Sepsis: A Study of Physician’s Knowledge about the Surviving Sepsis Campaign in Puerto Rico

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Abstract

**Purpose:** To measure the degree of physician’s knowledge of the SSC management guidelines in Puerto Rico.

**Materials and methods:** A questionnaire was administered personally to 231 physicians. It included therapeutic interventions and important elements of the guidelines. Physicians including internal medicine and general surgery from public and private hospitals around the entire island answered the questionnaire.

**Results:** In general, the sample population performed quite poorly, with a mean of less than 50% correct answers, including the internal medicine attendings. PGY-3 residents had a higher percentage of correct answers than attending (52.5% vs. 47.4%, p =0.21). Correlating directly with the level of training, a trend toward more knowledge was noted (PGY-3 52.5% vs. PGY-1 42.2%, p =0.08).

PGY2 and PGY-3 residents in internal medicine demonstrated a significant knowledge of the SIRS criteria compared with the first year residents (p =0.01 for PGY-1 vs. PGY-2, and p =0.02 for PGY-1 vs. PGY-3).

Of the questions concerning bundle components, the worst scores were on those focused on use of steroids (21.3%), glucose control (42.6%) and ventilation (40.1%).

**Conclusions:** Regardless of their levels of training, internists and surgeons fared quite poorly in those questions that specifically address most therapeutic interventions known to reduce sepsis mortality.

Our findings revealed no difference in knowledge between physicians in-training and their counterparts in private practice. This is quite unexpected, as one would anticipate improved and updated knowledge in those in the academia. Considering the morbidity and mortality associated with sepsis, these findings warrant an initiative to correct them.

**Key words:** Sepsis, systemic inflammatory response syndrome (SIRS), Surviving Sepsis Campaign (SSC) guidelines, drotrecogin-alfa.

Background

Sepsis is a clinical syndrome characterized by systemic inflammation and widespread tissue injury. It results from an excessive inflammatory host response to an infective agent which, when generalized, involves normal tissue not originally affected by the causative organism(s) [1]. There is massive release of inflammatory mediators, causing leukocytes to accumulate in organs distant from the initial infection, with further inflammation. Recent evidence recognizes the active role of a deregulated coagulation cascade
in the pathophysiology of sepsis [2,3]. These changes result in severe alterations of the microcirculation with the end result being tissue hypoperfusion.

The term systemic inflammatory response syndrome (SIRS) was coined to describe the host’s response to a wide array of noxious stimuli and is defined by the presence of two or more of the following manifestations: a core temperature of >38° or <36°C, a heart rate >90 beats/min, respiratory rate >20/min or PCO₂ <32 mmHg, and a white blood cell count of >12,000, <4,000 or >10% immature neutrophils (“bands”). Sepsis is thus defined as SIRS that occurs due to a known or suspected infection.

Recent years have seen an increased incidence of sepsis. Martin et al [4] showed that over 650,000 cases of sepsis are diagnosed annually in the United States, leading to more than 100,000 deaths. Despite medical and technological advances in treatment, the overall mortality rate in most institutions has remained at 40-45%. Data from Puerto Rico confirms that the incidence of sepsis and its associated mortality are comparable to that of the United States.

In 2004, a group of international critical care and infectious diseases physicians gathered to develop management guidelines, with the ultimate goal of improving the outcome of patients with severe sepsis and septic shock. At the end of that year, and with the support of the Society of Critical Care Medicine (SCCM), the Surviving Sepsis Campaign (SSC) guidelines was published [5]. The guidelines emphasize early interventions that have had a positive impact in survival. Hence, knowledge of the guidelines will parenthetically result in improved sepsis mortality. However no studies to date have evaluated the degree of penetration.

We decided to audit the depth of practicing physician’s knowledge of the SSC guidelines in both teaching and private hospitals in Puerto Rico.

Methods

Our study was approved by the Institutional Review Board of the VA Caribbean Healthcare System.

We conducted a prospective, descriptive study in which a questionnaire written by the Pulmonary/Critical Care Medicine staff at the VA Caribbean Healthcare System was administered to residents and practicing physicians at six teaching and five private hospitals in Puerto Rico. Three independent pulmonary/critical care medicine physicians who were not part of the study reviewed the questionnaire for appropriateness of the questions and specific area of the guidelines covered. Then, the questionnaire was administered to the Pulmonary/Critical Care Medicine attendings and fellows at our hospital (4 Pulmonary/Critical Care attendings and 7 fellows) and the results reviewed; since the percent correct answers for that group approached 100%, we elected to exclude Pulmonary/Critical Care Medicine attendings and trainees from our audit.

Hospitals were chosen based on their number of beds, geographic location and willingness to participate in the study. There are 52 acute-care hospitals in Puerto Rico, with a total of 8,070 beds. Seven of these are teaching hospitals [with Accreditation Council on Graduate Medical Education (ACGME)-accredited internal medicine and/or surgery residency programs) with the remainder been private hospitals. Nineteen hospitals are located within the geographic Greater Metropolitan (San Juan) area, 7 in the North region, 10 in the South, 6 in the East and 10 in the West. Approximately 10% of these are ICU beds. We selected 6 teaching hospitals (4 in the Metropolitan area, one in the West and one in the South) representing the majority of residency training positions in Puerto Rico. We then contacted all private hospitals to seek their participation in the study; 5 hospitals volunteered to participate (1 in the West, 1 in the South, 1 in the North and 2 in the Metropolitan areas). Our sample represents approximately 21% of all hospital beds in the island, and approximately 80% of all ACGME-accredited internal medicine and surgery residency position.

The study population included general internists and subspecialists, general surgeons and
residents in both internal medicine and surgery (Figure 1). All subjects volunteered to participate in the survey. Three investigators (RF, JLN and MF) visited all participating hospitals to supervise the administration of the study questionnaires and collect the answer sheets.

The questionnaire consisted of 13 questions, each designed to specifically test knowledge in broad aspects of the SSC guidelines: questions 1 to 4 addressed general knowledge regarding the SSC and its goals, question 5 measured knowledge of the diagnostic criteria for SIRS, question 6 addressed the current data regarding the outcome of severe sepsis and questions 7 to 13 tested knowledge on specific management recommendations (see Appendix).

We chose to analyze our data based on level of training and type of hospital. Residents were divided based on their year of training (PGY-1 to PGY-3); attendings were divided based upon their type of practice (teaching vs. non teaching hospital). Surgeons constituted the smallest part of our study population and were evaluated separately.

Statistical analysis: Differences between groups were analyzed by both chi square and Student’s t-test. Results were considered significant at a p value <0.05. Data are expressed as percent correct answers.

Results

A total of 231 physicians at all levels agreed to answer the questionnaire. The majority of responders were internal medicine residents (Figure 1). Participants from surgery were a very small part of our group (n =39, 17%).

Overall Scoring: In general, our study population performed quite poorly, with a mean of less than 50% correct answers (Figure 2). Internal medicine attendings fared weakly as well; PGY-3 residents had a higher percentage of correct answers than attendings although the results were not statistically significant (52.5% vs. 47.4%, p =0.21). The percentage of correct answers appeared to improve based on the level of training; residents at the PGY-3 level did better than PGY-1 residents, with a trend towards statistical significance (52.5% vs. 42.2%, p =0.08). As a group, surgical residents did significantly better than attending surgeons (55.1% vs. 38.8%, p =0.05).

Practice-Based Results: Internal medicine attendings from teaching hospitals did not have a higher percentage of correct answers than private internists practicing in non-teaching hospitals (Figure 3).

Specific Questions: We divided our questionnaire based on the type of guideline-based intervention. It addressed into 4 large groups: general knowledge, mortality data and goals, resuscitation and management bundles; the first class of questions also included knowledge on the criteria that define SIRS.

General Knowledge and Mortality (Figures 4 and 5): There was a tendency towards better awareness of the initiative leading to publication of the SSC guidelines throughout training in internal medicine, although the differences did not reach statistical significance. Moreover, we also identified a tendency for a reduced degree of such knowledge between PGY-3 residents and attending physicians, which again did not reach statistical significance. Similar tendencies were noted when we analyzed the responses to the questions addressing the current mortality rate in severe sepsis and the SSC’s goals towards reducing that rate.

SIRS Diagnosis (Figure 6): PGY-2 and PGY-3 residents in internal medicine demonstrated a significantly better understanding of the definition of SIRS than PGY-1 residents (p =0.01 for PGY-1 vs. PGY-2, and p =0.02 for PGY-1 vs. PGY-3). Once again, attendings scored poorly in this question when compared with PGY-3 residents, with the difference being almost statistically significant (p =0.06).

Resuscitation Bundle (Figure 7): Questions in this group measured knowledge on the early use of appropriate antibiotics, the serial evaluation of plasma lactate as a marker of tissue perfusion, and the choice of resuscitation fluids. PGY-3 residents scored significantly better on the issue of lactate measurements
compared to both PGY-1 and attendings (p =0.05 and 0.02 respectively); this was also the question with the highest overall percentage of correct answers (79.3%). The percent correct scores were comparable between the groups on the issues of antibiotics and resuscitation fluids.

**Management Bundle (Figure 8):** Questions within this group addressed knowledge on such interventions as tight glucose control, low-dose steroids, lung protective ventilation and the use of drotrecogin-alfa. Once more, the percent correct scores in each of these questions averaged less than 50%, except for the question on the use of drotrecogin-alfa where the mean percent correct score for the entire population was 54%. The latter was the second-best percent correct score question for the entire population. Performance was particularly weak on the question concerning the use of low-dose steroids, with a mean percent correct score for the entire population of 21.3%.

**Discussion**

Our questionnaire is a simple but effective instrument created to measure knowledge of the SSC guidelines for the management of sepsis. We designed and administered the questionnaire to both house staff and attending physicians at 2 years of the publication of the guidelines. Since the initial publication of the guidelines in 2004 many local and national educational activities, including medical service grand rounds, mortality conferences and resident seminars repeatedly reviewed and discussed these guidelines to house staff at our University Hospital as well as at the VA. At other academic centers in the island conferences and lectures, several of them presided by some physicians within our group, also presented this information to residents and attendings within these teaching hospitals. Outside of the academic medicine environment, meetings such as the American College of Physician’s annual scientific congress also addressed these guidelines.

Thus, we expected that residents and attendings in teaching hospitals will have a working knowledge of the guidelines that would allow them to answer many of the questions correctly. We were disappointed to find that this was not the case; furthermore, the attending physician’s performance was as poor as the residents. In fact, attendings working in teaching hospitals performed just as poorly as general internists in private practice, many of whom have been working outside of an academic setting for many years and whose practices may not allow them to keep abreast of the published literature on severe sepsis.

A number of factors can explain our findings. We believe that having physicians adopt guidelines is dependent on a number of factors, including the guidelines’ applicability to their daily practice, their ease of use, the availability within the hospital of the recommended diagnostic or treatment tools, and others. Despite the fact that the SSC guidelines are based on publications available to physicians for several years already, we found that the interventions suggested by the guidelines are not well known or understood appropriately followed. We are particularly concerned about our findings given the realities of critical care medicine in Puerto Rico, where the great majority of ICUs are open units and patients are managed by internists with the aid of multiple consultants. When internists have such limited knowledge of the SSC guidelines, the initiation and continued use of diagnostic and therapeutic interventions essential for improving the outcome of septic patients may be delayed or omitted altogether. Other barriers to the adoption of the guidelines include the fact that physicians in private practice may lack an evidence-based approach to medicine, as well as a particular hospital’s politics and/or policies. Lastly, the fact humans are slow to incorporate and adapt to change cannot be negated.

The fact that residents in training did little better than attendings suggest that the problem may perpetuate itself unless an aggressive strategy directed at improving physician’s working knowledge of the guidelines is adopted. Such a strategy must, by definition, begin early in training, perhaps even at a medical school level. For example, SCCM has sponsored an initiative directed at introducing critical care medicine in medical school curricula.

Within the resuscitation bundle, lactate measurement was the diagnostic intervention with the
highest percent of correct answers. Lactate has been an established marker of tissue perfusion for over thirty years; one would anticipate such an intervention to be well ingrained in clinical practice. Interestingly, the use of recombinant human activated protein C, or drotrecogin-alfa, was the best recognized therapeutic intervention out of the sepsis management bundle. Although this drug was approved by the FDA in 2002, it is already a well recognized component in the approach to septic patients. This may be related to the effectiveness of the manufacturer’s marketing campaign, and the controversies surrounding this drug.

We believe that our problem is not only a local one but a reflection of a pervasive deficiency and lack of knowledge regarding the SSC guidelines. Other authors (De Miguel Yanes et al [6]) have shown that their own institution’s compliance with SSC guidelines was also poor.

As already implied by the SSC, the publication of guidelines is not sufficient to expand their knowledge and acceptance, or to accomplish a rapid improvement in patient care. The implementation of sepsis bundles is already producing positive results as suggested by Kortgen et al [7] in a study showing a 25% reduction in sepsis related mortality in patients in whom a standard operating procedure based on the SSC guidelines was applied.

Recognizing and treating septic patients effectively remains a clinical challenge. We realize that the manifestations of sepsis in an elderly and chronically ill patient population are quite frequently protean. However, failing to intervene early in the course of severe sepsis will not result in an improvement in patient survival, the predefined goal of the SSC. The failure to intervene early and effectively is commonly caused by deficiencies in awareness of the interventions known to improve outcome in sepsis. We believe our study provides the basis for the design of strategies directed towards correction of these deficiencies. For example, given that lectures and presentation on the guidelines seem to have failed to positively impact knowledge on these guidelines, an approach that includes bedside rounds by visiting professors may be better suited to teaching them. A workshop similar to the Fundamental Critical Care Support (FCCS) course, but limited to sepsis, may represent another approach. Lastly, encouraging medical schools to include sepsis as a separate topic in basic and clinical science courses, with special emphasis in the guidelines and their updates may also improve future physician’s knowledge regarding the diagnosis and treatment of severe sepsis.

Conclusions

Physicians who are most often involved in the care of septic patients (general internists, internal medicine subspecialists, general surgeons and residents) lack a working knowledge of the SSC guidelines for the management of sepsis. This finding was evident in both teaching and non-teaching hospitals in Puerto Rico, and occurred despite an aggressive educational program directed at raising awareness of the guidelines. We need to redesign our educational program throughout the island in order to educate our physicians and consequently provide the best care to these patients.

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Figure 1. STUDY POPULATION

Figure 2. PERCENT CORRECT ANSWERS: INTERNAL MEDICINE GROUP

Figure 3. PERCENT CORRECT ANSWERS: ATTENDING PHYSICIANS
Figure 4. SSC AWARENESS AND BUNDLES: INTERNAL MEDICINE GROUP

Figure 5. SSC MORTALITY REDUCTION GOAL AND SEPSIS MORTALITY

Figure 6. DEFINITION OF SIRS
Figure 7. RESUSCITATION BUNDLE

Figure 8. MANAGEMENT BUNDLE
Appendix

Physician:

a. Attending ______
b. Fellow PGY: ______
c. Resident PGY: _____

Specialty _____________________

1. I have heard about the Surviving Sepsis Campaign
   a. Yes
   b. No

2. The Surviving Sepsis Campaign is an international effort to reduce sepsis mortality by _____ % in 5 years
   a. 5%
   b. 10%
   c. 15%
   d. 20%
   e. 25%

3. There are published guidelines on the management of sepsis
   a. Yes
   b. No

4. SIRS criteria include all except:
   a. Temperature > 100.4 or <96.8 °F
   b. Heart rate >90 beats/minute
   c. RR >20 breaths/minute or hyperventilation pCO₂ <32 mmHg
   d. WBC >12,000 cell/mm³ or <4,000 cell/mm³ or presence of 10% immature neutrophils
   e. Systolic blood pressure <90 mmHg

5. I have heard about the sepsis bundles
   a. Yes
   b. No

6. The mortality of sepsis ranges from:
   a. 2 to 5%
   b. 10 to 15%
   c. 20 to 30%
   d. 20 to 50%
7. The resuscitation bundle include measurement of serum lactate
   a. True
   b. False

8. Antibiotics should be administered within ______ of the presumptive diagnosis of severe sepsis
   a. 15 minutes
   b. 30 minutes
   c. 1 hour
   d. 3 hours
   e. 24 hours

9. Glucose control goals include maintaining the serum glucose:
   a. Between 80-110 mg/dL
   b. Less than 150 mg/dL
   c. Less than 200 mg/dL
   d. Less than 250 mg/dL
   e. Greater than 250 mg/dL

10. According to the sepsis bundle, plateau pressure on the mechanical ventilator should be maintained
   a. Less than 50 cmH₂O
   b. Less than 40 cmH₂O
   c. Less than 30 cmH₂O
   d. Less than 20 cmH₂O
   e. No relevant

11. Colloid solutions should be used in preference to crystalloids as part of fluid resuscitation in septic shock
    a. True
    b. False

12. IV steroids should be given to:
    a. All patients with severe sepsis
    b. Nobody. They have been demonstrated to increased mortality
    c. No relevant
    d. According to ICU policy

13. Drotrecogin alfa should be considered in all except:
    a. APACHE 25
    b. Patient with intracranial hemorrhage
    c. Severe sepsis with high risk of death
    d. >2 organs failure
References