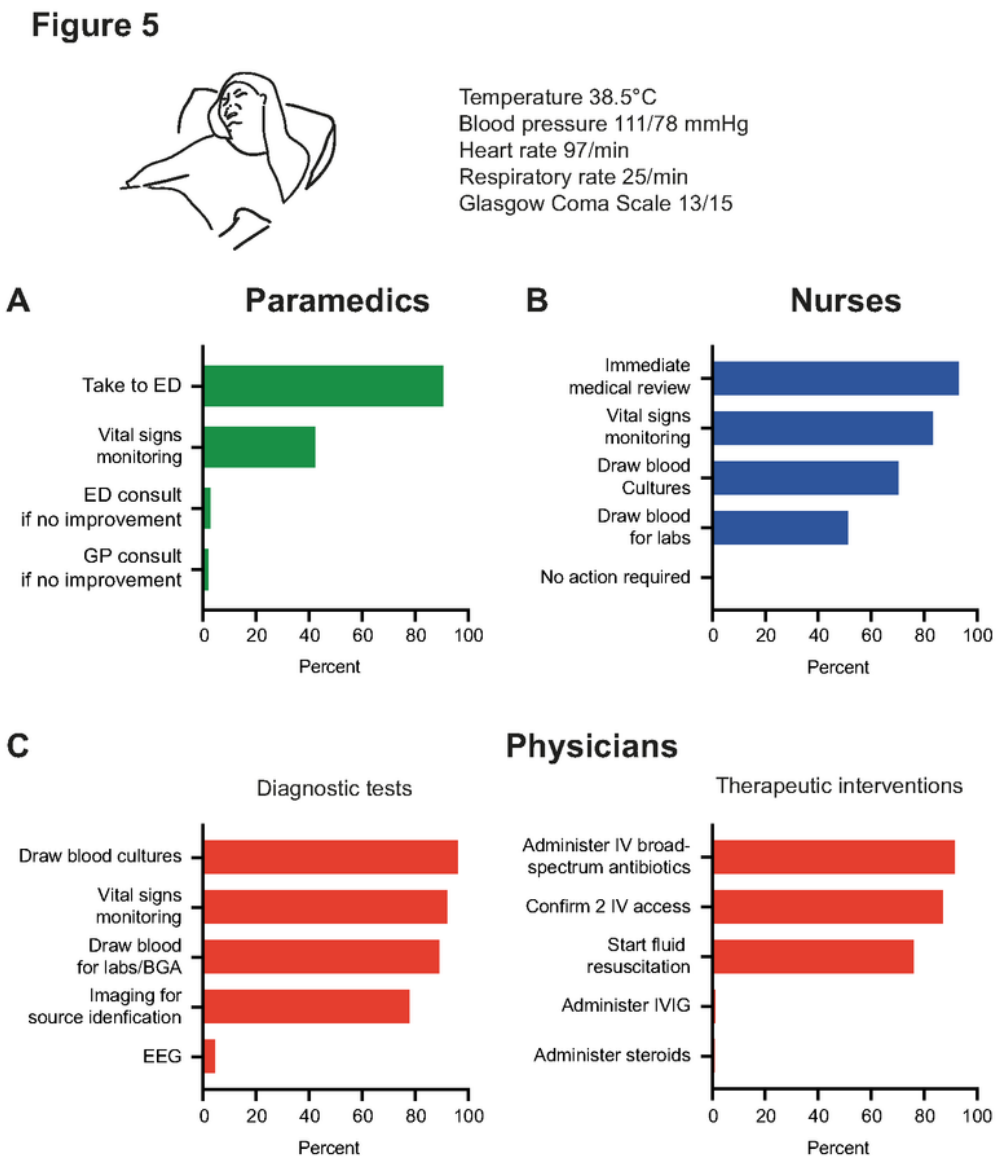


Figure 5

Clinical vignette. Management of a patient with suspected sepsis and a qSOFA of 2 (i.e. respiratory rate of 25 per min and a Glasgow Coma Scale score of 13) by paramedics (A), nurses (B) or physicians (C). In panel C, assessment of evaluation tools (step 1) and of management (step 2). Abbreviations: GP (general practionner), ED (emergency department), EEG (electroencephalogram), IVIG (intravenous immunoglobulins).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- AbstractCC.pdf
- AbstractCC2.pdf