Sepsis in Haiti: Prevalence, treatment, and outcomes in a Port-au-Prince referral hospital ☆

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A R T I C L E   I N F O

A B S T R A C T

Purpose: Developing countries carry the greatest burden of sepsis, yet few descriptive data exist from the Western Hemisphere. We conducted a retrospective cohort study to elucidate the presentation, treatment, and outcomes of sepsis at an urban referral hospital in Port-au-Prince, Haiti.
Materials and methods: We studied all adult emergency department patient encounters from January through March 2012. We characterized presentation, management, and outcomes using univariable and multivariable analyses.
Results: Of 1078 adult patients, 224 (20.8%) had sepsis and 99 (9.2%) had severe sepsis. In-hospital mortality for severe sepsis was 24.2%. Encephalopathy was a predictor of intravenous fluid administration (adjusted odds ratio [OR], 5.63; 95% confidence interval [CI], 1.46-21.76; $P = .01$), and lower blood pressures predicted shorter time to fluid administration. Increasing temperature and lower blood pressures predicted antibiotic administration. Encephalopathy at presentation (adjusted OR, 6.92; 95% CI, 1.94-24.64; $P = .003$), oxygen administration (adjusted OR, 15.96; 95% CI, 3.05-83.59; $P = .001$), and stool microscopy (adjusted OR, 45.84; 95% CI, 1.43-1469.34; $P = .03$) predicted death in severe sepsis patients.
Conclusions: This is the first descriptive study of sepsis in Haiti. Our findings contribute to the knowledge base of global sepsis and reveal similarities in independent predictors of mortality between high- and low-income countries.

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1. Introduction

Sepsis is a global phenomenon affecting high- and low-income countries alike, yet resource-constrained countries carry the greatest burden of sepsis-related mortality [1]. A recent audit of 730 intensive care units (ICUs) spanning 9 geographic regions across the world demonstrated in-hospital mortality from sepsis as high as 47.2% in Africa compared with 13.1% in North America [2]. Although compliance with international sepsis guideline bundles has been shown to reduce mortality [3], these guidelines require resource-intensive methodologies that are challenging to implement in many austere environments [4].

Despite the high burden in resource-constrained countries, data are lacking regarding the epidemiology and optimal treatment of sepsis in these settings, particularly in low- and low-middle income countries. Although efforts, such as the World Health Organization's (WHO) Integrated Management of Adult Illness District Clinician Manual, have been made to develop simplified, resource-appropriate treatment guidelines [5], such guidelines are limited by low-quality evidence and lack of clinical validation. Existing studies, moreover, suggest conflicting outcomes. Whereas a study of severely septic adult patients in Uganda demonstrated improved mortality after implementation of a sepsis protocol that included increased volume of bolus fluids [6], 2 other studies, one involving children with severe febrile illness in East Africa and another involving severely septic adults in Zambia, demonstrated increased mortality with bolus-fluid resuscitation. [7,8]. Consequently, clinicians must avoid extrapolating data developed in high-income countries because doing so may contribute to poor outcomes.

There are currently no descriptive data outlining the epidemiology of sepsis in Haiti, a low-income country with some of the lowest health

indices in the Americas [9]. Haiti's health infrastructure deteriorated after a devastating 2010 earthquake and was stressed beyond its capabilities during an ensuing cholera epidemic. St Luke Hospital was founded as a field hospital in the immediate aftermath of the earthquake and has grown into an important regional referral center, especially for patients who cannot afford private care and who cannot travel to the central government hospital. Equipment and medications are financed entirely by charitable donation, however; so resources, limited at baseline, can vary tremendously based on funding. How these resource limitations impact sepsis treatment for Haitian patients remains unknown. In an attempt to fill the knowledge gap of sepsis in Haiti and as a first step to improving care of septic Haitian patients, we conducted a retrospective cohort study to elucidate the prevalence, treatment, and outcomes of sepsis in the emergency department (ED) at St Luke Hospital.

2. Materials and methods

St Luke Family Hospital is an 80-bed faith-based community referral hospital in Port-au-Prince, Haiti. Facilities at the time of study included a 12-bed emergency department, 6-bed ICU, outpatient clinics, 2 operating theaters for elective surgeries, 3 inpatient medicine wards, and a cholera ward. After passing security gates, patients were directed to a triage tent, where nurses took vital signs and initiated intravenous fluids (IVFs) when appropriate. Patients then were triaged to the outpatient clinic, the ED, the cholera ward, or directly to the ICU. All charting was done on paper; no electronic medical record was available. No sepsis protocol was in place at the time of study.

In-hospital resources consisted of portable digital radiograph (MinXray, Northbrook, IL), portable head computed tomographic scanner (NeuroLogica, Danvers, MA), point-of-care ultrasound (FujiFilm SonoSite, Bothell, WA), and basic microscopy for diagnosis of malaria. Point-of-care iSTAT Chem 8 meter (Abbott, Princeton, NJ) and point-of-care Lactate Plus meter (Nova Biomedical, Waltham, MA) were available when finances allowed for replenishment of test strips. Aside from point-of-care devices and basic microscopy, all other laboratory and microbiology services were referred to external private facilities at the time of the study. Turnaround time for external laboratory testing depended greatly on patient finances; laboratory tests were ordered frequently but often not performed because of the prohibitive costs. The ICU maintained basic invasive and noninvasive ventilation capability with 3 donated LTV-1200 transport ventilators (CareFusion, San Diego, CA). Mechanical ventilation could not be initiated in the ED. Supplemental oxygen was provided readily by portable oxygen cylinders to all patients that needed it; no oxygen concentrators were used. No dialysis or emergency surgery services were available at the hospital.

Intravenous fluids and antimicrobial types and quantities varied depending on finances. During the study period, more than 20 different antimicrobial agents were available in the inpatient pharmacy, but the hospital was limited to 100 half-liter bottles each month of crystalloid solution. All hospital services were provided to patients for a charge of approximately US $1.50 for consults and medication and US $3 for inpatient care.

A retrospective chart review of all ED patient evaluations from January through March 2012 was performed to determine the number of patients meeting criteria for sepsis. We reasoned that a 3-month time period overlapping both the Haitian dry and rainy seasons would provide a representative convenience sampling of patients evaluated throughout the year from the hospital's catchment area. *Systemic inflammatory response syndrome* (SIRS) was defined according to the WHO's IMAI District Clinician Manual's guidelines for the management of severe sepsis and septic shock in resource-limited countries (pulse >100 beats per minute, respiratory rate >24 breaths per minute, temperature <36°C or >38°C) [4]. This definition differs from that used by the Surviving Sepsis Campaign [5] because of its emphasis on physiologic parameters that are more practical in facilities where laboratory

testing is infrequent [10]. We included patients with values of ≥100 for pulse, ≥24 for respirations, and ≥38°C for temperature because of the observation that nurses at this facility tend to round (eg, a pulse of 102 often is recorded as 100). Severity of illness scores were not calculated because, to date, all scoring systems validated in resource-constrained countries require laboratory testing, which was seldom performed at St Luke Hospital at the time of study.

Sepsis was defined as 2 or more WHO SIRS criteria plus suspected or confirmed infection. *Severe sepsis* was defined as sepsis plus any of the following: hypotension (ie, systolic blood pressure ≤ 90 mm Hg); oxygen saturation ≤ 90% on room air pulse oximetry; point-of-care serum lactate ≥4 mg/dL (0.44 mmol/L); or any physician or nurse documentation of low urine output, jaundice, scleral icterus, or encephalopathy on physical examination. ED clinical staff did not routinely calculate Glasgow Coma Scale, so encephalopathy was based on any physician or nurse documentation of confusion or mental status change. Exclusion criteria were (*a*) age <17 years, (*b*) hemoglobin <7.0 g/dL, (*c*) trauma, (*d*) pregnancy or peripartum (ie, within 1 month of pregnancy), and (*e*) bleeding/hemorrhage other than intracranial hemorrhage. Patient comorbidities were unknown for the majority of patients and thus were not included in the analysis. Institutional Review Board approval was obtained from the University of Maryland School of Medicine in Baltimore, MD, and by the research Ethics Committee at St Luke Hospital, Port-au-Prince.

Patient charts were abstracted by a single, US-trained intensivist (AP). Areas of uncertainty were resolved by consensus with 1 of 3 Haiti-based physicians (MEA, LNC, CHJF). Data were entered into a Microsoft Excel spreadsheet (Redmond, WA), and analysis was performed using Stata v11.2 (College Station, TX). Continuous variables with a normal distribution were reported as means with standard deviations and were compared with the Student *t* test. Continuous variables with a nonnormal distribution were reported as medians with interquartile ranges and were compared with the Mann-Whitney test. Categorical variables were reported as counts and percentages and compared using the χ^2 test or Fisher exact test when cell counts were less than 10. To identify predictors of fluid and antibiotic administration in patients with severe sepsis, logistic or linear regression was used for dichotomous or continuous outcomes, respectively, in unadjusted models or adjusting for age and sex. Clinical features on admission predicting death in patients with severe sepsis admitted to the hospital were determined using logistic regression, adjusting for age and sex. Clinical interventions predicting death in these patients were also determined using logistic regression, adjusting for age, sex, and markers of severity of illness: presence of encephalopathy, presence of hypoxemia (oxygen saturation [SpO_2] ≤ 90%), and mean arterial pressure. A sensitivity analysis was performed excluding patients who were transferred to another hospital. For all analyses, statistical significance was defined as $P < .05$.

3. Results

3.1. Baseline characteristics and mortality

As summarized in Figs. 1, 1078 adult records were available for review. Two hundred twenty-four (20.8%) patients met criteria for sepsis. Ninety-nine of these patients (9.2% of the overall adult cohort; 44.2% of all septic patients) met criteria for severe sepsis, and outcomes data were available for 98. The characteristics of these patients at presentation to the hospital are shown in Table 1. Patients with severe sepsis were older ($P = .02$) and had lower mean systolic ($P = .003$), arterial ($P < .001$), and diastolic ($P < .001$) blood pressures, and median oxygen saturations ($P < .001$). The most commonly identified source of infection in septic and severely septic patients was the lung (Fig. 2). Physician documentation of sepsis in the clinical impression was extremely low, noted for only 1 patient with severe sepsis (1.0%). A sizeable proportion of patients meeting clinical criteria for sepsis (n = 29, 23.2%) and severe