

# Improving Sepsis Diagnosis: Key to Better Patient Outcomes, Higher Reimbursement

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The incidence of sepsis—a severe and sometimes fatal immunological response to infection—is on the rise in the United States, with serious implications for the health of patients and the financial health of hospitals.

According to a recent epidemiological study conducted by Emory University School of Medicine and the Centers for Disease Control and Prevention, sepsis rates increased by more than 300 percent between 1979 (164,000 cases) and 2000 (660,000 cases).<sup>1</sup> And septicemia, a form of sepsis, is currently the 11<sup>th</sup> leading cause of death among Americans.<sup>2</sup> Sepsis, which is common in the elderly, is likely to become even more prevalent as the U.S. population ages.<sup>3</sup>

In addition to its human toll, sepsis places a large financial burden on the healthcare system. A typical case of severe sepsis costs \$22,100 to treat and results in a 19.6 day hospital stay.<sup>4</sup> In total, U.S. hospitals spend nearly \$17 billion per year treating patients with severe sepsis.<sup>5</sup>

What is sepsis? Sepsis is an infection with a systemic inflammatory response. The systemic response to the infection (also known as Systemic Inflammatory Response Syndrome or SIRS) manifests with two or more of the following symptoms:

- fever >38°C (>100.4°F) or hypothermia <36°C (<96.8°F)
- tachycardia: heart rate >90/min
- tachypnea: respiratory rate >20/min or PaCO<sub>2</sub> <32 mm Hg
- leukocytosis: WBC >12,000/mm<sup>3</sup>; leucopenia: WBC <4,000/mm<sup>3</sup>; or bandemia >10 percent immature (bands) forms

Septicemia is the term used when the organisms causing the sepsis are identified in the blood. Hence, sepsis and septicemia are often used interchangeably by clinicians. In more severe cases of sepsis/septicemia, the patient may go into organ or multi-organ failure (e.g., respiratory, renal, cardiac, coma) or septic shock, possibly resulting in death.

Although many clinicians confuse bacteremia with septicemia, the conditions are not synonymous. Bacteremia is defined as the presence of viable bacteria in the blood. However, unlike septicemia, bacteremia does not manifest systemic illness (i.e., the hallmarks of SIRS). For example, localized infections may have transient bacteremia but do not manifest systemic symptoms.

Thus, a physician is beset with several diagnostic conundrums with respect to sepsis/septicemia. Are the patient's manifestations due to sepsis or not? Are the blood culture results contaminants or viable organisms? If the organism is viable, is the patient bacteremic or septic?

The good news is that with the proper diagnostic tools, such as automated blood culturing systems, hospitals can now more easily substantiate a diagnosis of septicemia, allowing them to improve patient outcomes, deliver more cost-effective care and obtain appropriate reimbursement from third-party payors.

Early diagnosis and treatment of sepsis is associated with better patient outcomes. In 2003, the Academic Medical Center Consortium Sepsis Project Working Group published research identifying a wide variation in the way academic medical centers approach sepsis. Based on these observed differences in care and related outcomes, the study concluded that delay in appropriate antibiotic therapy is strongly correlated with higher patient mortality rates.<sup>6</sup>

Correctly diagnosing sepsis can also have positive financial results for hospitals. Patients with septicemia and other forms of sepsis typically require a high level of resource intensity and thus are very costly to the system. The diagnosis related group (DRG) for septicemia generates substantial payments that reflect the typical resources required for care and treatment of septic patients. The alternative diagnoses are often much less resource-intensive and result in lower-paying DRGs (see Table 1).

**Table 1: Sample Reimbursement Rates**

DRG	Description	Relative Weight	2005 Medicare
416	Septicemia	1.5982	\$7,192
420	Fever of Unknown Origin	0.6021	\$2,709
416	Septicemia	1.5982	\$7,192
90	Simple Pneumonia w/o CC	0.6172	\$2,777
416	Septicemia	1.5982	\$7,192
321	Urinary Tract Infections w/o CC	0.5681	\$2,556

Note: These data are presented as a general guideline based on an average base rate of \$4,500.

Unfortunately, it can be extremely challenging to accurately diagnose sepsis, particularly among older patients. Because of diminished immune systems and other concomitant comorbid conditions that exist in this age group, the manifestations of sepsis may be subtle or masked. Is the patient's lethargy or altered mental state a result of sepsis or Alzheimer's disease? Is the patient's respiratory distress a symptom of sepsis or chronic obstructive pulmonary disease? Is the tachycardia due to sepsis or a heart condition?

One way to overcome these difficulties is to replace older, less accurate testing modalities with sophisticated, automated blood culturing systems. These systems are more sensitive than their predecessors, resulting in a higher number of positive blood cultures and more reliable diagnoses. In one study, a hospital relying on conventional manual blood culturing estimated that 38.7 percent of septicemia cases were either left untreated or treated inappropriately because of inaccurate or delayed test results.<sup>7</sup> After switching to an automated blood culture system, the hospital demonstrated a 33% increase in significant blood culture isolates and a 24% increase in the number of patients with bacteremia.<sup>8</sup> Moreover, the automated system offered significantly faster test results, allowing clinicians to initiate appropriate therapy sooner.<sup>9</sup>

Hospitals can choose from a number of blood culturing systems currently available on the market: ESP Culture system offered by Trek Diagnostic systems; BacT/Alert from bioMerieux; and BACTEC from BD.

Although all of these systems offer advantages over manual blood cultures, some are more effective at identifying septicemia than others. A recent study presented at a meeting of the American Society for Microbiology focused on three diverse hospitals in the Meridian Health system in New Jersey, each using a different blood culture system or media type. After consolidation of services and standardization of their microbiology laboratory systems to BACTEC and premium blood culture media, the hospitals conducted a retrospective analysis to determine the ability of all three blood culturing systems to detect septicemia. The study concluded that the BD system led to more septicemia diagnoses and higher reimbursement from third-party payors. Specifically, the study found that the BACTEC system, when compared to its competitors, offered a 2.6 percent to 3.4 percent increase in positive blood cultures and a 35.4 percent to 51.4 percent increase in septicemia diagnoses (DRG 416), resulting in a \$1.7 million increase in reimbursements.<sup>10</sup>

A 2003 study conducted by International Marketing Ventures (IMV) validated the findings of the Meridian Health system on a national level. IMV collected information from 1,388

hospitals, including blood culture instrument and media type used and annual blood culture testing volume. IMV integrated these data with hospital statistics on DRG 416 reimbursements for septicemia in order to calculate rates of septicemia detection per blood culture bottle. The data demonstrated that use of the BACTEC system with premium resin media was associated with a 35.7 percent increase in sepsis diagnoses compared to the BacT/Alert with FAN media and a 26.7 percent increase when compared to the Trek ESP system (see Table 2).<sup>11</sup>

	Manufacturer	Sepsis Cases Per Bottle
<b>Standard Media</b>	BD	0.015
	BioMerieux	0.012
	Trek	0.015
<b>Premium Media</b>	BD Resin	0.019
	BioMerieux FAN	0.014
	Trek*	NA

\*Trek manufactures standard media only.

These findings have significant implications for hospital reimbursement under a prospective payment system. As demonstrated in Table 1, the DRG for septicemia pays approximately \$4,500 more than the DRGs for three common alternative diagnoses. In effect, every missed sepsis diagnosis costs a hospital \$4,500. For every 1,000 blood culture bottles, a hospital employing the BACTEC system with premium resin media potentially could collect \$18,000 more in reimbursement than a facility relying on Trek ESP standard media and \$22,500 more than a hospital using bioMerieux premium FAN media. Assuming an annual volume of 40,000 bottles, a hospital using the BACTEC system could potentially collect DRG reimbursements of \$720,000 to \$900,000 more than facilities using other blood culturing systems.

With sepsis on the rise, it is more important than ever for hospitals to accurately diagnose and treat septicemia and other forms of this life-threatening condition. Choosing the most sensitive blood culturing system and media type helps clinicians make quick, precise diagnoses and initiate appropriate antibiotic therapy, resulting in better patient outcomes. A confirmed diagnosis of sepsis also allows hospitals to boost their revenues by billing third-party payors appropriately for the resource-intensive care required by septic patients.

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<sup>1</sup> Martin MS, Mannino DM, et al. The epidemiology of sepsis in the United States from 1979 through 2000. *N Engl J Med*. 2003;348:1546-1554.

<sup>2</sup> National Center for Health Statistics. National vital statistics reports. 2004;53:9.

<sup>3</sup> Angus DC, Linde-Zwirble WT, et al. Epidemiology of severe sepsis in the United States: analysis of incidence, outcome, and associated costs of care. *Crit Care Med*. 2001;29:1303-1310.

<sup>4</sup> *Ibid.* page 1305.

<sup>5</sup> *Ibid.* page 1306.

<sup>6</sup> Yu DT, Black E, et al. Severe sepsis: variation in resource and therapeutic modality use among academic centers. *Crit Care Med*. 2003;7:R24-R34.

<sup>7</sup> Gray J, Brockwell, M, et al. Experience of changing between signal and Bactec 9240 blood culture systems in a children's hospital. *J Clin Pathol*. 1998;51:302-305.

<sup>8</sup> *Ibid.* p. 303.

<sup>9</sup> *Ibid.* p. 304.

<sup>10</sup> Whittier S, Casey M, et al. Financial impact of blood culture system consolidation and media selection. Study presented at: 103<sup>rd</sup> General Meeting of the American Society for Microbiology; 2003; Washington, DC.

<sup>11</sup> IMV CensuTrak. Profile of the hospital marketplace for blood culture instrumentation. February, 2004.