Sepsis

Survey on physicians' knowledge of sepsis: Do they recognize it promptly?

Murillo Assunção MD⁹, Nelson Akamine MD⁹, Guttemberg S. Cardoso MD⁹, Patricia V.C. Mello MD⁹, José Mário M. Teles MD⁹, André Luís B. Nunes MD⁹, Marcelo Oliveira Maia MD⁹, Álvaro Rea-Neto MD⁹, Flavia Ribeiro Machado MD⁹ for the SEPSES study group

Disciplina de Anestesiologia, Dor e Terapia Intensiva, Universidade Federal de São Paulo, São Paulo, São Paulo, Brazil
Latin American Sepsis Institute, Brazil
Hospital de Terapia Intensiva, Universidade Estadual do Piauí, Teresina, Piauí, Brazil
Hospital Português, Salvador, Bahia, Brazil
Hospital São Camilo, São Paulo, São Paulo, Brazil
Hospital Santa Luzia, Brasília, Distrito Federal, Brazil
Hospital de Clínicas, Universidade Federal do Paraná, Curitiba, Paraná, Brazil

Abstract

Purpose: In Brazil, sepsis has a high mortality; and early recognition is essential in outcome. The aim of the study was to evaluate physicians’ knowledge about systemic inflammatory response syndrome (SIRS), sepsis, severe sepsis, and septic shock concepts.

Methods: This was a prospective, observational study performed in 21 hospitals in Brazil, which enrolled physicians working in the participant institutions. A previously validated questionnaire was applied to physicians including 5 clinical cases.

Results: Twenty-one Brazilian institutions enrolled 917 physicians. The percentage of physicians correctly recognizing SIRS, infection, sepsis, severe sepsis, and septic shock was 78.2%, 92.6%, 27.3%, 56.7%, and 81.0%, respectively. Intensivists performed better in all diagnoses. There was a significantly higher rate of correct answers for SIRS ($P < .001$), sepsis ($P = .001$), and severe sepsis ($P = .032$) among physicians from university hospitals as compared with those from public hospitals. A mean global score of $3.36 ± 1.08$ was found, with better performance for residents ($P = .012$) and intensivists ($P < .001$); but no difference was found for emergency physicians ($P = .875$).

Keywords:
Sepsis;
Severe sepsis;
Septic shock;
Professional practice;
Education and diagnoses

☆ The author(s) declare that they have no competing interests.
☆☆ Authors’ contribution: MA, FRM, and NA conceived and participated in the design and coordination of the study. All authors contributed to data collection. MA performed the statistical analyses. MA and FRM drafted the manuscript. GSC, PVCM, JMMT, ALBN, MOM, and ARN revised the article. All authors read and approved the final manuscript.

* Corresponding author. Disciplina de Anestesiologia, Dor e Terapia Intensiva, Universidade Federal de São Paulo, Rua Napoleão de Barros, 715-6° andar, Vila Clementino, 04024-002 São Paulo, Brazil. Tel.: +55 11 55764069; fax: +55 11 55757768.
E-mail addresses: murilloassuncao@gmail.com (M. Assunção), akamine@einstein.br (N. Akamine), gscar1@ig.com.br (G.S. Cardoso), patmello03@yahoo.com (P.V.C. Mello), zemario@atarde.com.br (J.M.M. Teles), murilloassuncao@gmail.com (A.L.B. Nunes), murilloassuncao@gmail.com (M.O. Maia), reaneto@uol.com.br (A. Rea-Neto), fmachado.dcir@epm.br (F.R. Machado).

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doi:10.1016/j.jcrc.2010.03.012
1. Introduction

Sepsis incidence and mortality are high all over the world [1-4]. The Brazilian Sepsis Epidemiological Study involved patients in intensive care units (ICUs) in Brazilian private and public hospitals, with mortality rates of 33.9%, 46.9%, and 52.2% for sepsis, severe sepsis, and septic shock, respectively [5]. In 2008, Sogayar et al [6], while assessing the costs of sepsis treatment in Brazilian hospitals, reinforced the data found in the Brazilian Sepsis Epidemiological Study on the high general mortality rate (43.8%). A further series involved 75 Brazilian hospitals; and sepsis, severe sepsis, and septic shock related mortality was 16.7%, 34.4%, and 65.3%, respectively [7]. In a study conducted using data on patients with severe sepsis and septic shock from several countries, Brazil presented a 55.0% mortality rate, being the country with the highest mortality rate [8].

Early treatment through protocols with well-established therapeutic targets can reduce sepsis-related morbidity and mortality [9-14]. However, early intervention calls for prompt recognition by the team managing the patient. The few studies that have assessed health professionals’ capacity to recognize patients with sepsis suggested knowledge of the concepts of sepsis and its clinical forms of presentation to be limited among the health care professionals, with very low rates of correct answers [15-19]. Most of them involved a limited series [15-19], and only one [15] assessed the theoretical knowledge of the 1992 American College of Chest Physicians/Society of Critical Care Medicine consensus definitions [20]. In that study, a multicenter and international trial with 1058 physicians from several specialties; as few as 22.0% of those physicians achieved 100% correct diagnosis. Those physicians were considered to be those that specified intensive care as their primary specialty, whether or not they were board certified in critical care medicine by the Associação Medicina Intensiva Brasileira (AMIB; Brazilian Intensive Care Association) and whether or not they had completed a critical care medicine fellowship. Work in the emergency department (ED) was defined as performance of a systematic on-call duty in the ED, although this was not their main professional activity. Intensivists and current residents were not included in this group.

Sepsis can affect any patient, regardless of the presence or type of comorbidity. Thus, physicians in all specialties should be aware of the early signs of sepsis. This would make an early diagnosis and appropriate treatment possible, leading to a better prognosis in these patients. This study aimed to assess the capacity of the practicing physicians in Brazilian hospitals to recognize clinical cases of infection, systemic inflammatory response syndrome (SIRS), sepsis, severe sepsis, and septic shock according to the definitions in the 1992 consensus conference, as well as to correlate the level of accuracy in such recognition with the demographic and professional characteristics of the physician.

2. Material and methods

This is a multicenter study involving physicians practicing in several Brazilian states. Representative hospitals from all regions were invited for a nationwide characterization of the physician’s sepsis knowledge profile. Public, private, and university hospitals participated in the study. Public hospitals were considered to be those in which the main paying source was the Brazilian Sistema Único de Saúde (Unified Healthcare System), even if these hospitals also handle private patients or if these hospitals are with partnerships. Hospitals whose paying source was the patient himself/herself or his/her health plan were considered private. University hospitals were considered to be only those connected to public or private schools of medicine and not the ones with medical residency program.

All physicians, including residents, were allowed to participate in the study by completing a single questionnaire. There were no exclusion criteria. Physicians practicing in the ICU could participate as long as they would not exceed, in absolute numbers, half the sample provided.

The following data were collected to characterize the responding physicians’ year of graduation, medical residency background, specialty, and type of hospital in which they work the most, using the same definitions used in the study center classification. Intensivist physicians were considered to be those that specified intensive care as their primary specialty, whether or not they were board certified in critical care medicine by the Associação Medicina Intensiva Brasileira (AMIB; Brazilian Intensive Care Association) and whether or not they had completed a critical care medicine fellowship. Work in the emergency department (ED) was defined as performance of a systematic on-call duty in the ED, although this was not their main professional activity. Intensivists and current residents were not included in this group.

Confidentiality was strictly maintained, and the subjects were informed that completion of the questionnaire would be equivalent to obtaining an informed consent. The study was approved by the coordinating center’ Research Ethics Committee at Federal University of São Paulo.

The questionnaire was composed of demographic data; the medical activity characteristics; and, in separate sheets, 5 fictitious medical cases involving patients that presented with infection, SIRS, sepsis, severe sepsis, and septic shock (see additional data file 1 for the original questionnaire). Before the study began, 5 AMIB board-certified intensivists, all of them considered experts in sepsis, validated the questionnaire. Those physicians achieved 100% correct diagnosis.

The principal investigator in each center was instructed on the application of the questionnaires through a manual. Every center received 50 questionnaires, with no autonomy to reproduce them; additional copies when needed were requested from the coordinating center. The questionnaire’s

Conclusion: The prompt recognition of sepsis and its severity is not satisfactory. This difference is probably due to the difficulty in the recognition of organ dysfunction, which hampers early identification of septic patients.
sheets were handed to the participant by the center coordinator or someone he or she assigned after training. The sheets were distributed in a strict order: identification card, medical cases of SIRS, septic shock, sepsis, severe sepsis, and infection. Upon completion of each sheet, the participant would put it in an envelope. The participant was not allowed to review the answers. As soon as the last sheet was completed, the envelope was sealed with no identification of the participant. This method was adopted to ensure confidentiality.

2.1. Statistical analysis

The study sample was based on a predicted incidence of correct answer considering an infinite population and not in comparison between different groups. The hypothesis was that 70% of this infinite population would provide an incidence of 70% correct answers, with a 3% sampling error and 95% confidence interval. The number of samples was estimated at 896.

In regard to the questions, only one was considered correct. The erasure answers were considered incorrect. The results were demonstrated using percentages and number of correct answers, varying from 1 to 5. In addition, in an assessment as a continuous variable, the global score was considered to be the sum of correct answers to the 5 questions, each one of which was assigned a score of 1 or 0, resulting in a highest global score of 5. Those values were expressed as mean ± standard deviation and as median (25%-75% interval).

The global score variable was subject to a variance homogeneity test (Bartlett test) and to the D’Agostino and Pearson normality test, identifying nonnormal distribution. Thus, in the analyses of subgroups, the Mann-Whitney or Kruskal-Wallis test, followed by the Dunnett test in case of more than 2 groups, was used. Pearson correlation was used to correlate the global score with the respondent’s age. The erasure answers were considered incorrect. The results were demonstrated using percentages and number of correct answers, varying from 1 to 5. In addition, in an assessment as a continuous variable, the global score was considered to be the sum of correct answers to the 5 questions, each one of which was assigned a score of 1 or 0, resulting in a highest global score of 5. Those values were expressed as mean ± standard deviation and as median (25%-75% interval).

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Results with values of $P < .05$ were considered statistically significant. GraphPad (La Jolla, CA) Prism 5 for Windows version 5.0-2007 and SPSS (Chicago, IL) 15.0 package for Windows were used for statistical analysis.

3. Results

A total of 21 hospitals participated in this study, 17 located in the state capitals and 4 in the interior of the states. Four were public; 9, private; and 8, university hospitals. One thousand and two hundred questionnaires were sent to these hospitals. Nine hundred seventeen (76.4%) questionnaires were completed between January and April of 2005.

The characteristics of the population studied are demonstrated in the Table 1. Physicians specialties and number of participants per specialty were as follows: intensive care, 228 (25%); surgery, 175 (19.2%); internal medicine, 154 (16.9%); cardiology, 107 (11.7%); anesthesiaology, 34 (3.7%); nephrology, 22 (2.4%); gynecology, 21 (2.3%); gastroenterology, 16 (1.8%); pulmonary, 15 (1.6%); hematology, 7 (0.8%); rheumatology, 7 (0.8%); endocrinology, 6 (0.7%); and other specialties, 119 (13%). Among the nonintensivist physicians, 414 (60.1%) had on-call duties in the ED, 140 (33.9%) of which were residents. Therefore, 274 made up the group considered as working in the ED.

The percentage of correct answers according to the diagnosis is demonstrated in Table 2. Sepsis was most frequently misdiagnosed as infection (66.5%), that is, misdiagnosed as the presence of infection without clinical and laboratory signs of inflammatory response. In cases of severe sepsis, misdiagnosis varied from sepsis (17.5%), septic shock (12.1%), and infection (11.12%).

Univariate analysis showed a significantly better performance in recognizing all diagnosis by intensivists than...
nonintensivists. Boarded intensivists performed better than nonboarded in sepsis diagnosis. There was a significant difference between physicians with or without activity in ED only in promptly recognizing infection. Resident physicians performed better than nonresidents when diagnoses were SIRS and septic shock.

Regarding institutions in which physicians work, partition \( \chi^2 \) analysis showed a significantly higher rate of correct answers for the SIRS diagnosis among physicians from university hospitals as compared with public \((P < .001)\) and private ones \((P = .004)\). For sepsis and severe sepsis, the rate of correct answers was higher among physicians from university hospitals as compared with public ones \((P = .001\) and \(P = .032\), respectively), with a difference also in favor of private hospitals in relation to the latter \((P = .053\) and \(P = .044\), respectively).

In the multivariate logistic regression, 2 variables remained related to sepsis recognition: the specialty (AMIB board-certified intensivists: \(OR = 5.031 \ [3.440-7.358]\) and not AMIB board-certified: \(OR = 2.512 \ [1.645-3.838]\), in relation to nonintensivists) and the type of institution (university: \(OR = 2.017 \ [1.353-3.006]\) and private: \(OR = 1.486 \ [0.994-2.221]\), in relation to public). Similarly, in regard to severe sepsis, both the institution and the specialty were considered significant (institutions—private: \(OR = 1.411 \ [1.010-1.971]\) and university: \(OR = 1.455 \ [1.033-2.049]\); specialty—boarded: \(OR = 3.107 \ [2.017-4.786]\) and nonboarded: \(OR = 1.871 \ [1.220-2.869]\)).

Categorized distribution of scores among all physicians was as follows: score 0, 0.2% (2); score 1, 3.7% (34); score 2, 18.3% (168); score 3, 32.1% (294); score 4, 29.0% (266); and score 5, 16.7% (153). Between resident and nonresident physicians, there was a difference in the distribution of scores \((P = .006)\), specifically for scores 2 \((P = .001)\) and 4 \((P = .001)\). A significant difference was also found among board-certified intensivists, non–board-certified intensivists, and other specialties physicians \((P < .01\), Fig. 1), but not among physicians with and without ED activity \((P = .861)\). The distribution of scores in relation to the type of hospital was significantly different \((P < .001, \text{Fig. 2})\).

Considering the global score, a mean value of 3.36 ± 1.08 was obtained. There was no correlation between mean score and age \((r = −0.235, P < .0001)\) or sex \((\text{median, 3.0 [3.0-4.0]}\) and \(3.0 [3.0-4.0], \text{respectively, } P = .870)\). Resident physicians performed better in relation to nonresidents \((\text{medians, 4.00 [3.00-4.00] and 3.00 [3.00-4.00], respectively, } P = .012)\), as did intensivists compared with nonintensivists \((\text{medians, 4.00 [3.00-5.00] and 3.00 [2.00-4.00], respectively, } P < .001)\) (Fig. 3). There was no difference in the global score in relation to physicians with and without ED activity \((\text{median, 3.00 [2.00-4.00] and 3.00 [2.00-4.00], respectively, } P = .875)\). When comparing the scores among physicians from different types of hospital, a significant difference was noted favoring university hospitals \((\text{public, 3.00 [2.00-4.00]; private, 3.00 [3.00-4.00]; university, 4.00 [3.00-4.00]; } P = .005)\) (Fig. 4).

### Table 2  Rate of correct answers for each diagnosis according to professional characteristics

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Infection</th>
<th>SIRS</th>
<th>Sepsis</th>
<th>Severe sepsis</th>
<th>Septic shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>92.6% (849)</td>
<td>78.2% (717)</td>
<td>27.3% (250)</td>
<td>56.7% (520)</td>
<td>81.0% (743)</td>
</tr>
<tr>
<td>Medical specialty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensivist</td>
<td>96.9% (221)</td>
<td>91.7% (209)</td>
<td>48.2% (110)</td>
<td>71.9% (163)</td>
<td>86.0% (196)</td>
</tr>
<tr>
<td>Nonintensivist</td>
<td>91.1% (628)</td>
<td>73.7% (508)</td>
<td>20.3% (140)</td>
<td>51.7% (356)</td>
<td>79.4% (547)</td>
</tr>
<tr>
<td>(P)</td>
<td>.004 *</td>
<td>&lt;.001 *</td>
<td>&lt;.001 *</td>
<td>&lt;.001 *</td>
<td>.028 *</td>
</tr>
<tr>
<td>Intensivist</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boarded</td>
<td>96.7% (117)</td>
<td>93.4% (113)</td>
<td>56.2% (68)</td>
<td>76.9% (93)</td>
<td>82.6% (100)</td>
</tr>
<tr>
<td>Nonboarded</td>
<td>97.1% (102)</td>
<td>90.5% (95)</td>
<td>39.0% (41)</td>
<td>66.7% (70)</td>
<td>90.5% (95)</td>
</tr>
<tr>
<td>(P)</td>
<td>&gt;.999 †</td>
<td>.420 *</td>
<td>.010 *</td>
<td>.088 *</td>
<td>.088 *</td>
</tr>
<tr>
<td>Activity in ED</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>94.5% (259)</td>
<td>70.4% (193)</td>
<td>16.1% (44)</td>
<td>51.8% (142)</td>
<td>77.7% (213)</td>
</tr>
<tr>
<td>No</td>
<td>88.3% (181)</td>
<td>74.1% (152)</td>
<td>21.0% (43)</td>
<td>49.8% (102)</td>
<td>76.1% (156)</td>
</tr>
<tr>
<td>(P)</td>
<td>.014</td>
<td>.371</td>
<td>.167</td>
<td>.654</td>
<td>.673</td>
</tr>
<tr>
<td>Resident physicians</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>90.8% (158)</td>
<td>88.5% (154)</td>
<td>31.6% (55)</td>
<td>59.2% (103)</td>
<td>85.6% (149)</td>
</tr>
<tr>
<td>No</td>
<td>93.1% (622)</td>
<td>77.5% (518)</td>
<td>26.9% (180)</td>
<td>56.7% (379)</td>
<td>79.5% (531)</td>
</tr>
<tr>
<td>(P)</td>
<td>.299 *</td>
<td>.001 *</td>
<td>.222 *</td>
<td>.559 *</td>
<td>.067 *</td>
</tr>
<tr>
<td>Type of institution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>92.0% (206)</td>
<td>70.1% (157)</td>
<td>19.6% (44)</td>
<td>50.0% (112)</td>
<td>77.2% (173)</td>
</tr>
<tr>
<td>Private</td>
<td>70.1% (338)</td>
<td>76.9% (280)</td>
<td>26.6% (97)</td>
<td>58.5% (213)</td>
<td>80.5% (293)</td>
</tr>
<tr>
<td>University</td>
<td>92.6% (300)</td>
<td>85.5% (277)</td>
<td>33.0% (107)</td>
<td>59.3% (192)</td>
<td>81.0% (273)</td>
</tr>
<tr>
<td>(P)</td>
<td>.922 *</td>
<td>&lt;.001 *</td>
<td>.002 *</td>
<td>.066 *</td>
<td>.113 *</td>
</tr>
</tbody>
</table>

Data shown in percentage (number) of correct answers.

* Pearson \(\chi^2\).

† Fisher exact test.
4. Discussion

Our results demonstrated that physicians’ knowledge of sepsis and severe sepsis concepts is unsatisfactory, even among intensivists and those working in the ED. This study showed lower rates of correct answers in regard to sepsis (27.3%) and to severe sepsis (56.7%). Despite the differences in the study design and in the sample number, those rates are better than the ones reported by Poeze et al.[15], in which as few as 22.0% of the intensivists and 5.0% of the physicians from other specialties were able to define sepsis correctly [15,20]. Fernandez et al [17] showed that 31.4% of the sample was able to recognize SIRS. Pizzolatti et al [16] showed, in a small sample of Brazilian responding physicians (n = 25), that 62.0% and 74.0% were able to correctly define SIRS and sepsis, respectively [16]. Those data, different from the ones herein, can be explained once they involved mainly boarded intensivists in university centers. Besides, the small size of the sample may have compromised a more accurate analysis.

The low rate of correct answers for severe sepsis (56.7%) must be related to the difficulty in recognizing organ dysfunction as an indicator of the severity of illness because the validation process and the presence of 2 well-characterized dysfunctions preclude problems related to the clinical case proposed in the questionnaire. Interesting is the finding that what many believe to be sepsis is actually the disease with the presence of organic disorder, that is, severe sepsis, as most of the mistakes in the severe sepsis question occurred through the answer “sepsis.” It is true that many clinicians use the words sepsis and severe sepsis synonymously, although this mistake does not necessarily lead to equal treatment in both situations. Although we did not specifically ask respondents what they thought the patient’s risk of death was or what should be the clinical conduct in each case, this finding may be a sign that physicians have difficulty in recognizing the presence of organ dysfunction as an alert for emergency care. As this
In regard to sepsis, the issue probably is the differentiation from infection with no signs of inflammatory response, which was the selection made by the majority of those who gave the incorrect diagnosis. However, it is not clearly shown that the presence of SIRS signs per se would imply increased morbidity and death risk, although a study demonstrated that the association of 3 or 4 SIRS criteria would imply increased mortality [21]. However, other studies already showed that the presence of SIRS did not change mortality rates of infection [22-24]. Could that actually be considered a risk factor, this limited knowledge of the sepsis concept may also have more severe implications in prognostic terms, assuming relevance also in regard to educational policies.

The intensivist physicians presented a better performance as compared with nonintensivists. This had been expected because sepsis is a disease of high prevalence and incidence in the Brazilian ICU. However, the rates of correct answers were quite low for sepsis (48.2%), severe sepsis (71.9), and even septic shock (86.0%). These results are better than the ones reported by Poeze et al (2004), where as few as 22.0% of intensivist physicians were able to define sepsis as per the consensus. The differences in the study design, fictitious medical cases attempting to depict the reality instead of telephone interviews focusing on the concepts, may have facilitated the development of the diagnostic hypothesis; that is, perhaps, mastering a concept is more difficult than assessing a medical case. Differently from the intensivists, it was not possible to detect any difference between physicians with and without ED activity in regard to recognizing sepsis and severe sepsis concepts. Such situation can be worrisome, as it might reflect a difficulty in recognizing the clinical scenario of organ dysfunction. This category of physicians, like the intensivists, is in contact with a large portion of the population with sepsis.

Ziglam et al [18] showed that 48.0% and 67.0% of the resident physicians were able to identify severe sepsis and septic shock; and these results are less satisfactory than the ones found in our study (59.2% and 85.6%, respectively). Furthermore, in regard to the global score, resident physicians performed better as compared with nonresidents, probably for being in the educational phase, for a large portion of them, in university centers. This suggests that the current medical education process may become responsible for improved knowledge and, as a result, for recognition of the different clinical forms of presentation of this disease; it may even play a role in mortality reduction in the future.

The physicians from public hospitals showed a lower global score than the other ones. In Brazil, several studies have demonstrated high sepsis-related mortality [5,7,25,26], particularly in public hospitals [5,25]. There are many possible reasons for this higher mortality in public hospitals. However, disease severity and treatment resources did not seem to be different, as stated in those studies [5,25], although another Brazilian study of a small sample of patients clearly showed that delay in sepsis recognition in a public hospital was associated with higher mortality [27]. This may be one of the possible reasons for this finding, and we can hypothetically suppose that absence of knowledge may be one of the reasons for this delayed recognition of organ dysfunction.

This study has some strengths. First, the questionnaire validation by 5 board-certified intensivists was, in our opinion, adequate. This validation process occurred in just one of the studies cited, but with no description of the process itself [17]. Likewise, the application process was strictly established. Aiming to maintain data homogeneity, each center’s coordinator was instructed on how to apply the questionnaire. Second, this is one of the largest reported series on physicians’ knowledge of sepsis concepts. Previous studies have assessed from 25 up to 144 individuals [15-19]. This one achieved almost 1000 physicians assessed, accounting for 76.4% of the total of questionnaires forwarded, with minimum losses, which makes the data quite robust when compared with other studies [28,29]. Third, it evaluated the assimilation of concepts and not only their definitions. Most previous studies have assessed mainly the theoretical concepts of knowledge, not evaluating its correlation with the clinical practice through the use of clinical cases [15-18]. Fourth, this study approached, in a single sample, residents, intensivists, and nonintensivist physicians and those with ED activity, representing a large portion of the medical team directly responsible for medical assistance. The subjects included in the previous studies were variable. Some included nonresidents, intensivists, and nonintensivist physicians [15]; one study included only resident physicians [18]; one included ED and intensive care physicians [16]; one included resident and nonintensivist physicians [17]; and one study studied the knowledge of ward nurses [19].

On the other hand, the study has some limitations. First, assessing knowledge through clinical cases, particularly because of the small number of questions, may be considered inadequate from the educational point of view. Although clinical cases are more realistic than a test of theoretical knowledge, we cannot firmly infer that the performance of the physicians that completed the questionnaire would be the same within a real setting. Moreover, our study did not measure physicians’ knowledge about sepsis or its management. It did measure the ability of physicians to articulate the specific diagnostic criteria of the 1991 consensus conference, which is not necessarily a sign of a lack of knowledge or a lack of recognition of the clinical entity. However, it has to be pointed out that knowing the concepts may be an important step to recognizing the disease in the clinical scenario. Taking this into account, it is also a limitation regarding the stated superior performance of intensivists, as it might not be a reflection of greater diagnostic acumen but simply a greater
familiarity with the specific criteria of the American College of Chest Physicians/Society of Critical Care Medicine consensus conference. However, the low rates of correct answers suggest an actual knowledge deficiency. Second, our series may not adequately represent the national reality considering that the centers were located in the capitals and hospitals were previously selected to participate in a multicenter study. In a way, this may mean a better quality of the medical staff in those hospitals in relation to the national reality.

5. Conclusions

Our main conclusion is that, although the medical knowledge of the concepts of SIRS, infection, and septic shock is satisfactory, the same cannot be said in regard to the concepts of sepsis and severe sepsis. This difference is probably due to the difficulty in the recognition of organ dysfunction per se and to the lack of knowledge that the presence of organ dysfunction defines severe sepsis. The intensivist physicians and residents in training had a better performance when compared with ED physicians. The physicians practicing mainly on Brazilian public hospitals had the worst performance, which may play a role in the higher sepsis-related mortality found in this type of hospitals.

Acknowledgments


Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jcrc.2010.03.012.

References