Knowledge, Attitudes and Practices of Sepsis Management at
Moi Teaching and Referral Hospital, Kenya

by

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Gerald S. Bloomfield

Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in the Duke Global Health Institute in the Graduate School of Duke University

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ABSTRACT

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Abstract

Background: This study aimed to describe sepsis related intervention practices among health care providers within a referral center in Kenya. **Methods:** Knowledge Attitude and Practice (KAP) surveys assessing sepsis related activities were distributed to health care providers at the Moi Teaching and Referral Hospital (MTRH) in Eldoret, Kenya. The target population was physicians, clinical officers, and nurses working in the Intensive Care Unit (ICU), casualty (emergency) and medicine wards in July 2014. **Results:** The response rate was 100% (86/86). Crystalloid fluids were the most common resuscitation fluids. About 80% of the providers in the medicine wards and casualty department utilized the drop count method. Fifty percent of providers at the ICU reported using intravenous fluid pumps. The most common reported cause of sepsis was respiratory infections. The most common reported antibiotics were ceftriaxone and metronidazole. All providers at casualty reported having access to these antibiotics, while only 75% of providers at the ICU indicated that they had access to antibiotics (p = 0.018). Only 43% of providers reported ordering blood cultures as the initial investigation in patients with sepsis. Invasive catheters were mostly unavailable in the ICU and casualty departments. Common reported barriers to providing care included advanced patient presentation, lack of antibiotics, and lack of sufficient staff. **Conclusion:** Providers reported a severe lack of invasive critical care equipment across all departments. Participant reported that lack of broad-spectrum antibiotics, lack of staff and lab test and equipment severely hinder optimal management of sepsis in this setting.
Dedication

I would like to dedicate this work to three people who have deeply impacted my life in ways that I did not think could be possible.

First, to my father and mother, Daniel and Margaret Mathenge. Your love, support, encouragement, patience and ever-constant presence continue to be the biggest anchor in my life.

Second, to Donna Shalala, who took the biggest chance on me six years ago and whose incredible kindness and support during my undergraduate career continues to resonate in my life. You created a home away from home for me, and made my move to a new country far easier than it should have been. I will never be able to find the words to convey my appreciation fully, except maybe try and live out my life in service to others.
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I would also like to thank my friends, particularly Claire Rotich, Tito Ngeno, Steve and Raha Kimani, and Philip Angwenyi for our philosophical debates, exchange of ideas and tough conversations throughout the graduate program.
1. Introduction

Sepsis is defined as suspected or confirmed infection with evidence of systemic inflammation, consisting of two or more of the following: fever or hypothermia, tachycardia, tachypnea, leukocytosis or leukopenia (Annane, Bellissant, & Cavaillon, 2005). If left untreated, sepsis progresses to severe sepsis and septic shock, and is ultimately fatal.

Mortality from sepsis and its sequelae is high. Most of the studies that have attempted to characterize the incidence and prevalence of sepsis have mainly been conducted in Europe and North America where up to 750,000 people suffer from sepsis every year and 29% of these patients progress to death (Cheng, West, Limmathurotsakul, & Peacock, 2008). Even in high resource countries, characterization of the burden of sepsis is not an easy undertaking due to limitations imposed by a variety of factors. These factors include the need for multiple studies to diagnose sepsis, the relatively short prodrome of early sepsis, the high short-term mortality, and finally the ever-changing criteria for diagnosis and management and differences in administrative coding of critical illness (Adhikari, Fowler, Bhagwanjee, & Rubenfeld, 2010). Mortality rates are especially high in the older populations reaching 38.4% in the older populations (Angus et al., 2001).

While there is substantial body of work regarding incidence, prevalence, mortality and morbidity of sepsis in high-income countries, data from low and middle-
income countries (LMIC) is strikingly sparse. The Brazilian Sepsis Epidemiologic study characterized the incidence rates for sepsis, severe sepsis and septic shock, in which they found increasing trend in mortality rates (Becker, Theodosis, Jacob, Wira, & Groce, 2009). A meta-analysis of available data on the burden of non-maternal sepsis, severe sepsis and septic shock between 1980 and 2008 found that there were no studies on this topic in low income countries (Jawad, Luksic, & Rafnsson, 2012). Given the burden of sepsis in high income countries, it is estimated that most of the 15-19 million cases of sepsis globally are in LMICs, where the majority of the world’s population is concentrated (Adhikari et al., 2010).

### 1.2 Sepsis in Sub-Saharan Africa

Sub-Saharan Africa (SSA) has the highest burden of infectious diseases, with HIV/AIDS being the leading cause of death (Lozano et al., 2012). The Joint United Nations Programme on HIV/AIDS (UNAIDS) estimated that 1 in every 20 adults in SSA are living with HIV (4.9%) which translates to 69% of the 34 million people living with HIV in the world in 2011 (Global Report, 2012). Given this high burden of infection, it is likely that sepsis is a significant problem in SSA. Despite these numbers, the paucity of sepsis related data is especially apparent in this region of the world. A study at Mbarara hospital in Uganda found that more than half of the study subjects who met criteria for sepsis at this center were concurrently people living with HIV/AIDS (PLHIV), for whom the most common presenting infection was TB (Auma et al., 2013). Although robust data
on the epidemiology of sepsis in SSA is lacking, it is plausible that there is an extremely high burden of sepsis given the high burden of HIV/AIDS, an immune-suppression state that predisposes individuals to infections. The steep rise of HIV/AIDS as the leading cause of death in Kenya has been dramatic. In 1990, Aids was ranked 13th in terms of the causes of mortality. Ten years later, in 2010, HIV/AIDS was the leading source of mortality and decreased years of life (YLL) (Ortblad, Lozano, & Murray, 2013). It is tenable that this high prevalence of HIV/AIDS in Kenya makes sepsis a significant problem in this country.

1.3 Management of Sepsis

Management of sepsis consists of interventions aimed at rapid recognition of the clinical syndrome, followed by rapid treatment of symptoms while an etiology for infection is concurrently been sought. The Surviving Sepsis Campaign (SSC) was launched in 2002 with the aim of disseminating an evidence-based, standardized approach to caring for patients with sepsis (Marshall, Dellinger, & Levy, 2010). These guidelines consist of a set of time sensitive therapeutic interventions, divided into two major bundles. The first bundle, consisting mainly of fluid resuscitation, should be completed within 3 hours; the next bundle, consisting mainly of vasopressor use, should be completed within 6 hours.

By 2009, more than 15,000 patients had been enrolled into the SSC database, mostly in North America, Europe and South America. Studies on their outcomes were
generally positive, with increased compliance rates and subsequent decreased mortality rates. For example, mortality rates decreased from 37.0% to 30.8 percent in the 165 hospitals that had enrolled people (Marshall et al., 2010). Yet since the initial SSC international guidelines were published in 2002, very few studies have looked at adherence to these recommendations in government hospitals in SSA. This is reflective of a point of disconnect, as many of the guidelines are heavily dependent on the presence of the correct equipment, medication and staff.

The results of a self reported survey provided to anesthesiologists at the 4th All Africa Anesthesia Congress held in Nairobi in 2009 found that many hospital systems in sub-Saharan Africa, excluding South Africa had significant implementation limitations (Baelani et al., 2011). On the other hand management of patients with sepsis seems to differ depending on the type of hospital. A 2010 survey of physicians working in a private institution in Nairobi found that 92% of the physicians complied with the SSC fluid resuscitation recommendations and 96% complied with the recommendations regarding the use of vasopressors (Mung’ayi & Karuga, 2010). These data might suggest that it is indeed possible to follow the care algorithms in SSA, if there exists institutional capacity to rapidly deal with this syndrome.

1.4 Barriers to management of sepsis

In SSA, lack of successful critical care provision is multifactorial. One aspect of care is correct and functional equipment. Even when the physicians have a good
understanding of critical care algorithms, their impact tends to be severely curtailed by lack of monitoring equipment. Many critical care algorithmic interventions require specialized diagnostic equipment, much of which is lacking in SSA (Mundy et al., 2003). For example, invasive arterial monitoring and hemodialysis require a lot in terms of disposables, meaning that they can only be found in private hospitals or academic institutions that are able to come up with the cost (Towey & Ojara, 2007). This greatly diminishes the level of intervention that can be offered to a septic patient. Additionally, while haemoglobin and WBC levels, HIV testing and blood transfusion services are readily available in many institutions of care, other important laboratory services like blood gas and creatinine measures are lacking (Mundy et al., 2003).

The presence of affordable, safe, efficacious and appropriately used health products and technologies (HPT) is necessary in any health care setting. These include medication, monitoring equipment and spaces that are used in the management of patients with sepsis. In Kenya, investment in HPT is chronically low. The total pharmaceutical expenditure in Kenya is only 20% of the total health expenditure, majority of which is from private sources. In 2009/10, the government of Kenya allocated 7.3 billion to go towards purchasing Essential Medicines and Medical Supplies (EMMS). This actually represents a gradual decrease – from 15.2% to 12.9% - from fiscal year 2000/01 and 2009/10.

Additionally, critical care is the work of an adequate number of appropriately
trained physicians, mid-level providers and nurses. The large-scale migration of physicians from developing countries has had a negative impact on provision of critical care. The emigration factor, as opposed to the absolute number of emigrants, is a useful tool for looking at the regional impact of physician emigration to high-income countries. It gives a measure of the loss of physicians from various regions of the world as a proportion of the physicians remaining to do work. Sub-Saharan Africa has the highest emigration factor at 13.9%, followed by the Indian subcontinent at 10.7%. North America has the lowest emigration factor of 1.3% (Mullan, 2005).

There has been remarkable decrease in sepsis-related mortality in many developed countries. In the US for example, mortality from sepsis decreased from 27.8% in 1979 to 17.8% in 2000, even as the incidence of sepsis increased (Martin, Mannino, Eaton, & Moss, 2003). The hospitals that adopted the SSC guidelines outcomes that were generally positive, with increased compliance rates and subsequent decreased mortality rates - for example, mortality rates decreased from 37.0% to 30.8 percent in the 165 hospitals that had enrolled people (Marshall et al., 2010). This can be attributed to a better understanding of the sepsis disease process as well as adoption of standardized therapeutic algorithms for patients who are septic.

While adherence to SSC guidelines has been shown to improve mortality in developed nations, most facilities in SSA are not equipped to implement these guidelines. Development and implementation of standardized evidence-based
approaches to sepsis care that are better suited to these settings is important. Importantly, efforts to improve the capacity of these health systems to be able to provide the most fundamental treatment of sepsis are necessary. To this end, the WHO (2011) published the *IMAI District Clinician Manual: Hospital Care for Adolescents and Adults*, a manual that provides protocols for the management of common, life threatening conditions in resource constrained settings. While robust studies evaluating the effectiveness of these guidelines in improving mortality are limited, we suspect that adhering to these guidelines in resource limited settings may improve outcomes for patients with sepsis.

### 1.6 Impact

In order to effectively address the high mortality from sepsis and its subsequent sequelae, it is important to know the current practices. The primary goal of this project was to evaluate the current practices in management of septic patients at a referral hospital in a resources limited setting using a knowledge attitudes and practice (KAP) survey. We also sort out to define common barriers to optimal sepsis management in these settings.

As there are few studies looking at sepsis in Kenya, this study also forms the basis for other important studies, for example further studies looking at health outcomes for patients who are diagnosed with sepsis, as well as morbidity and mortality rates for these patients. Using survey questions, this study will also look at the awareness of the
IMAI WHO guidelines for management of sepsis in resource-limited settings.

Additionally, within the same survey, this study will also assess adherence and use of the SSC guidelines in a resource limited setting. This information will be gathered from health care providers in the casualty, adult medicine and ICU departments of a hospital in western Kenya.

This information is particularly important when considering practical policy alternatives. The adoption of change from a health systems level, as opposed to the current model of tackling specific diseases might be more apt to improve the management of patients with sepsis. In 2013, Kenya adopted a new constitution leading to the creation of 47 autonomous counties. More specifically, in line with the new constitution the Kenyan Ministry of Health is in the midst of the process of devolution, where health care service provision will be coordinated at the county level. The results of this study would stand to provide useful evidence based data for use in leveraging the current highly mobile political economy as the devolution conversation continues to happen. From a public health perspective, the results of such a study would be useful in the identification of hospital attitudes and behavior that are in need of change.
2. Methods

2.1 Setting

This study was conducted at the casualty (emergency), general adult medicine and ICU departments of Moi Teaching and Referral Hospital (MTRH) in Eldoret, Kenya. Eldoret is the second largest town in Western Kenya and is about 300 kilometers northwest of Nairobi. It is the capital of Uasin Gishu county and an important trading and education center. MTRH is the second largest referral hospital in Kenya, after Kenyatta National Hospital. It has an 800 bed capacity and mainly serves the western Kenya community, as well as parts of eastern Uganda and Southern Sudan. MTRH is also the flagship teaching hospital of the Moi University School of Medicine.

2.2 Participants

We surveyed medical providers at MTRH. This included physicians, clinical officers and nursing officers (nurses) working in the adult medicine, ICU or casualty department. Physicians included in this study were consultants, registrars, medical officers and interns. Exclusion criteria included participants who have not had at least 6 months working experience in their respective departments. This was to ensure that participants had ample work and patient management experience as well as exposure to the WHO guidelines for management of patients with sepsis.
2.3 Procedures

A modified questionnaire was used to gather data (appendix 1). We adapted our questionnaire from two sources. The first source is a questionnaire from a cross-sectional survey that was performed at the 4th All Africa Anaesthesia Conference in Nairobi (Baelani et al., 2011). This was a continent-wide study looking at the capacity to execute the SSC guidelines in hospitals across the African continent. The questionnaire used in this study was constructed based on the SSC guidelines and treatment bundles. The second source was a cross-sectional survey study in Kenya looking at the knowledge and intervention activities of physicians who manage patients with sepsis at a private institution in Nairobi, the Aga Khan Hospital (Mung’ayi & Karuga, 2010). We used these two questionnaires and adapted them for use in a setting that is comparatively much more resource constrained. To aid in the adaptation process, we also used the set of guidelines outlined in the WHO’s publication: IMAI District Clinician Manual: Hospital Care for Adolescents and Adults. Additionally, the original questionnaire used in the Aga Khan study mainly incorporated questions on current practices. We thus included survey questions on the attitudes and perceptions of physicians caring for septic patients. The WHO’s A Guide to Developing Knowledge, Attitude and Practice Surveys was also an important handbook in designing the questionnaire.

The survey was anonymous and was administered in English. Response options included modified Likert scales as well as open form options. The final questionnaire
contained questions on sepsis knowledge, questions on current management of sepsis and questions on physician attitudes when caring for patients with sepsis, including what barriers they encounter while caring for these patients.

2.3.1 Piloting

This survey was tested on a pilot sample of 3 providers who have experience working in an inpatient hospital setting in Kenya. They were asked to examine the questionnaire with regard to its flow, salience, acceptability and administrative ease. Suggestions were incorporated into the final questionnaire. This study was declared exempt by the Duke University Hospital System institutional review board and the Institutional Research and Ethics Committee (IREC) of the Moi University College of Health Sciences.

2.3.2 Informed consent

Verbal consent was obtained prior to enrollment. Written informed consent documents were not used since it was implied by a participant’s agreement to complete the questionnaire and a written informed consent form would be the only study document linking the individual with the questionnaire. The researcher explained the purpose of the study to potential participants, including the study results dissemination plan. The researcher also explained why each participant has been selected and why he or she would be useful to help us understand the research question.
2.3.3 Anonymity

The researcher administered the survey to all participants. To maintain anonymity, the study supervisors and administrative staff were blinded to the identity of the participants. No identifying information was collected from the participating physicians or health providers. The various hospital departments were coded to ensure further privacy. Assurances were given to participants that the choice of participation or not would not have any consequences regarding employment. The researcher also explained the format of the study as well as the duration of time that it would potentially take to complete the questionnaire for each participant. The participants were assured that survey results would be available upon request, once the study was completed.

To administer the survey, the researcher scheduled a time that worked best for the participant. For confidentiality considerations, this survey was administered in a private location. This was mainly the participants’ personal offices, the registrars’ room or a private room doctors’ break room. In the event that the participant did not have an office, the researcher carried out the interviews in the office of the Nursing Officer in Charge at the respective department. The researcher was the sole data collector.

This study did not include patients or children.
2.3.4 Confidentiality

Participants were assured that no information that they give would be shared with anyone outside of the research team. This survey was anonymous and no identifying information was asked of the participating health care providers. The most serious anticipated risk of harm to the participants in this research study was a breach in confidentiality. All survey papers were locked up in the COE (Center of Excellence) office in the AMPATH building. The Academic Model for Prevention and Treatment of HIV/Aids (AMPATH) is a partnership between Moi University and a consortium of North American health centers led by Indiana University.

2.4 Analysis

At the end of the study, numeric data from completed questionnaires was manually entered into a Microsoft Excel sheet and a STATA 13 data file. Responses to the two open form questions were transcribed into a Microsoft Word files. Quantitative data was analyzed using STATA version 13, yielding descriptive statistics.

Closed ended questions included multiple choice questions and questions employing Likert scales. The Likert scale was based on five levels of availability – never available, rarely available, occasionally available, frequently available and always available. For analysis, these different levels were coded into binary variables, such that ‘never’, ‘rarely’ and ‘occasionally’ available was treated as one category while ‘frequently’ and ‘always’ available were coded as the second category. Associations
were sought between practices within different departments, knowledge and practices by department, and attitudes by department. Ordinal logistic regression was used to estimate the odds of availability of tests (lactate tests, blood sugar test, bilirubin test, INR test) by department (ICU, casualty and medicine). Differences between categorical variables were explored using Chi square and Fishers Exact test.

Open format responses were analyzed qualitatively into nominal categories using NVIVO. Themes representing the objectives of the study were identified.
3. Results

All the 86 health service providers invited to participate were considered eligible for this study. All surveys were included (100% response rate) in the analysis. Majority of the providers were from the general medicine wards. Respondent characteristics are summarized in Table 1.

<table>
<thead>
<tr>
<th>Characteristics of participating providers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Intern, n (%)</td>
<td>12 (14)</td>
</tr>
<tr>
<td>• Medical officer, n (%)</td>
<td>12 (14)</td>
</tr>
<tr>
<td>• Registrar, n (%)</td>
<td>14 (16)</td>
</tr>
<tr>
<td>• Consultant, n (%)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>• Clinical Officers, n (%)</td>
<td>11 (13)</td>
</tr>
<tr>
<td>• Nursing officers, n (%)</td>
<td>36 (42)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Department where providers practiced</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• ICU/HDU/CCU, n (%)</td>
<td>24 (28)</td>
</tr>
<tr>
<td>• Internal Medicine wards, n (%)</td>
<td>43 (50)</td>
</tr>
<tr>
<td>• Casualty department, n (%)</td>
<td>19 (22)</td>
</tr>
</tbody>
</table>

3.1 Pilot testing

Interim pilot analysis indicated a high rate of non-response to Question 3 (figure 1); with the providers opting not to continue with the rest of the survey after they encountered this question. Thus to improve participants responses, we removed this question, with subsequent huge improvements in responses.

Additionally to assess knowledge, we included another open form question in this survey – question 8 (figure 1). This question also exhibited a high rate of non-
response, but was retained as part of the final survey. Because of these reasons, there were significant limitations with regards to assessment of knowledge.

Figure 1: Diagram showing question 3 and question 8

3.2 Practices

Eighty-six percent of the providers utilized fever as the main diagnostic general variable, with tachycardia used by 71% of the providers. Almost 60% of the providers utilized tachypnea as a diagnostic variable with 47% of the respondents stating that they utilized hyperglycemia as a marker for sepsis. Chi square analyses indicated that there was no significant difference in the use of these variables by department.

On bivariate analysis, there was no differential use of the general variables to make a diagnosis of sepsis – the likelihood of using fever, tachypnea, tachycardia and hyperglycemia was the same on all levels of practice. Further, there was no difference in the use of these variables with respect to the different departments.

Ninety-two percent of the providers used WBC count as the main inflammatory variable (table 2)
Table 2: Availability of laboratory tests (inflammatory variables)

<table>
<thead>
<tr>
<th>INVESTIGATION N</th>
<th>DEPARTMENT</th>
<th>Frequently used</th>
<th>Rarely used</th>
<th>Frequently used</th>
<th>Rarely used</th>
<th>Frequently used</th>
<th>Rarely used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ICU/HDU/CCU</td>
<td>N = 24 (100%)</td>
<td></td>
<td>Internal Medicine (Nyayo)</td>
<td>N = 43(100%)</td>
<td>Casualty</td>
<td>N = 19(100%)</td>
</tr>
<tr>
<td>Leukocytosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20(83%)</td>
<td>4(17%)</td>
<td>40(93%)</td>
<td>3(7%)</td>
<td>19(100%)</td>
<td>NA</td>
</tr>
<tr>
<td>Leukopenia</td>
<td></td>
<td>14(58%)</td>
<td>110(42%)</td>
<td>32(74%)</td>
<td>11(26%)</td>
<td>14(74%)</td>
<td>5(26%)</td>
</tr>
<tr>
<td>&gt;10% immature forms</td>
<td></td>
<td>3(12%)</td>
<td>21(88%)</td>
<td>9(21%)</td>
<td>34(79%)</td>
<td>5(26%)</td>
<td>14(74%)</td>
</tr>
<tr>
<td>Plasma C-Reactive Protein</td>
<td></td>
<td>14(58%)</td>
<td>10(42%)</td>
<td>30(70%)</td>
<td>13(30%)</td>
<td>15(79%)</td>
<td>4(21%)</td>
</tr>
</tbody>
</table>

3.2.1 Fluid Therapy

Crystalloids were the most common reported rehydration fluid in all three departments (Figure 2). Majority of the providers, 84% in medicine and 79% in casualty, used the drop count method to monitor IV fluid flow. On the other hand, about half of the providers at ICU (54%) stated that they used IV fluid pumps to calibrate and monitor flow of IV fluids (figure 3). Blood pressure and urine output were the most commonly reported fluid loading assessment variables, with passive leg raise and orthostatic blood pressure being the least utilized (Figure 4).
Figure 2: Common resuscitation solutions used in the three departments.

Figure 3: Common resuscitation solution monitoring techniques used in the three departments.
Figure 4: Variables used to monitor perfusion status in patients with sepsis

3.2.2 Availability of Tests

Blood sugar tests were reported to be mostly available, with 90% of the respondents stating that they could access this test. For a breakdown of the availability of all tests, see table 3. Half of the respondents stated that they had access to blood gas tests while the other half stated that these test was unavailable. A majority of the providers, 72%, indicated that bilirubin testing was generally available. About 69% of the providers reported having access to an INR test.

Overall, lactate tests were not available, with only 45% of the providers in the hospital reporting that they could access these tests. Of these, 24% reported performed the test within an hour of the patient arriving at the department. There was a significant
difference in the time it took to administer the lactate test, depending on the department (p < 0.000). The probability of a lactate test being administered within the hour was highest in the ICU and casualty departments [OR 15.76 (95% CI 3.80-65.3 and OR 4.76 (95% CI 1.01 – 22.56) respectively] compared to the adult medicine department. Majority of the providers - 80% - declined to indicate what lactate threshold is typically used to indicate sepsis.

Table 3: Availability of laboratory tests per department

<table>
<thead>
<tr>
<th>INVESTIGATION</th>
<th>ICU/HDU/CCU N = 24 (100%)</th>
<th>Internal Medicine (Nyayo) N = 43(100%)</th>
<th>Casualty N = 19(100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Sugar Test</td>
<td>20(83%)</td>
<td>38(88%)</td>
<td>19(100%)</td>
</tr>
<tr>
<td>Blood Gas Test</td>
<td>12(50%)</td>
<td>17(40%)</td>
<td>10(53%)</td>
</tr>
<tr>
<td>Bilirubin Test</td>
<td>16(67%)</td>
<td>30(70%)</td>
<td>16(84%)</td>
</tr>
<tr>
<td>Prothrombin Time / INR Test</td>
<td>14(58%)</td>
<td>30(70%)</td>
<td>15(79%)</td>
</tr>
<tr>
<td>Serum Lactate Test</td>
<td>12(50%)</td>
<td>16(37%)</td>
<td>11(58%)</td>
</tr>
<tr>
<td>Other Coagulation tests</td>
<td>11(46%)</td>
<td>21(49%)</td>
<td>12(63%)</td>
</tr>
</tbody>
</table>
3.2.3 Management of Infection

Respiratory infections (45%) were the most common reported cause of sepsis in all three departments, followed by intra-abdominal infections (21%) (Figure 5). To seek the source of infection, 43% of the providers reported ordering a blood culture as the initial test (figure 6). When asked how often blood cultures were performed in a typical week, 72% of the providers indicated that they were rarely ordered (0 - 10 times).

Figure 5: Sources of infection per department
3.2.3 Broad-spectrum antimicrobials

Ceftriaxone and metronidazole were the most common antibiotics, with 85% of the providers stating that they were frequently available in their departments (figure 7).

There was a significant difference in the availability of these antibiotics per department (p = 0.018) with 100% of the providers at casualty stating that these antibiotics were available in their department while 75% of the providers at the ICU stated that these antibiotics were available. Ninety three percent of the providers at the medicine ward stated that they have access to these antibiotics. Majority of the providers, 76%, stated that these antibiotics were given within an hour of presentation. Reported compliance with this guideline was highest in the casualty department, where 95% of the providers stated that patients received antibiotics within an hour of arrival at the department. The
providers reported that the largest percentage of septic patients who did not receive antibiotics within an hour’s time was found in medicine wards (33%).

When presented with a list of different barriers to care, 42% of the respondents indicated that ‘lack of broad spectrum antibiotics’ was a barrier to providing care to patients (figure 9). There was a significant departmental difference in the number of providers who stated that lack of antibiotics was a major barrier to providing care to the patients (p = 0.048), with 58% of ICU providers, 42% of medicine ward providers, and 21% of casualty department providers indicating lack of antibiotics was a significant barrier to management of septic patients.

**Figure 7: Common antibiotics used in all departments**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceftriaxone and Flagyl</td>
<td>88%</td>
</tr>
<tr>
<td>Piperacillin tazobactam</td>
<td>2%</td>
</tr>
<tr>
<td>Carbapenems</td>
<td>3%</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>7%</td>
</tr>
</tbody>
</table>
3.2.4 Availability of equipment

This study revealed a general lack of critical care equipment across all departments (Table 4). All of the ICU and casualty providers reported that they had access to thermometers and non-invasive blood pressure (NIBP) monitors. Notably, 12% of the providers in the medical ward reported that they did not have access to thermometers and 21% of the providers in the Casualty department stated that they did not have access to non-invasive blood pressure monitors. Pulse oximetry equipment was freely available in the ICU and casualty departments, as indicated by 96% and 84% of the providers respectively. Only 72% of the providers in the medicine wards stated that they had access to pulse oximetry equipment.

Invasive equipment, including catheters to measure CVP, pulmonary arterial pressure and cardiac output was unavailable across all three departments. Notably, the majority of ICU providers reported that they did not have this invasive equipment. Based on what the providers reported, the odds of having equipment that measures CVP and cardiac output was highest in the ICU [OR 13.3 (95% CI 3.22 – 55.17) compared to the casualty department OR 9.5 (95%CI 2.29 – 39.66) respectively.
Table 4: Availability of monitoring equipment per department

<table>
<thead>
<tr>
<th>Monitoring Equipment</th>
<th>ICU/HDU/CCU</th>
<th>Internal Medicine</th>
<th>Casualty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = frequently available</td>
<td>n = rarely available</td>
<td>n = frequently available</td>
</tr>
<tr>
<td>Thermometers</td>
<td>24 (100%)</td>
<td>N/A</td>
<td>38 (88%)</td>
</tr>
<tr>
<td>NIBP monitors</td>
<td>23 (96%)</td>
<td>1 (4%)</td>
<td>38 (88%)</td>
</tr>
<tr>
<td>IBP catheter</td>
<td>5 (21%)</td>
<td>19 (79%)</td>
<td>5 (12%)</td>
</tr>
<tr>
<td>Pulse Oximetry</td>
<td>23 (96%)</td>
<td>1 (4%)</td>
<td>31 (72%)</td>
</tr>
<tr>
<td>Central Venous Pressure catheters</td>
<td>12 (50%)</td>
<td>12 (50%)</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Cardiac Output</td>
<td>10 (42%)</td>
<td>14 (58%)</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Pulmonary arterial Pressure catheters</td>
<td>11 (46%)</td>
<td>13 (54%)</td>
<td>8 (19%)</td>
</tr>
<tr>
<td>End-tidal carbon dioxide</td>
<td>5 (21%)</td>
<td>19 (79%)</td>
<td>1 (2%)</td>
</tr>
</tbody>
</table>

NIBP – Noninvasive blood pressure. IBP – invasive blood pressure monitors.

3.2.5 Vasopressor use

Forty seven percent of all of the providers reported that they used norepinephine (NE), while 53% said that NE was typically not used in their specific departments. Chi square analyses showed that there was a significant difference in NE use by the three department (p = 0.003). Seventy-five percent of providers in the ICU said that they typically utilized NE, while most of the providers in the casualty and medicine
departments stated that they did not use NE (53% and 67% respectively). Half of the providers reported having epinephrine, with the other half reporting that they had no access to epinephrine. There was however a significant difference in the use of epinephrine by department (p = 0.001) where it was mainly used in the medicine department, where 70% of providers stating that they typically used it. Providers in the ICU and casualty typically did not use epinephrine (67% and 74% respectively). Majority of the providers did not use dopamine or vasopressin in their departments – 69% and 75% respectively. There was also no significant difference in the use of dopamine and vasopressin per department (p = 0.246). In addition to hypotension, the other variables used by providers to initiate vasopressor are summarized in figure 8.

Figure 8: Main variables used to initiate vasopressor use in severe sepsis.
3.3 Monitoring

A little more than half (52%) of the providers stated that monitoring of patients with sepsis happened at least once every hour, with the remaining 48% indicating that these activities happened at least once every 2-3 hours. There was a significant difference in how often monitoring activities happened per department (p<0.00), with only 26 % of providers in the medicine department saying that they attended to patients at least once each hour. Providers in the ICU and Casualty department typically carried out monitoring activities more often, with over 79% of the providers stating that they attended to their patients at least once every hour.

3.4 Attitudes

Open form responses indicated certain barriers to care that were common to all the providers. Antibiotic availability was a common theme (table 5 and table 6). Providers also stated that they would like to see an increase in the number of staff (table 6). Analysis of open form responses also revealed that availability of diagnostic tests was a common concern reported by the providers. Open form responses also revealed that most providers perceived the constant availability of IVFs to be a positive factor that aided in their management of patients with sepsis.
Table 5: A sample of providers’ responses

‘What do you think are the most important changes that can happen in this hospital to allow you to take care of your septic patients? Please be as honest as possible’

<table>
<thead>
<tr>
<th>ANTIBIOTIC SPECIFIC RESPONSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Avail broad spectrum antibiotics as needed’</td>
</tr>
<tr>
<td>‘Ensure adequate provision of IVF and antibiotics’</td>
</tr>
<tr>
<td>‘Constant availability of antibiotics’</td>
</tr>
<tr>
<td>‘Availability of antibiotics to treat sepsis’</td>
</tr>
<tr>
<td>‘Constant availability of antibiotics’</td>
</tr>
<tr>
<td>‘Broad spectrum antibiotics’</td>
</tr>
<tr>
<td>‘Availability of constant supply of antibiotics’</td>
</tr>
<tr>
<td>‘Adequate broad spectrum antibiotics’</td>
</tr>
<tr>
<td>‘Provide the necessary supplies – IVF, broad-spectrum antibiotics’</td>
</tr>
<tr>
<td>‘Availability of antibiotics like meropenem’</td>
</tr>
<tr>
<td>‘Availability of quality antibiotics’</td>
</tr>
<tr>
<td>‘Adequate resources – staff, investigations e.g. blood culture to be available, drugs e.g. norepinephrine and dopamine’</td>
</tr>
<tr>
<td>’Include drugs like vancomycin and other broad spectrum antibiotics when procuring drugs’</td>
</tr>
<tr>
<td>‘Availability of drugs within the hospital’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EQUIPMENT SPECIFIC RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Provision of monitoring equipment’</td>
</tr>
<tr>
<td>‘Adequate CVP rulers to carry out CVP’</td>
</tr>
<tr>
<td>‘Create more beds in the ICU and HDU’</td>
</tr>
<tr>
<td>‘Make sure BP machines have batteries at all times to make it easy for nurses to take BP without searching for machines from elsewhere’</td>
</tr>
<tr>
<td>‘Providing enough supplies and equipment like dressing and stitching packs’</td>
</tr>
<tr>
<td>‘Equipment – adequate and in good condition e.g. syringe pump’</td>
</tr>
<tr>
<td>‘Presence of monitors to monitor patients’</td>
</tr>
<tr>
<td>‘Advanced machines’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LAB SPECIFIC RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Increase lab efficiency’</td>
</tr>
<tr>
<td>‘Availability of laboratory tests and drugs’</td>
</tr>
<tr>
<td>‘Quick lab tests’</td>
</tr>
<tr>
<td>‘Availability of tests within 12 hours’</td>
</tr>
<tr>
<td>‘Availability of blood culture bottles’</td>
</tr>
<tr>
<td>‘Equip the lab with all the necessary equipment and supplies to perform tests’</td>
</tr>
<tr>
<td>‘Improve on ICU space and lab efficiency’</td>
</tr>
<tr>
<td>‘Efficiency in processing lab equipment’</td>
</tr>
</tbody>
</table>
When asked to select the main barriers from a structured list of barriers, most providers (70%) indicated that patients presented at an advanced stage of their diseases (Figure 9).

Table 6: Main reported barriers to providing adequate care to patients with sepsis

<table>
<thead>
<tr>
<th>MAJOR THEMES/CONCERNS/NEEDS</th>
<th>% of respondents who indicated that this is a barrier to providing adequate care</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEME</td>
<td></td>
</tr>
<tr>
<td>1. Lack of antibiotics</td>
<td>51.2%</td>
</tr>
<tr>
<td>2. Lack of staff</td>
<td>39.5%</td>
</tr>
<tr>
<td>3. Lab inefficiency / Tests take longer than 24 hours</td>
<td>28%</td>
</tr>
<tr>
<td>4. Lack of continuous training of health care providers</td>
<td>17.4%</td>
</tr>
<tr>
<td>5. Inadequate working equipment, like BP machines, thermometers and stitching packs</td>
<td>17.4%</td>
</tr>
<tr>
<td>6. Inadequate ICU space / Lack of critical care facilities</td>
<td>13%</td>
</tr>
<tr>
<td>7. Need for blood cultures</td>
<td>12%</td>
</tr>
<tr>
<td>8. Insufficient monitoring equipment / Lack of frequent monitoring</td>
<td>10.4%</td>
</tr>
</tbody>
</table>
Figure 9: Main reported barriers to providing care to patients with sepsis
4. Discussion

This study aimed to characterize providers’ perception of the critical care environment in a major referral center in western Kenya. In particular, this study evaluated the management of patients with sepsis in three main departments – adult medicine, casualty and ICU. The findings suggest that there is high adherence to the simplified WHO IMAI guidelines for the management of severely ill patients. These guidelines call for prompt recognition of sepsis and septic shock using the main general variables - hypotension, tachycardia, tachypnea and fever. Majority of the providers reported utilizing these variables in the initial assessment of patients suspected of having sepsis. The guidelines also call for an initial crystalloid fluid bolus of 1000ml, continued at 20ml/kg/hour up until 60ml/kg within the first 2 hours. Providers overwhelmingly noted that they used crystalloid solutions for fluid loading. However the majority of the providers in all departments noted that they did not have automated IV fluid devices. These findings suggest that there is a service capacity gap at MTRH, where certain services are presumably provided although the full capacity to properly deliver these services is lacking e.g. due to lack of equipment or lack of medication.

Most of the providers reported that ceftriaxone and metronidazole are the most common broad-spectrum antibiotics at MTRH. This study suggested that availability was different depending on the department – while all providers in the casualty department reported that they could access and administer these two antimicrobials
within the hour, this was not the case in the medicine wards where a third of the providers reported that they did not administer the antimicrobials within the hour. This differential access was also apparent in the self-reported availability of vasopressors - norepinephrine was reported to be fairly available in the ICU, but providers felt that it was not available in the casualty and medicine department. On the other hand epinephrine was commonly used in the medicine department, but not in the ICU or the casualty department. These findings might allude to a weakened intra-institutional procurement system, with breakdown at either or all of three levels – inefficient supply chain, weak departmental regulatory structures or insufficient human resources for medication procurement. Thus, while there might be antimicrobials at MTRH, the way that they are apportioned to the different departments may not be standardized. Importantly, when asked to list three changes that they would like to see happen at MTRH, more than half of the providers stated that they would like to see increased antimicrobial availability.

This reported lack of antimicrobials could also point to insufficient budgetary allocation towards procurement of medication. According to The Kenya Health Sector Strategic & Investment Plan (KHSSP), 2012 – 2018, centralized bulk procurement by KEMSA is price efficient in that most medication is generic and procured at prices 44% and 61% below international reference prices. While this implies a high level of antimicrobial availability, it is not reflected in what the physicians’ perceive to be
available to them. These findings only represent part of the understanding of antimicrobial awareness at MTRH - a robust understanding of exactly how much broad-spectrum antimicrobials are available at MTRH would also include an actual count of the medication available in the hospital warehouse.

About three-quarters of the providers reported that patients presented to their specific departments at an advanced stage of their diseases. Late presentation is a multifactorial phenomenon that could be the direct result of individual health behavior and/or intrinsic features with the health system. On a systemic level, the county referral process is an important aspect that is likely to be implicated. In any county in Kenya, the referral system is divided into four tiers – community health units, primary care services, country referral institutions and national referral services. Patients’ late presentation may suggest that services at the lower tiers are not available, which means that patients have to present to the higher-level hospitals. It could also suggest that inter-institutional patient movement is impaired, either at the initiation, uptake or completion of the referral process.

This study looked at two main aspects of health infrastructure – medical equipment and health products and technologies (HPT). This study revealed that providers perceived that there was a severe lack of medical equipment, as well as limited access to maintenance of available equipment. Management of severe sepsis and septic shock includes taking certain specific invasive measurements, all of which require
highly specialized equipment. While providers felt like thermometers and blood pressure cuffs were available to all providers in the ICU and the casualty department, it is noteworthy that they were not accessible to all providers in the medicine department. Invasive equipment like CVP catheters and pulmonary arterial pressure catheters were largely reported to be unavailable in the casualty and ICU department.

The Kenya Medical Supplies Authority (KEMSA) is the state corporation tasked with procurement, warehousing and distribution of medical commodities to all the 47 counties in Kenya. This is done through 10 warehouses located in major cities within the country, from which hospitals can access essential medicines and monitoring equipment. With the enactment of the new constitution and the advent of health care devolution activities in 2013, KEMSA’s model of operation has changed such that respective county health committees are now in charge of procurement activities for the health facilities that fall in that specific county. Two years in, the process of devolution of procurement activities continues to have a huge effect on how health care is practiced in Kenya. While this new model expands the local government’s decision space, it has been marked by lack of clarity with regards to delineation of activities and funds.

The second most common barrier reported by the providers is lack of sufficient staff. The Kenya Health Sector Strategic & Investment Plan (KHSSP), 2012 – 2018 acknowledged that there is a skewed distribution of health workers in Kenya, with significant gaps in the North Eastern and North Rift regions of Kenya, where MTRH is
located. Based on KHSSP targets, national referral hospitals like MTRH are expected to have at least 90 doctors, 45 clinical officers and 195 nurses. While this study did not look at the total number of providers in the hospital, it did reveal that the current providers perceived that there were insufficient providers to support optimum performance. This was especially true in the adult medicine department. The IMAI WHO guidelines also recommend that monitoring be carried out every 30 minutes for the first two hours, and every hour thereafter. Only a little more than half of the providers in this study reported adhering to this recommendation, suggesting that they were probably not adequately staffed. Further, this need is compounded by reported lack of functional structures to support performance, e.g. inefficient lab services and absence of critical medication.

Many providers reported utilizing the majority of the clinical assessment guidelines outlined in the IMAI WHO protocols. Despite this, a majority of the providers reported that they were constrained by lack of essential antibiotics, lack of necessary equipment (especially invasive monitoring equipment and essential diagnostic lab tests) and advanced patient presentation. Given the responses to this KAP survey, it would not be feasible to implement the international SSC guidelines at MTRH. This highlights the assessments of previous studies that SSC guidelines may not be practical in low-income countries (Baelani et al., 2011; Becker, Theodosis, Jacob, Wira, & Groce, 2009; Cheng, West, & Peacock, 2008)
4.1 Implications for policy and practice

The *Kenya National Drug Policy* (1994) mandated the establishment of a Medicines and Therapeutic Committees (MTC) within each hospital in Kenya. This committee consists of the medical superintendent, the pharmacist-in-charge, consultants and other members of the medical staff and the nursing officer in-charge. Going forward, leveraging the expertise of this MTC in MTRH is useful in the overall management of the hospital formulary. The study findings suggest that most providers perceive there to be a lack of essential medications, diagnostic tests and equipment. If this represents a gap in knowledge, the MTC is a useful source of knowledge dispensation in the form of what essential medications are available at MTRH as well as how to access them. From a QI standpoint, in depth analysis of the procurement process would be useful in order to establish even more specific priority intervention areas. This information is useful in assessing the hospital formulary with the aim of decreasing any hospital stock outs, a fact that might lead to physicians reporting that they do not have access to medication.

Health provision in Kenya is based on the principal-agent approach, in which the central government, in the figure of the Ministry of Health, sets the goals and parameters for health policy and programs. The agents, in this case the county governments, are the entities charged with implementation of goals and objectives. County governments are autonomous in terms of financial decision making and annual health budgets. From a policy point of view, the role of the county government in
improving patient access to critical care services cannot be overlooked. The County Department for Health (CDH) is responsible for health service delivery activities as outlined in the new constitution. The CDH has three directorates, each of which has distinct constitutionally defined functions – Preventive and Promotive Services, Clinical Services and Planning and Monitoring Services. The Clinical Services directorate, whose functions include ambulance procurement and management of county health facilities and pharmacies, most directly affects critical care. Reporting important study findings to the CDH, through regular briefings provide an important avenue through which the county can make evidence based decisions. Elaboration of a national level critical care policy, complete with specific aims and targets would serve as a guide for all counties with regards to achieving a set of circumstances for the optimum management of critically ill patients. This would serve to clarify goals and to increase targeted funding.

This study indicates that increased capital expenditure for all health products and technologies, and in particular critical care equipment, is long overdue. Critical care is a hugely equipment-intensive branch of medicine. Machines are operated on a 24-hour basis in order to keep the sickest patients alive. Most of these machines are highly advanced, very expensive and require significant initial capital for purchase and installation. Importantly repair of broken equipment poses a huge challenge in terms of technical expertise, because the majority of these equipment are imported from
companies that are located outside of the African continent. Significant funds are 
required for the continual funding of an ICU.

With the advent of health care decentralization, many counties now have an 
expanded fiscal space. While this is good in terms of evidence based spending based on 
region specific needs and testing, it means that certain aspects of the health system are 
vulnerable to decreased funding. This is especially true of financially intensive 
departments like the ICU department, which are highly dependent on drugs and other 
medical consumables. To this end, it would be useful to uncouple the funding 
mechanism, such that the MoH bears the financial burden of capital-intensive 
equipment. This then leaves the county government with the decreased financial burden 
of purchasing only the consumables.

Most providers in this study reported that lack of staff was a barrier to providing 
sufficient care to patients with sepsis. Undertaking regular health worker mapping 
activities to establish the available skills and gaps in each department provides a starting 
point to assess specific needs in each department. This information would ideally be 
incorporated in the annual Uasin Gishu County Heath Strategies report, with the aim of 
securing funds to meet the need in identified priority areas. The hospital should also 
undertake to increase budgetary support to enhance recruitment and equitable 
remuneration of current health workers.
4.2 Study strengths and limitations

Our study had important limitations. The survey instruments did not undergo any assessment of test-retest reliability, which limits the validity of the results on the study. Secondly, respondent bias is an issue in this study – there is the possibility that providers responded by giving information on what current practices should be, as opposed to what current practices are. This study was limited by the fact that we only sampled three departments, such that it is difficult to extrapolate these findings to other hospital departments.

This study was also limited by the fact that the survey was administered to a small number of consultant physicians. For this reason, it was not possible to get the wealth of experience and knowledge that is unique to this sub-set of providers. The high rate of non-response on the knowledge questions also affected assessment of the providers’ sepsis knowledge.

The strengths of this study included getting firsthand information on what many providers felt were the main barriers to providing adequate care. The departmental samples of the providers were also representative of the provider population within the specific departments.

5. Conclusion

The results of this study strongly suggest that there is a perceived lack of essential medications; inadequate staff and lack of essential medical equipment among
providers working at MTRH. Advanced patient presentation was an important reported barrier to providing adequate care. Most providers reported a high adherence to the simplified IMAI WHO sepsis guidelines, however there exists an infrastructural and human resource deficit that makes it difficult to implement the international SSC guidelines.
6. Appendix

SEPSIS SURVEY

- All completed surveys will be confidential.
- Beyond the use of your time, there are no anticipated risks related to your participation in this study.
- No individuals or programs will be identified. If you choose to participate, please DO NOT write your name on this survey.
- Your return of a completed survey will indicate your consent to participate in this study.

1. Which of the following best describes you?
   a. Consultant (Please specify field.........................)
   b. Registrar (Please specify field.........................)
   c. Medical Officer
   d. Intern
   e. Clinical officer
   f. Nursing officer

2. How long have you been practicing in your field?................

General Variables.

3. In addition to suspected or confirmed infection, the following are general diagnostic criteria for sepsis. How often are these presenting symptoms or signs found in your patients who have sepsis? (Please check one option)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Occasionally</th>
<th>Frequently</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever (more than 38.3C)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Tachycardia (more than 90/minutes)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Tachypnea (more than 20 breaths/minute)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Hyperglycemia</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>
4. Suppose a patient comes into the hospital unit where you work with symptoms suggestive of sepsis and you would need to do additional tests. How often are the following laboratory investigations available for your use? (Please check one option)

<table>
<thead>
<tr>
<th></th>
<th>Never available</th>
<th>Rarely available</th>
<th>Occasionally available</th>
<th>Frequently available</th>
<th>Always available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Sugar</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Blood gas analysis</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Bilirubin</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Prothrombin time/INR</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Serum Lactate</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Other coagulation tests</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Infection variables

5. What is the most common cause of infection in the majority of your septic patients? (Please circle one option)
   a. Respiratory tract infections
   b. Urinary tract infections
   c. Intra-abdominal infections
   d. Central nervous system infections
   e. Musculoskeletal and skin infections
   f. Other (Please specify___________________________)

6. Suppose a patient presents to your hospital unit with symptoms suggestive of sepsis. From the time the patient arrives at your door, how much time elapses before the patient receives antibiotics? (Please circle one option)
   a. 0-30 minutes
   b. 31 minutes – 60 minutes
   c. 61 minutes – 120 minutes
   d. 121 minutes – 180 minutes
   e. 181 minutes – 240 minutes

7. Suppose a patient presents to your hospital unit with symptoms suggestive of sepsis. From the time the patient arrives at your door,
how much time elapses before a lactate test is performed, if at all? (Please circle one option)

a. 0–30 minutes  
b. 31 minutes – 60 minutes  
c. 61 minutes – 120 minutes  
d. 121 minutes – 180 minutes  
e. 181 minutes – 240 minutes  
f. Not typically performed

8. Please write down the lactate threshold which indicates that your patients are septic

____________________

9. Suppose a patient presents to your department with symptoms suggestive of sepsis. What is the first examination or test that you would perform? (Please circle one option)

a. Malaria test  
b. Rapid HIV test  
c. AFB smear and culture of sputum  
d. Blood Culture  
e. Urinalysis or microscopy for leukocytosis  
f. Gram stain of relevant body fluid

10. On a typical hospital WEEK, how often do you perform each of the following tests? (Please check one option)

<table>
<thead>
<tr>
<th></th>
<th>Never (0 times)</th>
<th>Rarely (0-5 times)</th>
<th>Occasionally (6-10 times)</th>
<th>Between (11–15 times)</th>
<th>Always (more than 15 times)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria test</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Rapid HIV test</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>AFB smear and sputum culture</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Blood culture</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Gram stain of body fluid</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Urinalysis</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
11. Suppose a patient presents to your department with sepsis. Which broad-spectrum antibiotic is typically used in your department? (Please circle one option)
   a. Ceftriaxone/Flagyl
   b. Piperacillin tazobactam (Orotaz)
   c. Carbapenems (e.g. Meropenem)
   d. Vancomycin
   e. Ciprofloxacin
   f. Other (Please Specify) ______________________

12. How often are these antibiotics available?
   a. Never
   b. Rarely
   c. Occasionally
   d. Frequently
   e. Always

**Inflammatory Variables**

13. The following are indicators of inflammation. How often do you use them to diagnose sepsis in your patients?

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Never</th>
<th>Rarely</th>
<th>Occasionally</th>
<th>Frequently</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leukocytosis (WBC count &gt;12000)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Leukopenia (WBC &lt;4000)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>More than 10% immature forms</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Plasma C-Reactive protein</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Plasma pro-calcitonin</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

**Fluid Therapy**

15. Please indicate the most common type of rehydration fluid that is used in your department (please circle one option)
   a. Colloid solutions (e.g. Fresh Frozen Plasma, Albumin)
   b. Crystalloid solutions (e.g. Normal Saline, and Ringer’s Lactate or Hartmann’s Solution)

16. There are different ways that many institutions monitor the rate of resuscitation, depending on what is readily available. When you start an IV fluid infusion, how do you monitor the rate of flow of the IV fluid? (Please circle one option)
   a. IV infusion pump
   b. Drop count
17. Suppose that you have started and IV fluid infusion on your patient. Some time afterwards, you check on your patient. How do you establish that appropriate fluid resuscitation has been achieved this patient? (Please circle all that apply)
   a. Systolic Blood Pressure
   b. Pulse
   c. Urine Output
   d. Skin Turgor
   e. Orthostatic blood pressure
   f. Passive leg raise
   g. Other (Please specify ____________________ )

18. Suppose you want to monitor urinary output for severely septic patients. How often do you place urinary catheters in your patients? (Please circle one option)
   a. Never
   b. Rarely
   c. Occasionally
   d. Frequently
   e. Always

19. If you answered ‘never’ and ‘rarely’, how is urinary output measured in your department? ____________________________

20. How often do monitoring activities happen in the unit in which you work? These activities can include taking the blood pressure, respiratory rate, SPO2, JVP and mental status of a septic patient. (Please circle option)
   a. At least once every 30 minutes
   b. At least once every 1 hour
   c. At least once every 2 hours
   d. At least once every 3 hours
21. How often do you have equipment that can monitor the following variables? (Please check one option)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Occasionally</th>
<th>Frequently</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body temperature</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Non invasive blood pressure</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Invasive blood pressure</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Oxygen saturation</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Central venous pressure</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Cardiac output</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Pulmonary arterial pressure</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>End-tidal carbon dioxide</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

22. When you have a patient with sepsis you need to perform a diagnostic test, how often are these tests available?

<table>
<thead>
<tr>
<th></th>
<th>Never available</th>
<th>Rarely available</th>
<th>Occasionally available</th>
<th>Frequently available</th>
<th>Always available</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-Ray</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Ultrasonography</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Echocardiography</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

23. When severe sepsis progresses to septic shock, which of these vasopressors are typically used in your department? (Please circle all that apply)

   a. Norepinephrine
   b. Epinephrine
   c. Vasopressin
   d. Dopamine

24. Suppose you have a severely septic patient or a patient in septic shock. Which of these clinical variables would lead you to begin an infusion of vasopressors? (Please circle all that apply)

   a. Low BP (Systolic Blood Pressure <90)
   b. Fast pulse
   c. Cold extremities
   d. Decreased capillary refill
   e. Dizziness/inability to stand
   f. Decreased urine output
g. Difficulty breathing
h. Impaired consciousness, lethargy, agitation, confusion

25. Management of patients who have sepsis depends on many factors. Which TWO FACTORS, in your opinion, are the biggest barriers to providing quality care to patients who present with sepsis (Please circle two factors)

a. There is no time to attend to patients
b. Patient presents at a very advanced state
c. Lack of IV fluids
d. Lack of broad spectrum antibiotics
e. Shortage of staff
f. Limited knowledge by physicians, nurses, clinical officers etc.

26. Please write down one factor that helps you the most when it comes to taking care of your septic patients

………………………………………………………………………………………………………………………………
………………………………………………………………………………………………………………………………
………………………………………………………………………………………………………………………………

27. What do you think are the most important changes that can happen in this hospital to allow you to take the best care of your septic patients? Please be as honest as possible.

a. ..........................................................................................................................................................
   ..........................................................................................................................................................

b. ..........................................................................................................................................................
   ..........................................................................................................................................................

c. ..........................................................................................................................................................
   ..........................................................................................................................................................

THANK YOU FOR YOUR PARTICIPATION!!
6. References


