

# Compliance with the Surviving Sepsis Guidelines: A prospective cohort study of critical care in lesser developed countries

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## Abstract

### Introduction

Mortality rates from severe sepsis/shock have declined with implementation of the Surviving Sepsis Guidelines in the western world. Unfortunately, lesser developed countries continue to exhibit high death rates. We hypothesized that this is because of poor adherence to the guidelines and we carried out this study to determine compliance and to identify variables that relate to improved compliance.

### Materials and Methods

Critical care providers were asked to fill out a survey instrument designed to assess compliance with the 2012 Surviving Sepsis Guidelines. Providers from countries located in the Eastern Mediterranean Region were sampled. The study protocol was approved by the Hospital Research Ethics committee.

### Results

175 responses from 11 countries were received; 95 high-income (Saudi Arabia, Bahrain), 8 mid-income (Lebanon, Jordan, Turkey, Iran, Libya), 72 low-income (Pakistan, Syria, West Bank & Gaza, Sudan). Compliance with the Resuscitation bundle was 66% and 47% with the Management bundle. Amongst the individual components, 84% (148) routinely measured lactate, 51% (89) give antibiotics within the first hour of sepsis, 36% (64) measure procalcitonin, 7% (12) routinely use colloidal fluids for resuscitation. 32% (56) do not use lung protective ventilation for patients with acute respiratory distress syndrome and

22% (39) use no stress ulcer prophylaxis. Compliance was significantly associated with 24 hour intensivists coverage,  $p=0.004$ ; 1:1 nurse: patient ratio,  $p=0.000$ ; a rapid response service,  $p=0.001$  and routine measurement of critical care performance indicators,  $p=0.029$ .

### Conclusion

Poor compliance with key recommendations may be responsible for the continued high mortality observed from severe sepsis and shock in these countries. Any effort to improve outcomes will need to address these knowledge and practice deficiencies.

### Introduction

In 2002, the Surviving Sepsis Campaign (SSC) was launched with evidence-based guidelines for the resuscitation and management of patients with severe sepsis and septic shock published in 2004<sup>1</sup>. These recommendations incorporated care processes such as; early goal directed therapy<sup>2</sup>, early antibiotics<sup>3</sup> and ventilatory management of patients with ARDS<sup>4</sup> to improve outcomes. The widely available guidelines have been continually updated, most recently in 2012<sup>5</sup>. Correspondingly, mortality rates from severe sepsis have declined, from 46% (1991-2000) to 29% (2001-2009)<sup>6</sup>, largely ascribed to the implementation of the SSC guidelines as hospital-wide protocols<sup>7,8,9</sup>. Unfortunately, this improved mortality has not been observed in the lesser developed countries with recent reports indicating a still high rate of 40%<sup>10,11,12,13</sup>.

Whether this is related to inability to implement, non-compliance with or lack of awareness of the SSC guidelines is not known. We hypothesized that poor knowledge or practice of the SSC guidelines is a

major hindrance to compliance amongst critical care practitioners.

The aim of this study was to determine compliance with the SSC guidelines in lesser developed countries located in the Eastern Mediterranean Region (EMRO) of the World Health Organization, and to identify variables associated with a higher compliance.

### Materials and Methods

#### Questionnaire Development and Content

A 35-question survey instrument was developed (available on request) that collected resource and institutional information (21 questions) and specific questions regarding compliance with the Resuscitation (5 questions) & Management bundles (9 questions) of the SSC Guidelines. We used the 2012 version of the SSC guidelines<sup>5</sup> as a template for formulating questions. The questions were fixed response with one best choice. A local panel comprised of three board certified critical care physicians and a critical care nurse-educator developed the questionnaire. The questionnaire was then pilot tested on 10 clinicians (5 nurses and 5 physicians) but these responses were not included in the final sample. Based on their feedback, the final instrument underwent expressional and grammatical modifications to maximize clarity. The final instrument required 15 min to fill.

#### Study Group and Survey Methods

This was a prospective, cohort study carried out over a 6-month period in 2013. Any physician or nurse credentialed for critically ill patients was included in the study sample. Participants at critical care conferences in Saudi Arabia and Pakistan were asked to fill out the self-administered, anonymous questionnaire provided at the conference venue. In addition, all

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members of the Middle East Critical Care Assembly (MCCA); a non-profit organization affiliated with the Society of Critical Care Medicine, were invited by e-mail to fill out an online version of the questionnaire. Each questionnaire contained a cover letter from the investigators explaining their interest in determining knowledge and practice of the SSC guidelines. The questionnaire did not solicit any personal information that could link the responses to specific persons. The study protocol was approved by the institutional Research Advisory Committee of the King Faisal Specialist Hospital (RAC No 2131 062).

### Data analysis

After measuring frequencies for presentation of the data, we assessed for adherence to each component of the resuscitation and management bundles. Compliance was defined as adherence to 60% or greater of the guidelines. We grouped countries according to the World Bank's Income Classification, 2012<sup>14</sup> into high, mid and low-income countries and explored differences in compliance using Chi<sup>2</sup> analysis. Fisher's exact test was used where the individual cell counts were less than five. A two-sided p-value of < 0.05 was considered statistically significant. Statistical analysis was carried out using SPSS version 20.0.

### Results

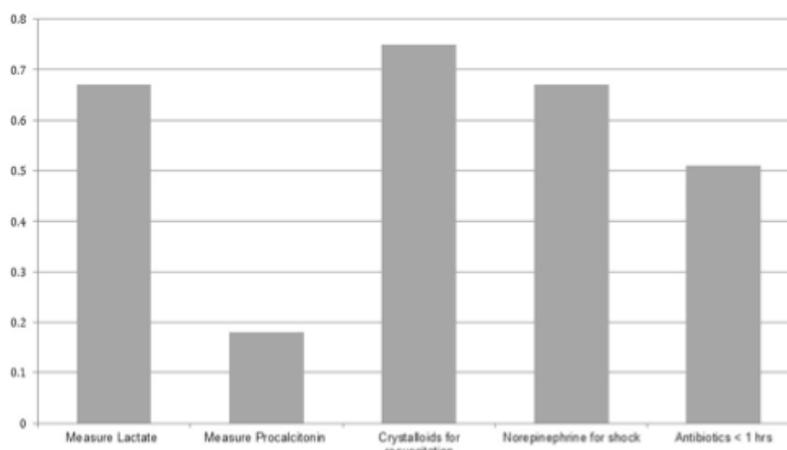
175 responses from 11 countries were received; 95 high-income (Saudi Arabia, Bahrain), 8 mid-income (Lebanon, Jordan, Turkey, Iran and Libya) and 72 from low-income (Pakistan, Syria, West Bank & Gaza and Sudan). One hundred forty (80%) respondents were physicians, 28 (16%) nurses and 7 (4%) 'other' healthcare professionals. One hundred and fifteen (66%) had been formally trained in critical care medicine. Of the physician respondents, 74 (53%) had a background in Internal Medicine followed by Anaesthesiology, 25 (18%) and others (Emergency Medicine, Surgery, none specified), 38

(27%). One hundred fifty-nine (91%) were practicing in urban centres and 69 (39%) were affiliated with governmental hospitals, 65 (37%) University hospitals, 20 (12%) private hospitals and 21 (12%) military hospitals. One hundred twenty-one (69%) worked in hospitals with more than 300 beds. 109 (62%) respondents worked in 'mixed' medical and surgical intensive care units (ICUs) with 16 (9%) in closed units, 24 (14%) in open units, 135 (77%) were not specified. 108 (62%) worked in ICUs with negative pressure rooms and for 110 (63%) participants, hand washing facilities were present in each ICU room.

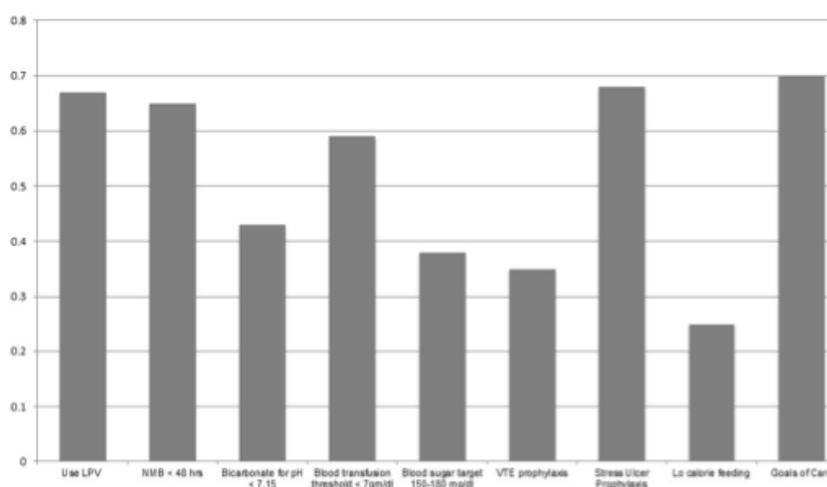
Twenty-four hour intensivist cover was available for 133 (76%)

respondents and 85 (49%) had 1:1 nurse to patient ratios in their ICUs. 90 (51%) respondents worked in hospitals with a Rapid Response Team (RRT). One hundred eighteen (67%) had routine measurement of outcome indicators and established ICU protocols with Lung Protective Ventilation (LPV) protocol for 114 (65%), Sepsis Bundle; 105 (60%), Therapeutic Hypothermia protocol; 94 (54%) and Insulin protocol; 142 (81%).

Overall Compliance with the Resuscitation bundle was 116 (66%); 27 (15%) do not routinely measure lactate levels due to non-availability of the test, 89 (51%) give antibiotics within the first hour of presentation, 112 (64%) respondents do not measure procalcitonin levels, 94 (54%) due to



**Figure 1:** Proportion (%) of Respondents Adhering to Individual Components of the Resuscitation Bundle of the Surviving Sepsis Campaign Guidelines.



**Figure 2:** Proportion (%) of respondents adhering to components of the management bundle of the SSGs. Lung Protective Ventilation (LPV), Neuromuscular blockade (NMB), Venous thromboembolism (VTE).

non-availability of the test. Twelve (7%) respondents routinely give colloids as the fluid of choice for resuscitation in severe sepsis and shock (Figure 1).

Compliance with components of the Management bundle overall was 82 (47%). In patients with ARDS; 56 (32%) do not routinely perform lung protective ventilation with 20 (11%) ventilating with 10 ml/kg IBW and 38 (22%) with no parameters. Twenty-eight (16%) do not use neuromuscular blockade and 33 (19%) paralyze for greater than 48 hours. Seventy-nine (45%) do not routinely use compression devices with subcutaneous heparin for venous thromboembolism prophylaxis with 49 (28%) citing reasons of non-availability and 24 (14%) not needed.

Thirty-nine (22%) use no stress ulcer prophylaxis whilst 119 (68%) use proton pump inhibitors (PPIs), 17 (10%) histamine 2 blockers and other agents. For feeding during the first week of ICU admission, (8%) routinely use total parenteral nutrition, 16 (9%) keep patients NPO and 67 (38%) use full calorie enteral feeding. One hundred and twenty-three (70%) set goals of therapy within the first few days with no discussion of goals or with a noncommittal response by 52 (30%) respondents (Figure 2).

Compliance with the Resuscitation bundle was significantly associated with 24 hour intensivist coverage,  $p$  0.004; 1:1 nurse to patient ratio,  $p$  0.000; a hospital rapid response team (RRT),  $p$  0.001 and measurement of ICU indicators,  $p$  0.029. There was no significant association with training in critical care,  $p$  0.57 or a hospital Sepsis bundle,  $p$  0.075.

Compliance with guidelines in the management bundle was significantly associated with 1:1 nurse to patient ratio,  $p$  0.008; RRT,  $p$  0.042, and ICU protocols for Lung Protective Ventilation,  $p$  0.019; Heparin,  $p$  0.001, Insulin,  $p$  0.011 and Ventilator Associated Pneumonia (VAP) bundle,  $p$  0.026.

On subgroup analysis, there was a significant difference between countries, in the use of lung protective ventilation,  $p$  0.001 and a trend

**Table 1: Respondent and Hospital characteristics by World Bank country classification. \*Chi2 analysis for differences between categorical variables. Abbreviations: Critical care medicine (CCM) Rapid Response Team (RRT), Lung protective ventilation (LPV), Ventilator associated pneumonia (VAP), Central venous catheter (CVC).**

	High Income Countries (n = 95)	Mid-Low Income Countries (n = 80)	p value*
Physicians	67 (70%)	73 (91%)	0.002
Nurses	23 (24%)	5 (6%)	
Other	5 (6%)	-	
CCM training	67 (70%)	48 (60%)	0.01
Nurse:Patient ratio 1:1	49 (52%)	36 (45%)	0.000
Measure Outcome Indicators	79 (83%)	39 (49%)	0.000
RRT	56 (59%)	34 (42%)	0.043
24 hour Intensivist coverage	74 (78%)	59 (74%)	0.000
<i>ICU protocols:</i>			
Sepsis Bundle	58 (61%)	47 (59%)	0.088
VAP bundle	74 (78%)	51 (64%)	0.025
CVC bundle	78 (82%)	49 (61%)	0.003
LPV protocol	68 (72%)	46 (57%)	0.028
Weaning protocol	72 (76%)	54 (67%)	0.069
Heparin protocol	78 (82%)	53 (66%)	0.015
Hypothermia protocol	55 (58%)	39 (49%)	0.061
Insulin protocol	83 (87%)	59 (74%)	0.021

towards greater proton pump inhibitor (PPI) usage in high income countries ( $p$  0.049)(Figure 3) (Table 1).

## Discussion

### Principal Findings

In this study of critical care providers from the Middle East and Western Asian countries of the WHO-EMRO region, we were able to determine an overall low level of knowledge and practice adherence to the SSC guidelines.

Respondents tended to perform better with the resuscitation bundle (66%) than the management guidelines (47%), with greater than 60% adherence for using lactate measurements, crystalloids, nor-epinephrine, stress ulcer prophylaxis and Lung Protective ventilation and limited neuromuscular blockade for ARDS.

More disturbing is that less than half of the critical care providers surveyed give antibiotics within the first hour of presentation, recognizing not to give bicarbonate in lactic acidosis or administering adequate venous thromboembolism prophylaxis.

Previous investigators have implied that resource limitations may explain poor compliance with the bundles<sup>15</sup>. However, we have shown that aside from the use of lung protective ventilation, there were no significant differences in compliance between countries by income.

Similarly, Mahavanakul, et al.<sup>16</sup> concluded that in the management of severe sepsis and shock in Thailand, "interventions fell within existing capabilities but their implementation was variable." Sixty-six percent of our respondents had received formal training in critical care; this may reflect training obtained abroad since most Middle Eastern countries do not offer specialty training in this field. Interestingly though, training had no impact on compliance rates.

In our study, hospitals with established rapid response teams, high nurse to patient ratios, measurement of outcome indicators and management protocols tended to have higher compliance rates. These findings may indicate that a hospital's commitment to Quality Improvement practices is a major factor in adhering to the SSC guidelines and efforts to educate hospital administrators may be as

important as changing the acceptance and behaviours of healthcare providers.

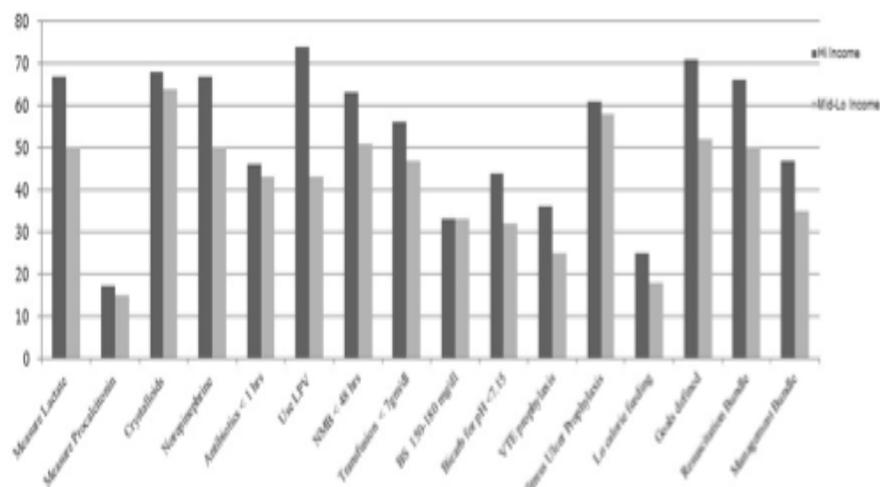
### Study Strengths and Limitations

This is the first study of severe sepsis/septic shock management from this region and provides important insights into the specific care deficiencies, lays to rest the issue of country income as a factor and highlights the importance of targeting hospital administration in any efforts to improve compliances. Major limitations of this study is the limited representation from mid-income countries, possible selection bias as the responses are limited to either participants of educational meetings or to solicitation from the MCCA website and that the definition of 'compliance' varies considerably across studies which may affect the generalizability of our results.

### Comparisons with other studies and Implications

Our compliance rates are higher than those reported by investigators from both the developed and developing world. A survey by Brunkhorst and colleagues<sup>17</sup> identified a wide disparity between perceived adherence and actual adherence to the bundles (79% v/s 2.6% for LPV) in German ICUs. Ferreret al.<sup>7</sup> reported only 5.3% compliance with the resuscitation and 10.9% with the management bundles in Spanish ICUs, whilst Gao<sup>18</sup> from the UK reported 52% compliance with the resuscitation and 30% with the management bundles. In 2011, Phua et al.<sup>10</sup> carried out a survey of 150 ICUs in 16 Asian countries. They found that out of 1285 patients with severe sepsis, there was 7.6% compliance with the entire resuscitation bundle and only 3.5% compliance with the management bundle. There was greater than 50% compliance with lactate measurement, early antibiotics, and fluids for resuscitation compared to our findings of greater than 60% for fluids and lactate.

We may have found higher compliance rates since most of these studies are older and the SSC guidelines have been established as



**Figure 3:** Differences in Compliance between countries to components of resuscitation & management Bundles of the SSC guidelines.\*p 0.001, Neuromuscular Blockade (NMB), Lung Protective Ventilation (LPV), Venous Thromboembolism (VTE). 'Low calorie' defined as 500 calories/day.

standard of practice for a longer period. Secondly, improved adherence may simply reflect greater education and awareness. Phua's study<sup>10</sup> identified a higher income category to be associated with greater compliance, however our results showed no significant differences between compliance rates of high, and mid-low income countries in most of the bundle components except for lung protective ventilation.

Our results identify deficiencies in key bundle components that have been linked to mortality and more importantly, the significant positive impact of an administration committed to quality improvement.

Micekin 2006<sup>19</sup> and Nguyen in 2007<sup>9</sup> amply demonstrated that compliance can be improved and the improvements sustained by not only dissemination of the guidelines (formalized education and training) but by identifying and addressing barriers to implementation (knowledge translation) and developing hospital-wide processes of care (team leaders, quarterly feedback). Our findings allow for the development of focused educational programs for both critical care providers and hospital administrators.

### Conclusion

Even though our results may not be

representative of all hospitals in the EMRO region, we identified that poor compliance with key recommendations of the SSC guidelines may be responsible for the continued high mortality observed from severe sepsis in these countries. Any effort to improve outcomes will need to address knowledge and practice deficiencies that we have recognized in this study.

### Acknowledgement

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