Physicians' and nurses' knowledge and attitudes in management of sepsis: An Italian study

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Abstract

Introduction: Sepsis is one of the most deadly and costly conditions at hospitals. Our study aimed to study levels of knowledge and attitudes in management of sepsis among nurses and physicians employed at Fatebenefratelli hospital, Milano, North-Italy, with particular regard to the analysis of the effects of educational training.

Methods: A cross-sectional, quasi-experimental study was conducted between June 1 and October 30, 2017. Physicians and nurses from Intensive Care Unit (ICU) and non-ICU hospital wards were recruited. The study participants were invited to attend some educational workshops and, after 6 months, to fill out a questionnaire based on the 2016 Surviving Sepsis Campaign guidelines. Descriptive statistics were expressed with frequency and percentage (%). Chi-square and Student's t-test were performed to compare the differences in awareness and knowledge between groups. P-values < 0.05 were considered statistically significant.

Results: Nurses and physicians reported both 'good' levels (> 75%) of knowledge of procedures that increase risk of sepsis, 'fairly' (50-75%) levels of knowledge, attitudes and behaviour towards blood culture techniques, and 'poor' (< 50%) levels of knowledge concerning early identification, methods and scores for diagnosis and management of sepsis. However, with regard to this latter point, T Student test for sample independent confirmed a significant difference in the average percentages of correct answers between recently (~ 6 months) trained (74 ± 3.4%) nurses (*n* = 33) and physicians (*n* = 19) and not recently (> 1 years) or never trained (34.8 ± 7.4%) nurses (*n* = 99) and physicians (*n* = 30) (t(10) = 11.72, *P* = < 0.001).

Discussion and Conclusion: Our findings showed that levels of knowledge concerning methods and scores for early identification of sepsis can be significantly improved by educational training. A good knowledge of sepsis guidelines is essential to correct management of this condition.

Riassunto

Introduzione: La sepsi è una delle condizioni ospedaliere più costose e ad elevata letalità. L'obiettivo della nostra ricerca è stato quello di studiare i livelli di conoscenza e gli atteggiamenti nella gestione della sepsi tra gli infermieri ed i medici dell'Ospedale Fatebenefratelli di Milano nel Nord Italia, con particolare attenzione all'analisi degli effetti della formazione.

Metodi: Uno studio trasversale, quasi sperimentale è stato condotto tra il 1 Giugno ed il 30 Ottobre 2017. Sono stati recrutati medici ed infermieri sia dall'Unità di Terapia Intensiva che dagli altri reparti dell'ospedale. I partecipanti sono stati invitati a frequentare alcuni laboratori didattici e, dopo 6 mesi, a compilare un questionario basato sulle linee guida del 2016 della Campagna di Sopravvivenza alla Sepsi (SSC). Le statistiche descrittive sono state espresse come frequenza e percentuali (%). Il Test del chi quadrato ed il test T di Student sono stati utilizzati per confrontare le differenze nei livelli di consapevolezza e di conoscenza tra i gruppi. Il livello di significatività statistica è stato pari a P < 0.05.

Risultati: Infermieri e medici hanno entrambi riferito "buoni" livelli (> 75%) di conoscenza delle procedure che incrementano il rischio di sepsi, "corretti" (50-75%) livelli di conoscenza, atteggiamenti e comportamenti sulle tecniche di emocoltura, e "scarsi" (< 50%) livelli di conoscenza sull'identificazione precoce, i metodi ed i punteggi per la diagnosi e la gestione della sepsi. Tuttavia, su quest'ultimo punto, il T test di Student per campioni indipendenti ha confermato una significativa differenza nelle percentuali medie delle riposte corrette tra gli infermieri (n = 33) e i medici (n = 19) che erano stati recentemente (~ 6 mesi) formati (74 ± 3.4%) rispetto agli infermieri (n = 99) e ai medici (n = 30) che non erano stati recentemente (> 1 anno) o non erano mai stati formati (34.8 ± 7.4%) (t(10) = 11.72, P = < 0.001).

Discussione e Conclusioni: I nostri risultati hanno evidenziato che i livelli di conoscenza sui metodi e gli "scores" per l'identificazione precoce della sepsi possono essere migliorati in modo significativo attraverso la formazione. Una buona conoscenza delle linee guida sulla sepsi è essenziale per la corretta gestione della sepsi.

TAKE-HOME MESSAGE
A good knowledge of sepsis guidelines among nurses and physicians is essential to correct management of this condition and could be improved through educational training.

INTRODUCTION

Sepsis may be defined as a 'life-threatening organ dysfunction caused by a dysregulated host response to infection' and is one of the most deadly and costly conditions at hospitals [1]. According to a US-based study, among medical conditions including acute myocardial infarction, heart failure, chronic obstructive pulmonary disease, and pneumonia, sepsis is a leading cause of readmissions to the hospital and associated costs [2]. The Agency for Healthcare Research and Quality lists sepsis as the most expensive condition treated in U.S. hospitals, costing nearly $24 billion in 2013 [3]. The incidence of sepsis is increasing in all areas of the world where epidemiology studies have been conducted [4], and this trend might continue, due to aging of the population, an increasing burden of chronic health conditions, and an increased use of immunosuppressive therapy, transplantation, chemotherapy and invasive procedures [5, 6]. Additional risk factors include also malnutrition, chronic illness, immunosuppression, recent surgery or hospitalization, and indwelling catheters or other devices [7]. Therefore, both the incidence and mortality rates of sepsis remain at a steadily high level [8]. As the most severe manifestation of acute infection, this condition poses a major challenge to health care systems around the world. For the above reasons, in 2002 an international campaign, called the 'Surviving Sepsis Campaign' (SSC), was launched with the aim of reducing mortality from sepsis by 25% by 2009, by disseminating an evidence-based, standardized approach to caring for patients with sepsis [9]. In addition, to face the huge burden of sepsis, the Surviving Sepsis Campaign guidelines were first published in 2004 [10], and afterly, were revised in 2008 [11], and 2012 [12]. In order to reduce mortality from sepsis and septic shock worldwide, the last edition (2012) of these guidelines have been recently updated in 2016 [13]. Indeed, management of sepsis is a complicated clinical challenge requiring early recognition and management of infection, hemodynamic issues, and other organ dysfunctions [14]. Ac-

cordingly, sepsis and septic shock are medical emergencies that require an immediate treatment and resuscitation [15]. The Surviving Sepsis Campaign provided numerous resources aimed at increasing awareness and providing education among health professions. Indeed, evidence showed that education and training of all health care professionals increase awareness of sepsis and the use of protocols for the management of patients with sepsis, particularly in emergency departments and hospital settings where specific standards are set, for example, for the delivery of fluids and antibiotics [16]. An early sepsis recognition by ward nurses has been shown to improve survival for patients in hospital with sepsis [17]. Furthermore, many studies have shown that increasing knowledge and attitude and improving the practice of nurses and physicians are effective methods to control sepsis [18–22]. A good knowledge of sepsis guidelines is essential, therefore, to correct management of this condition. Unfortunately, the 2016 Sepsis guidelines have been translated in eight languages, but just not like in Italy. Moreover, research on the role of education and its relationship with sepsis is very scarce and, to our best knowledge, there are few studies on this issue in Italy. In 2016, our hospital has formed the 'Sepsis Fatebenefratelli Hospital' group in order to elaborate a hospital-created protocol based on the SSC guidelines. The purpose of this protocol was to establish a continuous training activity for nurses and physicians through educational workshops and training events to disseminate among health professionals of our hospital good levels of knowledge, attitudes and behaviour for early identification and treatment of sepsis. Main objective of this research was to study the level of knowledge and attitudes in management of sepsis among nurses and physicians employed at Fatebenefratelli Hospital, Milano, North-Italy, with particular regard to its early recognition and timely treatment. Specifically, we evaluated the effects that an educational workshop, which was organized by our hospital sepsis group after the release of 2016 Sepsis Guidelines, had on levels of

knowledge and attitudes among nurses and physicians toward this life-threatening disorder.

METHODS

Study design, participants, and procedures

In 2016 Fatebenefratelli and Sacco Hospital (FSH) constituted a sepsis working group, in order to prepare operating protocols based on SCC guidelines for the management of patients with sepsis and shock septic and educate own health professionals through training programmes to successfully increase their awareness of sepsis [15]. This cross-sectional, quasi-experimental study was conducted between June 1 and October 30, 2017 at Fatebenefratelli Hospital in Milan, Italy. Physicians and nurses from 10 different types of wards and hospital units were eligible for participation. They were recruited from both Intensive Care Unit (ICU) and not-ICU departments of our hospital such as Emergency, Pneumology, Gastroenterology, Cardiology, Neurosurgery, General Surgery, Nephrology, Orthopedy and Anesthesiology Departments. Three departments were excluded from the current study: Oncology and Pediatrics for the patient's special features and Ofthalmology for poor utilization of blood cultures. Following informed consent, the participants were provided the questionnaire. This study was approved by the Institutional Review Board at our hospital.

Questionnaire development and statistical analysis

To evaluate the knowledge and attitudes of physicians and nurses about sepsis, a 26-question form was created. The questionnaire was developed by the researchers for the purposes of the current study and pilot-tested and revised by a panel of experts consisting of members of our hospital sepsis working group together with physicians and nurses employed as coordinators at departments surveyed by our study. Internal consistency among the questionnaire items was 0.88 Cronbach's alpha (α) and it was considered within the

acceptable range. A pilot study was used to test the instrument. It was conducted with 5 nurses and 5 physicians in the medical and surgical wards from Fatebenefratelli Hospital to determine the clarity of questions, completeness of response sets, effectiveness of instructions, time required to complete the questionnaire and success of data collection technique. Pilot subjects were asked to comment on the applicability and appropriateness (validity) of the questionnaire. All questions were answered and no clarity of questions was required [23, 24].

The questionnaire was developed using Italian language and was administered anonymously to each of the study participants. Verbal consent was obtained prior to enrollment. Researchers administered the survey to all participants. To maintain anonymity the study supervisors and administrative staffs were blinded to the identity of the participants. All of the questions, except those regarding demographic characteristics (age, gender, education, years of professional experience, type of occupation and department), were multiple choice. The 26-questions questionnaire assessed knowledge and attitudes towards some of the recommended procedures demanded in the 2016 International sepsis guidelines [15], which were before translated in Italian by authors for the purpose of this study. Items for physicians and nurses were partially different. Indeed, items for nurses also included practical questions regarding the blood culture techniques as described by guidelines to prevent contamination of the sample. Our questionnaire survey included questions concerning 'knowledge about type of procedure that increase risk of sepsis' ($n = 4$ items), 'attitudes and behaviours about blood culture techniques' ($n = 10$ items), 'knowledge about early identification and management of sepsis' ($n = 6$ items). Each of these questions had an only correct answer. We calculated the percentage (%) of correct answers given by groups for each item, and, then, the average percentage (%) of correct answers for each of the three questionnaire-sections. The knowledge and attitude scores were classified into

'Poor' knowledge (≤ 50%), 'Fair' knowledge (51 - 75%), and 'Good' (≥ 76%) knowledge [23, 24]. The investigators explained and distributed the questionnaire to all physicians (*n* = 100) and nurses (*n* = 200) of departments (*n* = 10) enrolled in this study. After the publication of the 2016 SCC guidelines, in March 2017 four educational workshops were carried out by our Sepsis group for all health professionals; after six months, between September and October 2017 we administered the questionnaire to compare levels of knowledge and attitudes between nurses and physicians and between participants and nonparticipants to our training events, which were based on 2016 SCC Guidelines.

Statistical analyses were perfomed using SPSS (Statistical Package for Social Science) version 12.0. Descriptive statistics were expressed with frequency and percentage (%). Data were expressed as percent correct answers. Chi-square and Student's t-test for sample independent were performed to compare the differences in awareness and knowledge between groups. P-values <0.05 were considered statistically significant.

RESULTS

Respondent profile

Our response rates were 66% for the nurses (*n* = 132; M = 38%, F = 62%), and 49% for the physicians (*n* = 49; M = 61%, F = 39%). Relevant socio-demographic data such as age, gender, lenght of service, type of education and specialization or department where they were employed are shown in Table 1. Most physicians (*n* = 30, 61%) were male and '41-50' age group was the most represented for physicians (*n* = 19, 38.8%). Most nurses (*n* = 82, 62%) were female and '31-40' age group was the most represented for nurses (*n* = 43, 32.6%). Most physician respondents (*n* = 23, 47%) had 11-20 years of work experience, while 'length of service' for nurses was well-represented in almost all groups. Of the physicians interviewed, 3 (6.1%) were anaesthesiologists, 6 (12.2%) cardiologists, 3 (6.1%) nephrologists, 4 (8.2%) pulmonolo-

gists, 6 (12.2%) general surgeons, 3 (6.1%) neurosurgeons, 16 (32.8%) emergency room physicians, 5 (10.2%) orthopedists, and 3 (6.1%) gastroenterologists. Of the nurses interviewed, 120 (23%) worked at departments as follows: 9 (6.8%) at Anesthesiology, 17 (9%) at Cardiology and Intensive Care Unit, 18 (13.7%) at Nephology and Dialysis, 11 (8.3%) at Pneumology, 12 (9%) at both Surgery and Neurosurgery, 32 (24.3%) at Emergency Room and Department of Emergency, 14 (10.7%) at Orthopedy, 7 (5.3%) at Gastroenterology.

Knowledge of sepsis and differences between groups

Table 2 shows the differences between nurses and medical doctors in prevalence of percentage answering correctly. Items concerned three types of knowledge: 1) procedure that increase risk of sepsis; 2) attitudes and behaviour about blood culture techniques; 3) early identification and management of sepsis, including sepsis scores such as 'SOFA' and 'qSOFA'. With regard to nurses, 82% of our sample applied disinfectants on skin surface correctly, 60% used the correct disinfectant (i.e. chlorhexidine) and collected venous blood specimens by antecubital vein (64%) or by central venous access catheter (CVC) in case of suspected bacteraemia (33%), as demanded in the 2016 Sepsis International Guidelines. Almost all nurses (93%) declared to collect the right number of set, which is comprised between 2 and 3 times per each episode of bacteraemia, and to use gloves as personal protective equipment in all steps of the procedure (98%). However, about half of them (55%) declared to not disinfect the tops of culture bottles, and only 12% of them answered to do it correctly, i.e. by using ethyl alcohol and not chlorhexidine. 81% of nurses did not exactly know the timing of specimen collection for blood cultures, 48% of them collected the correct quantities of blood (8-10 ml) and, finally, 80% of them did handle, transfer and storage the blood samples specimens properly. Physicians reported higher levels of knowledge than nurses with regard

Table 1. Socio-demographic data of the study participants (*n* = 181).

Characteristics	Physicians (*n* = 49) 38%	Nurses (*n* = 132) 62%
Gender		
Male	30 (61%)	50 (38%)
Female	19 (39%)	82 (62%)
Age (years)		
20-30	0	33 (25%)
31-40	13 (26.6%)	43 (32.6%)
41-50	19 (38.8%)	38 (28.8%)
51-60	14 (28.6%)	17 (12.9%)
>60	3 (6%)	1 (0.7%)
Educational Level		
Diploma	0	48 (36%)
Degree	49 (100%)	80 (60%)
Other	0	4 (4%)
Working experience (years)		
<5	9 (18.4%)	30 (22.8%)
6-10	3 (6.1%)	34 (25.8%)
11-20	23 (47%)	24 (18.2%)
21-34	12 (24.5%)	32 (24.2%)
>34	2 (4%)	12 (9%)
Types of specialization		
Anesthesiology	3 (6.1%)	9 (6.8%)
Cardiology/Cardiology Intensive Care Unit	6 (12.2%)	17 (12.9%)
Neurosurgery	3 (6.1%)	12 (9%)
Surgery	6 (12.2%)	12 (9%)
Orthopedy	5 (10.2%)	14 (10.7%)
Nephrology and Dialysis	3 (6.1%)	18 (13.7%)
Pneumology	4 (8.2%)	11 (8.3%)
Emergency Room/Department of Emergency	16 (32.8%)	32 (24.3%)
Gastroenterology	3 (6.1%)	7 (5.3%)

to the procedures increasing risk of sepsis (physicians = 91.5%; nurses = 81%, category: good) and early identification and management of sepsis (physicians = 49.6%; nurses = 42.3%, category: poor), while attitude and behavior about blood culture techniques were similar between these two groups (nurses = 60.3%; physicians = 61.8%, category: fairly).

As shown in Table 3, T test indicated a significant higher physicians' knowledge of procedures increasing risk of sepsis (*M* = 91.5 ± 7.1) than nurses' (*M* = 81 ± 2.1%), t(6) = 2.81, *P* = 0.031. Conversely, T test showed no significant trending indicating higher level of knowledge about early identification and management of sepsis between nurses (*M* = 42.3 ± 17.8%) and physicians (*M* = 49.6 ± 16.9%), t(10) = 0.73, and about attitude and behavior concerning blood culture technique between nurses (*M* = 60.3 ± 29.5%) and physicians (*M* = 61.8 ± 15.5%), t(15) = 0.12.

Finally, in Tables 4 and 5 we showed a comparison between recently trained and not recently trained groups of nurses and physicians on questions concerning early identification, methods and scores for diagnosis and management of sepsis. T Student test for sample independent confirmed a significant difference between recently (~ 6 months) trained (*M* = 74 ± 3.4%) nurses (*n* = 33) and physicians (*n* = 19) and not recently (> 1 years) or never trained (*M* = 34.8 ± 7.4%) nurses (*n* = 99)

Table 2. Differences between physicians and nurses on knowledge of sepsis (*n* = 181).

Knowledge and attitude	Percentage Answering Correctly	
Knowledge about type of procedure that increase risk of sepsis	Nurses (*n* = 132)	Physicians (*n* = 49)
Medication of surgical wound	84%	97%
Placement of Foley catheter	81%	90%
Medication of central venous access catheter	80%	97%
Placement of central venous access catheter (CVC)	79%	82%
Average Percentage	*81%*	*91.5%*
Knowledge level	*Good*	*Good*
Attitude and behaviour about blood culture techniques		
How to use disinfectants on skin surface	82%	50%
Use of chlorhexidine before venous blood samples collection	60%	-
Blood collection site selection	48.5%	47%
Number of set per each episode of bactaraemia	93%	76%
Use of gloves during the blood sample collection (or medication of CVC for physicians)	100%	84%
Use of sterile gloves during the blood sample collection (or medication of CVC for physicians)	61%	68%
Disinfection of the tops of culture bottles	12%	-
Timing of specimen collection for blood cultures	19%	43%
Quantities of blood samples collected	48%	-
Handling, transfer and storage of blood samples	80%	65%
Average Percentage	*60.3%*	*61.8%*
Knowledge level	*Fairly*	*Fairly*
Knowledge about early identification and management of Sepsis		
Risk factors for sepsis	75%	71%
Score for early identification of high-risk patients for sepsis	42%	51%
'Sepsis Six' definition	48%	67%
'qSofa Score' parameters	31%	39%
Significance of 'qSofa Score'	29%	43%
Score for assessing organ damage	29%	27%
Average Percentage	*42.3%*	*49.6%*
Knowledge level	*Poor*	*Poor*

Table 3. Results of T-test for knowledge and attitude about sepsis by type of occupation (*n* = 181).

Type of occupation									
Knowledge	**Nurses**			**Physicians**					
	M	*SD*	*n*	*M*	*SD*	*n*	95% CI for Mean Difference		*t*	*df*
							lower	upper		
Type of procedure that increase risk of sepsis	81.00	2.16	4	91.50	7.14	4	1.37	19.63	2.81*	6
Attitude and behaviour about blood culture techniques	60.35	29.50	10	61.86	15.57	7	7.65	24.63	0.12	15
Knowledge about early identification ad management of sepsis	42.33	17.80	6	49.67	16.91	6	15.00	29,66	0.73	10

*P < 0.05

Table 4. Knowledge about early identification and management of sepsis: the comparison between trained and not trained nurses and physicians (*n* = 181).

Knowledge about early identification and management of sepsis	Percentage Answering Correctly among nurses and physicians	
	Recently trained (*n* = 52; nurses = 33 and physicians = 19)	Not recently trained (*n* = 129; nurses = 99 and physicians = 30)
Risk factors for sepsis	75%	48%
Score for early identification of high-risk patients for sepsis	73%	30%
'Sepsis Six' definition	74%	35%
'qSofa Score' parameters	70%	30%
Significance of 'qSofa Score'	80%	28%
Score for assessing organ damage	72%	38%
Average Percentage	*74%*	*34.8%*
Knowledge level	*Good*	*Poor*

Table 5. Results of t-test for knowledge about sepsis by specific training at workplace.

Specific training on sepsis for nurses/physicians									
Knowledge	Yes			Not					
	M	*SD*	*n*	*M*	*SD*	*n*	95% CI for Mean Difference		*t*	*df*
							lower	upper		
Knowledge about early identification and management of sepsis	74	3.41	6	34.83	7.44	6	31.72	46.61	11.72*	10

*P < 0.001

and physicians (*n* = 30) (t (10) = 11.72, *P* = < 0.001).

DISCUSSION AND CONCLUSION

Our study aimed to study the effects of an educational workshop on levels of knowledge and attitudes about sepsis by nurses and physicians employed at Fatebenefratelli Hospital, in Milano, North Italy. With regard to knowledge of procedures that increase risk of sepsis, our findings showed the existence of significant differences (P < 0.05) between nurses (*M* = 81%) and physicians (*M* = 91.5%), who reported both 'good' levels of knowledge (> 75%). Conversely, with regard to knowledge, attitudes and behaviour towards blood culture techniques, our findings showed no significant differences (P > 0.05) between nurses and physicians, whose levels were both 'fairly' (50-75%); finally, with regard to knowledge of early identification and management of sepsis, levels of knowledge were 'poor' for both nurses (*M* = 42.3 ± 17.8%) and physicians (*M* = 49.6 ± 16.9%) and there were no significant differences between these two groups. However, regarding this latter point, our findings showed a significant difference between the small group (*n* = 52) of nurses/physicians who were recently trained (*M* = 74 ± 3.4%) and the most representative group (*n* = 129) of nurses/physicians not trained or trained by more than 1 year (*M* = 34.8 ± 7.4%). Specifically, the group of trained nurses and physicians reported a 'good' level of knowledge, whereas for the other group it was 'poor'. Even though the group of health professionals trained was small, this significant difference confirms that levels of knowledge on sepsis can be positively influenced by educational training, and this improvement can remain over a certain time, which was about 6 months in our study. On the other side, the overall 'low' level of knowledge of both nur-

ses and physicians about early identification and management of sepsis could be also justified by the fact that more than two-thirds of them did not attend any recent educational workshop focusing, for example, on 'qSofa Score' parameters and significance, concepts that were introduced only recently by 2016 SCCC Guidelines. This hypothesis could be confirmed by overall low percentage answering correctly on items concerning knowledge of 'qSofa Score' (31% and 39% among nurses and physicians, respectively) and 'significance of qSofa Score parameters' (29% and 43% among nurses and physicians, respectively) as compared to all other items of the third section of the questionnaire used.

In literature, several researchers highlighted a no-high level of knowledge of sepsis among physicians and nurses [18–20, 22]. However, Tromp et al. showed a significant improvement of knowledge on assessment of symptoms of sepsis among internal medicine residents after an educational intervention, emphasizing the active role of continuing educational activities during the training of residents [21]. Ferrer et al. showed that both diagnosis and treatment of sepsis may improve through the education of residents about the Surviving Sepsis Campaign (SSC) guidelines [25]. For this reason, our study explored the level of knowledge of sepsis among nurses and physicians after that an educational intervention was carried out, based on the most recent (2016) SCC Guidelines [15]. Overall, findings of our study support the hypothesis that educational training could be effective in improving the levels of knowledge of sepsis among nurses and physicians. Sepsis scores introduced by the 2016 Guidelines are essential in the early identification and timely management of sepsis and should be well-known by nurses and physicians. Indeed, several studies have shown that early diagnosis and prompt treatment of sepsis can lead to a decreased level of sepsis-related mortality [26] and sepsis should be identified as soon as possible in its course to obtain the greatest benefit from antibiotics [27, 28]. In a 2009 study [21], Tromp et al. confirmed that

lack of adherence to SSC guidelines was in part caused by lack or inadequate level of knowledge of these guidelines, pointing out the importance of a SCC guidelines-based continuing education. Indeed, a 2007 study in Puerto Rico showed that even physicians who are most often involved in the care of septic patients (general internists, internal medicine subspecialists, general surgeons and residents) lacked a working knowledge of the SSC guidelines for the management of sepsis [29]. Another recent (2017) internet-based study showed that physicians employed at internal and emergency departments had to both equally improve their level of knowledge of the 2016 'Surviving Sepsis Campaign Guidelines' for management of severe sepsis and septic shock [30]. Other researches have evaluated the positive impact of educational programmes on guidelines compliance and mortality in patients with sepsis. The decreased mortality observed by those studies might derive from better identification of patients with severe sepsis or from improved compliance with quality indicators, including earlier administration of antibiotics, or both [25].

Therefore, quality-improvement initiatives should be sustained applying the 'plan-do-study-act' cycles as the best approach to sustain the effect of the educational program [25, 31]. Our study paves the way to further research on this important issue, which is related to the need for continuous training among in-hospital nurses and physicians, because the SCC guidelines are constantly being updated. Indeed, the 'qSofa' score for early identification and management of sepsis was introduced only recently by 2016 guidelines. Our educational workshop was based on the Surviving Sepsis Campaign that offers on its website a wealth of materials to assist health professionals to implement and progress with sepsis performance improvement efforts in their institutions. Papers, practical tools and checklist, and educational opportunities, are there available. Based on the Surviving Sepsis Campaign, our questionnaire was an instrument created to specifically measure levels of

knowledge among nurses and physicians by focusing on innovations introduced by the 2016 SSC guidelines for the management of sepsis. For instance, 'Severe sepsis' category is no longer recommended for clinical use. Sepsis is defined as 'life-threatening organ dysfunction caused by a dysregulated host response to infection' and for clinical operationalization, organ dysfunction should be represented by an increase in the Sequential [Sepsis-related] Organ Failure Assessment (SOFA) score of 2 points or more, which is associated with an in-hospital mortality greater than 10%. Septic shock is defined as a subset of sepsis 'in which circulatory, cellular, and metabolic abnormalities are associated with a greater risk of mortality than with sepsis alone. These patients can be clinically identified by a vasopressor requirement to maintain a mean arterial pressure ≥ 65 mm Hg and serum lactate level > 2 mmol/L in the absence of hypovolemia'. This combination is associated with hospital mortality rates greater than 40%. In out-of-hospital, emergency department, or general hospital ward settings, adult patients with suspected infection can be rapidly identified as being more likely to have poor outcomes typical of sepsis if they have at least 2 of the following clinical criteria that together constitute a new bedside clinical score termed quickSOFA (qSOFA): respiratory rate of 22/min or greater, altered mentation, or systolic blood pressure of 100 mm Hg or less [1].

Poeze et al. found some differences between physicians working in Intensive Care Units (ICU) and other specialists, the first ones being more aware to consider sepsis as a leading cause of mortality and a significant burden on the health care system [19]. The important role of critical care nurses in detecting sepsis and importance of their specific training is well recognized and confirmed in a Turkish study by Yilmaz et al. [32] and in an Iranian research by Yousefi et al [33]. In Brazil, Assuncão et al. showed that intensivists performed better in all diagnoses and there was a significantly higher rate of knowledge among physicians from university hospitals as compared to those from public hospitals [34]. At the beginning, much work focused on improving sepsis care in intensive care units, but, however, many patients on general wards developed sepsis, and the need to educate nurses throughout all areas of the hospital was recognized. In 2007, a new part of the campaign was launched called 'Survive Sepsis', which aimed at delivering sepsis education to ward nurses and junior doctors explaining how nurses can dramatically improve the patient's rate of survival through the 'Sepsis Six' in the first hour [35].

According to Roebuck, for instance, it is important to improve the knowledge of sepsis even among pre-hospital clinicians through a screening tool for the quick recognition and management of sepsis [36]. In this way, multiple instruments have been developed to screen for sepsis, because use of a systematic screening tool to identify sepsis early is essential. However, screening must be a multidisciplinary process based on the education of all team members about their roles, responsabilities and the importance of the program [37]. Recent recommendations by the Society of Critical Care and European Society of Intensive Care Medicine advocate use of the qSOFA score in non-ICU settings to screen for septic patients at greater risk for poor outcomes. However, a recent (2017) study showed it has poor sensitivity for pre-hospital identification of severe sepsis and septic shock and should be used in combination with other clinical information such as age, nursing home status, fever, and tachycardia [38]. Another recent (2018) study stated that an improved score for pre-hospital triaging is needed to predict Intensive Care Unit admission of septic patients [39]. However, even if the optimal score has still to come, the routine use of SOFA score may help physicians in the definition of septic patients. An Italian study showed that at least half of patients affected by sepsis are admitted to Internal Medicine wards and, therefore, adherence to guidelines, routine use of clinical and lab scores and point-of-care ultrasonography are of help for early recognition of septic patients and treat-

ment optimization [40].

Therefore, even though training the staff of ICUs is essential, in our project we have recognized the importance of implementing education and training of nurses and physician from all working areas of our hospital, especially on the early identification of sepsis by screening tools such as 'qSOFA' score. For this proposal, our study sample was not composed of only ICU nurses and physicians, but it consisted of almost all the categories of hospital workers such as cardiologists, nephrologists, pulmonologists, general surgeons, neurosurgeons, emergency room physicians, orthopedists, and gastroenterologists. However, a limitation of this study was that we were not able to compare the levels of sepsis knowledge between ICU and not-ICU workers, because our sample was no sufficient for this proposal. Our study has also certain strengths, because educational workshops for nurses and physicians were performed for all wards of our hospital, following the publication of the 2016 SSC guidelines. Our questionnaire was validated and useful to study the level of knowledge of sepsis management and sepsis score for its early identification among nurses and physicians, and it could be used in further research on this topic. In addition, to our best knowledge, this was the first Italy-based study concerning the knowledge of sepsis among nurses and physicians from ICU and non-ICU hospital wards after the release of 2016 Sepsis Guidelines.

There is no much literature on this issue, which, however, is considered very important among health professionals. In 2004, Poeze et al. [19], through an international telephone survey on knowledge and perception of sepsis, showed that there was a general awareness of the importance and impact of sepsis among European and US hospital doctors interviewed, who considered sepsis as a leading cause of mortality, and a commonly encountered condition with an increasing incidence, whose diagnosis was being missed frequently. This was associated with a high perceived lack of common definition and monitoring tools for its early diagnosis.

In conclusion, our study shows the importance of continuous education for both nurses and physicians for early identification and management of sepsis. Education workshops should be updated and based on the 2016 SCC guidelines. Continuous educational programmes are effective to nurses and physicians to mantain their current skills and theoretical knowledge on sepsis. This could lead to their behavior change and a subsequent reduction in sepsis mortality [13, 17, 41]. The implementation of nationwide education programmes by the national professional societies worldwide, and specific in-hospital protocols should be developed based on the 2016 Surviving Sepsis Campaign (SSC) guidelines. Probably, following a shared protocol could reduce in-hospital occurrence and mortality rates of sepsis in the next future.

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