HOSPITAL TOOLKIT

for Adult Sepsis Surveillance

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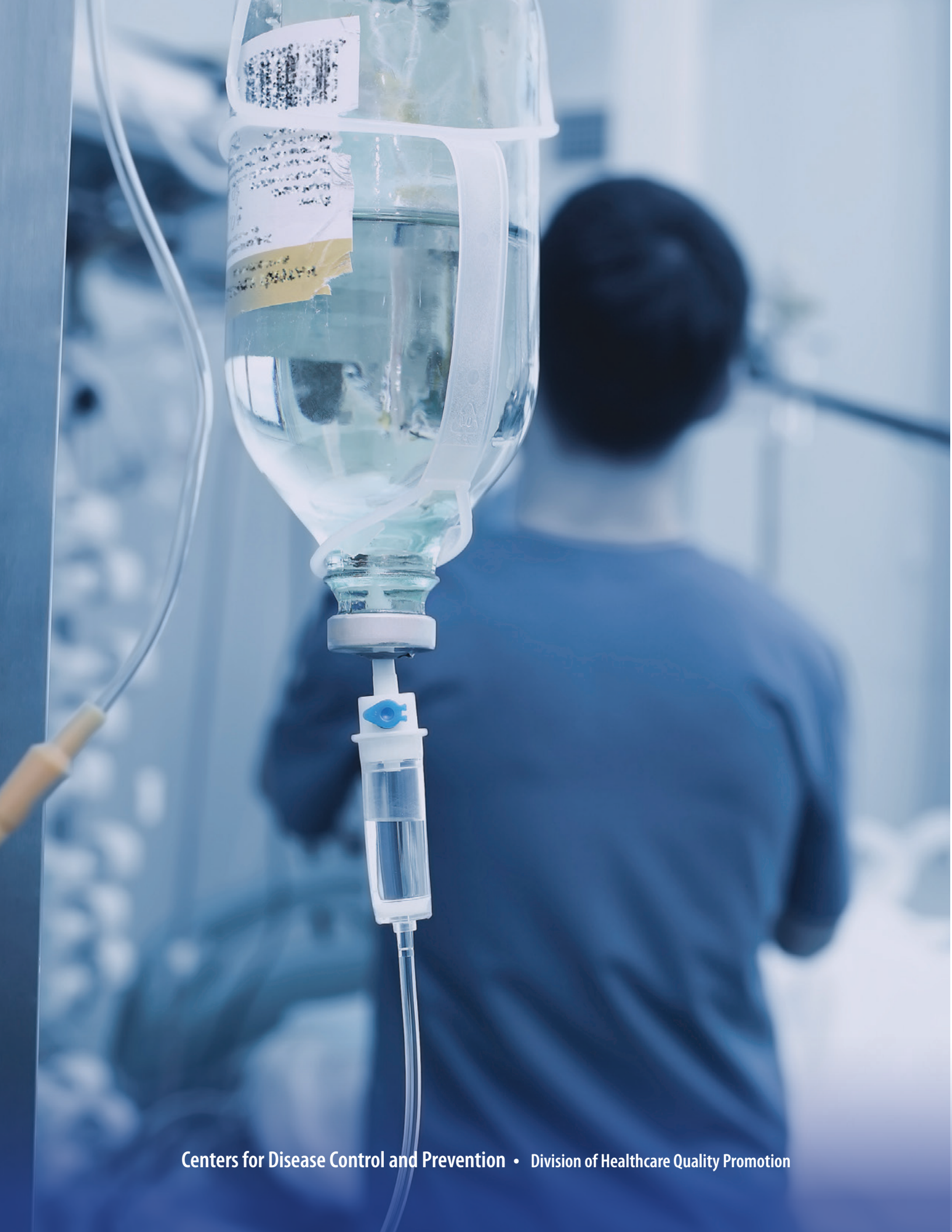

Centers for Disease Control and Prevention • Division of Healthcare Quality Promotion

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LIST OF ABBREVIATIONS

ASE	adult sepsis event
BSE	bacteremia/fungemia shock event
CDC	Centers for Disease Control and Prevention
CO	community-onset
CPT	current procedural terminology code
eGFR	estimated glomerular filtration rate
ED	emergency department
EHR	electronic health record
HO	hospital-onset
ICD-10	10th Revision of the International Statistical Classification of Diseases and Related Health Problems
ICU	intensive care unit
IV	intravenous
NHSN	National Healthcare Safety Network
QAD	qualifying antimicrobial days
PO	oral administration
RIT	repeat infection timeframe
SEP-1	Centers for Medicare & Medicaid Services Early Management Bundle, Severe Sepsis/Septic Shock
SOFA	Sequential Organ Failure Assessment

BACKGROUND

Sepsis is a clinical syndrome defined as life-threatening organ dysfunction caused by a dysregulated host response to infection.[1] The burden of sepsis is high, with over 1.7 million adult sepsis cases annually in the U.S. which contribute to 270,000 deaths.[2] Patients who survive sepsis often suffer long-term physical, psychological, and cognitive disabilities.

Because there is no confirmatory diagnostic test, the diagnosis of sepsis requires clinical judgment based on evidence of infection and organ dysfunction. A 1991 consensus conference established a clinical definition based on the patient's systemic inflammatory response syndrome (SIRS) to infection (later referred to as Sepsis-1)[3], and these clinical criteria were expanded in 2001 in the Sepsis-2 criteria.[4] In response to increasing understanding of sepsis pathobiology, a task force updated the clinical definitions in 2016[1], and in Sepsis-3, defined sepsis as "life-threatening organ dysfunction caused by a dysregulated host response to infection", with clinical guidelines defining organ dysfunction as acute change in total Sequential Organ Failure Assessment (SOFA) score ≥2 points consequent to the infection.[1]

The updated clinical definitions are critical for identifying patients at risk for sepsis and further complications, but there is also a need for a definition that can be used to retrospectively track sepsis for rigorous case counting and outcome monitoring. Different definitions for sepsis are needed for different purposes, which could include clinical care, research, surveillance, and quality improvement and audit.[5,6] For example, a sepsis definition optimized for public health surveillance would prioritize reliability and validity across healthcare facilities, and low measurement burden. However timeliness may be less of a priority because such definitions would be used retrospectively and not be intended for clinical management of individual patients.[5,6]

Prior to 2017, U.S. national estimates of sepsis burden primarily relied on the use of administrative codes, which have consistently demonstrated increasing incidence and decreasing mortality.[7] Administrative codes are also frequently used in sepsis quality initiatives, including the Centers for Medicare & Medicaid Services Early Management Bundle, Severe Sepsis/Septic Shock (SEP-1). However, studies have demonstrated that coding for sepsis has steadily increased over the past decade, yet coding for the most common underlying infections has been stable or decreasing.[8] These analyses demonstrate that coding practices are likely vulnerable to biases from increasing sepsis awareness and financial incentives (higher reimbursement for sepsis coding), and therefore unreliable for surveillance purposes.[8]

In 2017, a CDC Prevention Epicenters-funded consortium published results of a study which used a new definition for sepsis based on objective clinical data elements conceptually analogous to Sepsis-3. This definition was optimized for surveillance directly from electronic health records (EHRs) across over 400 facilities, and displayed superior sensitivity and similar specificity compared to administrative codes when using Sepsis-3 criteria determined by medical record reviews as a gold standard.[2] Furthermore, this definition demonstrated that national sepsis incidence and outcomes (combination of death and discharge to hospice) were stable from 2009-2014, in contrast to administrative codes which showed increasing incidence and decreasing mortality, but are confounded by increasing sepsis awareness, coding bias, and financial incentives.

OBJECTIVES

This toolkit allows healthcare professionals who are interested in using the sepsis surveillance methodology from the national burden study to track healthcare facility-level sepsis incidence and outcomes using an objective definition based on clinical data. Necessary data may be obtained and processed directly from electronic health record, but could also be obtained using manual chart review. These data may be useful for understanding the effectiveness of local sepsis prevention, early recognition, and treatment programs.

SURVEILLANCE SETTINGS AND APPROPRIATE USE

These sepsis definitions were developed for surveillance of adult patents in acute care hospitals where denominator data (total admissions or patient days) can be collected. Because this toolkit features sepsis definitions not subject to coding bias or variation in provider documentation, it may be helpful for objectively tracking sepsis incidence and outcomes within a facility for the purpose of quality improvement initiatives or public health and epidemiology.

It is not recommended to use these definitions for sepsis surveillance among pediatric patients, since these surveillance definitions were developed to mirror adult sepsis definitions and have not been validated in pediatric populations.

The following sepsis definitions are not intended to guide clinical diagnostic or therapeutic decision making. The antibiotic prescribing requirements to meet a sepsis case imply that patient can only meet one of the sepsis surveillance definitions after at least 4 days of antibiotic therapy, and therefore the determination of sepsis with these definitions is retrospective.

Hospitals serve a variety of different patient populations that vary by factors that influence patient outcomes, including sepsis risk factors, comorbidities, and acuity of illness. Therefore direct comparison of sepsis outcomes among hospitals may not reflect quality of sepsis care. Rigorous comparisons of sepsis outcomes for regional, state, or national ranking purposes would require additional research to create validated risk adjustment models that account for many patient and hospital-level factors. However, despite these limitations, these standardized surveillance definitions could be useful for comparing sepsis outcomes within the same hospital over time or to a peer institution serving a similar population.

DEFINITIONS

Two sepsis events definitions are presented.

The **Adult Sepsis Event (ASE)** captures the widest variety of sepsis patients. This definition was developed and tested in a study by Rhee, *et al*. which included more than 400 U.S. hospitals using a wide variety of electronic health records.[2] ASE surveillance requires access to microbiology, medication administration, laboratory, and administrative (ICD) coding data. Clinical records of mechanical ventilation may also be used in lieu of procedure codes.

This definition was validated by Rhee, *et al*. and shown to be present in 6% of hospital admissions, with a sensitivity of 69.7% (95% confidence interval [CI] 52.9% to 92.0%), 98.1% specificity (95% CI 97.7% to 98.5%), 70.4% positive predictive value (95% CI 64.0% to 78.8%), and 98.0% negative predictive value (95% CI 95.9% to 99.6%) when using Sepsis-3 criteria as the reference standard.[2]

There is no single diagnostic test for sepsis, or one set of criteria that can identify sepsis with perfect accuracy, and thus it is important to note the following limitations of this surveillance definition, which has been optimized for objectivity and standardization:

- While ASE is not subject to provider variation in documentation and coding of sepsis, it is still dependent on provider-initiated interventions (ordering blood cultures, antimicrobials, laboratory tests, vasopressors or mechanical ventilation) to measure presumed infection and organ dysfunction. This is also a limitation of the Sepsis-3 definition.
- It is not possible to determine whether organ dysfunction was a result of infection or other causes when using EHR-based automated determination of ASE. This can lead to misclassification.
- ASE criteria will miss organ dysfunction due to mild or moderate hypoxia that does not result in mechanical ventilation but would fulfill organ dysfunction criteria in the Sepsis-3 clinical definition. It will also miss neurologic dysfunction that would fulfill Sepsis-3 criteria.

The **Bacteremia/Fungemia Shock Event (BSE)** is a simplified definition that tracks a narrower sub-population of patients with a much higher mortality. This definition is based on positive blood cultures (excluding common contaminants), which almost always reflect true infections, and vasopressors, which almost always reflect clinically important hypotension. BSE requires fewer data elements than ASE and can be determined using only microbiology and medication administration records

In subsequent analysis of the dataset used by Rhee *et al*., BSE was present in 0.48% of hospital admissions (compared to 6.0% with ASE), and 35.4% of BSE events resulted in death during hospitalization (compared to 15% of ASE). It had a sensitivity of 6.0% and positive predictive value of 100% when using Sepsis-3 criteria as the reference standard (unpublished).

ASE: Adult Sepsis Event

(Must include the 2 components of criteria A AND include one or more organ dysfunction listed among B criteria)

A. Presumed Infection (presence of both 1 and 2):

1. Blood culture obtained (irrespective of the result), AND
2. At least 4 Qualifying Antimicrobial Days (QAD) – starting within the time period 2 calendar days before and 2 calendar days after the collection date of a blood culture. See below.

AND

B. Organ Dysfunction (at least 1 of following criteria met within the time period 2 calendar days before and 2 calendar days after the collection date of a blood culture.):

1. Initiation of a new vasopressor infusion (norepinephrine, dopamine, epinephrine, phenylephrine, OR vasopressin). To count as a new vasopressor, that specific vasopressor cannot have been administered in the prior calendar day. Vasopressors given in an operating room or other procedural area should be excluded. See Appendix B.
2. Initiation of invasive mechanical ventilation (must be greater than 1 calendar day between mechanical ventilation episodes). Invasive mechanical ventilation can be identified by ICD-10 Procedure Codes (5A1935Z, 5A1945Z, 5A1955Z) or CPT codes (94002, 94003, 94004, 94656, 94657), or by other clinical records.
3. Doubling of serum creatinine OR decrease by ≥50% of estimated glomerular filtration rate (eGFR) relative to baseline (see below), excluding patients with end-stage renal disease (which can be identified using ICD-10 codes [N18.6] or other clinical records). (If eGFR values are not readily available, creatinine alone can be used to determine renal dysfunction).
4. Total bilirubin ≥ 2.0 mg/dL and increase by 100% from baseline (see below).
5. Platelet count <100 cells/μL AND ≥ 50% decline from baseline (see below) - baseline must be ≥100 cells/μL.
6. **Optional:** Serum lactate ≥ 2.0 mmol/L. Note that serum lactate has become an increasingly common test to measure tissue perfusion. When serum lactate is included in the surveillance definition, the likely effect will be to slightly increase the number of sepsis cases identified. However, if serum lactate ordering practices are not stable over time in a particular hospital this will bias trends in the incidence of sepsis. For this reason, serum lactate was not used in the primary analysis of sepsis trends over time in the original study by Rhee *et al.*

BSE: Bacteremia/Fungemia Shock Event

(Must meet BOTH criteria A AND B)

A. Bacteremia OR Fungemia

Patient has a recognized pathogen identified (i.e., an organism which is not a common commensal – see CDC National Healthcare Safety Network list for guidance) from one or more blood specimens by a culture (non-culture based microbiologic testing methods could also be used to identify pathogens, but were not used in the initial study by Rhee et al.).

AND

B. New Vasopressor

Initiation of a new vasopressor infusion (norepinephrine, dopamine, epinephrine, phenylephrine, vasopressin) within the time period 2 calendar days before and after the collection date of a blood culture demonstrating a recognized pathogen (see A). To count as a new vasopressor, that specific vasopressor cannot have been administered in the prior calendar day. Vasopressors given in an operating room or other procedural area should be excluded.

Key Terms and Concepts

Blood Culture

Qualifying cultures include those drawn for bacterial (aerobic and/or anaerobic), acid-fast bacilli (AFB), and fungal cultures. Blood cultures for specific viruses (e.g., cytomegalovirus) are excluded. For ASE, blood cultures merely need to have been drawn, regardless of result. For BSE, blood cultures or other bacteremia or fungemia testing of blood must have yielded a recognized pathogen.

Window Period

The date the blood culture is obtained is the center of a window period extending both 2 days before and 2 days after the blood culture for both ASE and BSE. Multiple window periods during a hospitalization are possible. If multiple blood cultures are obtained in a short period of time, window periods may overlap.

Figure 1: Examples Illustrating Window Period

Hospital Day No.	1	2	3	4	5	6	7	8	9
Blood Culture				X					
Window Period		Window Period							

Hospital Day No.	1	2	3	4	5	6	7	8	9
Blood Culture	A						A		
Window Period	Window Period A				Window Period B				

Hospital Day No.	1	2	3	4	5	6	7	8	9
Blood Culture	A			B					
Window Period	Overlapping Window Periods								

If blood cultures, antimicrobial use, OR any organ dysfunction criteria are obtained on hospital day -1 or day 0 (i.e., up to 2 days prior to admission), these criteria can be used to qualify for events in order to account for medical care in the emergency department prior to admission.

Qualifying Antimicrobial Days (QAD)

For ASE events, the first QAD is the first day in the window period extending both 2 days before and 2 days after the patient receives a new antimicrobial (see Appendix A for list of qualifying antimicrobials). A new antimicrobial is defined as an antimicrobial not previously administered in the prior 2 calendar days. Oral and intravenous formulations of the same antimicrobial are counted as the same antimicrobial EXCEPT for vancomycin.

Subsequent QADs can be the same antimicrobial, or a different antimicrobial as long as the first dose of each antimicrobial in the sequence is new (not previously administered in the prior 2 calendar days). A subsequent new antimicrobial does not have to be started within the window period to be counted as a QAD.

Figure 2: Examples Illustrating QAD

Hospital Day No.	1	2	3	4	5	6	7	8	9
Blood Culture				X					
Window Period		Window Period							
Levofloxacin IV administration				X	X	X	X		
QAD				X	X	X	X		

This scenario includes at least 4 QAD that begin within the window period, and therefore meets criteria for presumed infection.

Hospital Day No.	1	2	3	4	5	6	7	8	9
Blood Culture				X					
Window Period		Window Period							
Vancomycin IV administration				X	X	X	X	X	
Piperacillin/Tazobactam IV administration	X	X	X	X	X				
QAD				1	2	3	4	5	

This scenario includes at least 4 QAD from Vancomycin that begin within the window period, and therefore meets criteria for presumed infection. Because Piperacillin/Tazobactam administration was administered prior to the window period, it does not qualify towards QADs.

There must be at least one new parenteral (intravenous or intramuscular) antimicrobial administered within the window period for the QADs to satisfy the definition.

Figure 3: Examples Illustrating QAD with Multiple Antimicrobials

Hospital Day No.	1	2	3	4	5	6	7	8	9
Blood Culture				X					
Window Period		Window Period							
Vancomycin IV administration				X	X	X			
Piperacillin/Tazobactam IV administration				X	X	X			
Levofloxacin Oral administration						X	X	X	
QAD				1	2	3	4	5	

In this scenario, the first 3 QADs were met by vancomycin IV administration and piperacillin/tazobactam IV administration. QAD 4 and QAD 5 were met by levofloxacin oral administration. Subsequent QADs may be oral as long as at least one QAD in the window period is parenteral. This scenario qualifies for presumed infection.

A gap of a single calendar day between administrations of the same antibiotic (oral or intravenous) count as QADs as long as the gap is not greater than 1 day.

Figure 4: Examples Illustrating QAD with Gaps in Antimicrobial Dosing

Hospital Day No.	1	2	3	4	5	6	7	8	9
Blood Culture	X								
Window Period	Window Period								
Levofloxacin IV administration	X		X		X				
QAD	1	2	3	4	5				

Even though levofloxacin is administered every other day, because the gap between doses is only 1 day, this levofloxacin administration counts as consecutive treatment doses, for a total of at least 4 QAD that begin within the window period, and therefore meets criteria for presumed infection.

If a patient's care transitions to comfort measures only, or the patient dies, is discharged to another hospital, or discharged to hospice before 4 QADs have elapsed, then the presumed infection criteria can be met with less than 4 QADs as long as they have consecutive QADs until day of, or 1 day prior to, death or discharge to hospice/other hospital or transition to comfort measures. For a patient only seen in the ED or ED observation unit, a QAD is required each day until day of, or 1 day prior to, death.

QAD does not apply to BSE events since administration of antibiotics is not required to meet the definition.

Figure 5: Example Illustrating QAD with Patient Death

Hospital Day No.	1	2	3	4	5	6	7
Blood Culture				X	X		
Window Period			Window Period				
Levofloxacin IV administration					X	X	
QAD					1	2	
Death							X

Even though only 2 QADs had elapsed before patient death, this scenario counts as an event since there were consecutive QADs until the day prior to death.

Onset Date

For ASE, onset date is defined as the earliest day in the window period extending both 2 days before and 2 days after the blood culture when EITHER the blood culture, first QAD, OR organ dysfunction criteria is met. For BSE, onset date is defined as the earliest day in the window period extending both 2 days before and 2 days after the blood culture when the vasopressor infusion was started.

Figure 6: Examples Illustrating Onset Date

Hospital Day No.	1	2	3	4	5	6	7	8	9
Blood Culture				X					
Window Period		Window Period							
QAD				1	2	3	4	5	
Organ Dysfunction			X						
Onset Date			X						

Organ dysfunction takes place on hospital day 3, while blood cultures and QADs begin on hospital-day 4. Because onset date is the date of the first criteria met (in this case organ dysfunction), onset date is hospital day 3.

Community-Onset vs. Hospital-Onset Events

Hospital-Onset Events require onset date to be on hospital day 3 or later, counting the date of admission as hospital day 1. Community-Onset Events require onset date to be on hospital day 2 or earlier, when the date of admission counts as hospital day 1.

Figure 7: Examples Illustrating Community-Onset vs. Hospital-Onset Events

Hospital Day No.	1	2	3	4	5	6	7	8	9
Blood Culture				X					
Window Period		Window Period							
QAD				1	2	3	4	5	
Organ Disfunction			X						
Onset Date			X						

Because Onset Date is on hospital day 3, this example qualifies as a Hospital-Onset Event

Hospital Day No.	1	2	3	4	5	6	7	8	9
Blood Culture				X					
Window Period		Window Period							
QAD				1	2	3	4	5	
Organ Disfunction		X							
Onset Date		X							

In this similar scenario, since the Organ Dysfunction was on hospital day 2, the Onset Date is also hospital day 2, and therefore this example qualifies as a Community-Onset Event.

Baseline Organ Function

Community-Onset Infection Events (Blood culture or first QAD on hospital day 1 or 2)

- Creatinine baseline is the lowest value during hospitalization.
- Estimated Glomerular Filtration Rate (eGFR) baseline is the highest value during the hospitalization. If eGFR value is documented as "≥60", eGFR is treated as 60.
- Bilirubin baseline is the lowest value during hospitalization.
- Platelet baseline is the highest value during hospitalization. If all platelet counts during hospitalization are <100 cells/μL, then platelet count should not be used to satisfy organ dysfunction criteria.

Hospital-Onset Infection Events (Blood culture and first QAD on hospital day 3 or later)

- Creatinine baseline is the lowest value within the window period extending both 2 days before and 2 days after the date of blood culture collection.
- Estimated Glomerular Filtration Rate (eGFR) baseline is the highest value within the window period extending both 2 days before and 2 days after the date of blood culture collection. If eGFR value is documented as "≥60", eGFR is treated as 60.
- Bilirubin baseline is the lowest value within the window period extending both 2 days before and 2 days after the date of blood culture collection.
- Platelet baseline is the highest value within the window period extending both 2 days before and 2 days after the date of blood culture collection, AND must be ≥100 cells/μL. If all platelet counts within window period are <100 cells/μL, then platelet count should not be used to satisfy organ dysfunction criteria.

Repeat Infection Timeframe Considerations

The repeat infection timeframe (RIT) is a timeframe after an ASE or BSE onset date when no new events are counted, in order to minimize the chance a single, prolonged episode of ASE or BSE is counted twice. RIT therefore only applies to determination of hospital-onset events.

Note that in Rhee *et al*., only one sepsis episode was counted per hospitalization, and thus no RIT was used.

Among healthcare associated infections reported to the CDC's National Healthcare Safety Network, an RIT of 14 days is used, and may be reasonable for hospitals looking to track hospital-onset events. However, other RIT timeframes (or simply counting a single sepsis episode per admission) may be more appropriate depending on the hospital's surveillance needs.

Use of an RIT is probably most useful in surveillance efforts where sepsis incidence is of primary interest. However, if mortality outcomes are the primary interest, then it may be prudent to eliminate the RIT since a patient with multiple sepsis episodes and a single hospitalization outcome (survival, death, or discharge to hospice) would be counted multiple times and thus skew results.

SURVEILLANCE METHODS

Pre-assessment of Sepsis Identification, Care and Surveillance Practices (Optional)

Prior to beginning sepsis surveillance efforts, it would be prudent to investigate sepsis diagnostic and treatment practices across the hospital, as well as administrative programs. This is especially important if this toolkit will be used to track the impact of quality improvement efforts. A pre-assessment of broad sepsis practices would be helpful for interpreting surveillance results and creating recommendations for improving patient care.

Existing sepsis practices to review may include:

Administrative and Programmatic Practices

- Sepsis education and awareness campaigns
- Sepsis CMS SEP-1 compliance efforts
- Emergency department, hospital ward, or intensive care unit sepsis teams
- Presence of "Code Sepsis" teams
- Antibiotic stewardship and systematic antibiotic de-escalation practices
- Electronic health record sepsis prediction tools, alerts, order sets, or protocols
- Sepsis ICD coding practices

Clinical Practices

- Emergency department sepsis identification and triage practices
- Hospital ward or intensive care unit sepsis screening practices
- Presence and compliance with sepsis diagnostic and management protocols
- Concurrent clinical trials or quality improvement initiatives
- Referral/Transfer of patients with sepsis to other hospitals

Electronic Case Finding

Electronic data collection will need to be planned and implemented with the hospital's information technology department, or the clinical data warehouse, if available. Detailed data specifications are provided in Appendix C. A summary of the data elements is below:

The following categories of data are needed to determine ASE:

- Microbiology data- blood and fungal culture collection date
- Medication administration records- antimicrobial and vasopressor administration
- Laboratory data- serum lactate, serum creatinine, eGFR, total bilirubin, platelet count
- ICD-10 codes- end-stage renal disease (N18.6), mechanical ventilation (5A1935Z, 5A1945Z, 5A1955Z, OR may use other clinical documentation of end-stage renal disease or mechanical ventilation, see below)
- CPT codes- indicating mechanical ventilation: (94002, 94003, 94004, 94656, 94657)
- Patient outcome - death during hospitalization, discharge to hospice, transfer to another acute care hospital, or transfer to hospice or comfort measures only
- (Optional) Clinical documentation of receipt of mechanical ventilation- (in lieu of mechanical ventilation procedure codes above)

The following categories of data are needed to determine BSE:

- Microbiology data and result-blood and fungal culture collection date and result
- Medication administration records-vasopressor administration by infusion

Optional: In addition to the data necessary to determine the presence of sepsis events, additional information could be collected to aid in the epidemiologic analysis and understanding of patients with sepsis. This include but are not limited to the following data categories:

- Patient demographics
- Comorbidities-from either patient problem lists or from ICD-10 codes
- Patient location within the hospital
- Additional microbiological culture data: including pathogen identification from blood culture, non-blood culture testing and diagnostic results
- Record of surgeries, procedures, and indwelling devices such as central venous catheters
- Additional patient outcomes: ICU admission, hospital length of stay, discharge to home, discharge to nursing home or rehabilitation
- Cost/Billing

Manual Case Finding

An Adult Sepsis Event worksheet (Appendix D) is provided to aid collection of appropriate data for each ASE case that is identified. A Bacteremia/Fungemia Shock Event Worksheet (Appendix E) is also provided to aid collection of appropriate data for each BSE case that is identified. Both templates are provided in a modifiable format and can be customized to include additional data of interest. Of note, these forms include the option of specifying the causative organism and antimicrobial sensitivities similar to healthcare-associated infections reported to the CDC's National Healthcare Safety Network; however these fields are optional.

Denominator Data Collection

For community-onset sepsis, several denominator options are available depending on the outcome measure of interest.

Table 1: Suggested Community-onset (CO) Sepsis Outcome Measures

Outcome Measure	Numerator	Denominator Data
Mortality Rate	Patients with CO Sepsis events (ASE or BSE) who either died during hospitalization or were discharged to hospice	Total CO sepsis events (ASE or BSE)
Sepsis Rate	Total CO sepsis events (ASE or BSE)	Total hospital admissions (inpatient AND observation/24 hour stays)

For hospital-onset sepsis, several denominator options are available depending on the outcome measure of interest.

Table 2: Suggested Hospital-onset Sepsis Outcome Measures

Outcome Measure	Numerator	Denominator Data
Mortality Rate	Patients with HO Sepsis events (ASE or BSE) who either died during hospitalization or were discharged to hospice	Total HO sepsis events (ASE or BSE)
Sepsis Rate	Total HO sepsis events (ASE or BSE)	Total hospital admissions (inpatient AND observation/24 hour stays)

Data regarding the total number of hospital admissions is often obtained from hospital administrative databases and vary by institution.

Data Analysis and Quality Assessment

A timeframe should be chosen for each sepsis event calculation. Months, quarters, and years are common time units for analysis of many healthcare surveillance and quality measures. The optimal choice of time-unit will vary by facility and volume of cases.

Onset	Outcome	Calculation	Notes
Community-Onset (CO)	CO event rate per 100 admissions	$\frac{\text{(Total CO events)}}{\text{Total Admissions}} \times 100$	
	CO Mortality Rate per 100 CO admissions	$\frac{\text{(CO events with in-hospital deaths + CO events with discharge to hospice)}}{\text{(Total CO events)}} \times 100$	May reflect results of care in multiple settings (emergency room, ward, intensive care unit), thus may not be a reliable measure of care in a single unit
Hospital-Onset (HO)	HO event rate per 1000 patient days	$\frac{\text{(HO events)}}{\text{Total inpatient days}} \times 1000$	
	HO Mortality Rate per 100 events	$\frac{\text{(HO events with in-hospital deaths + HO events with discharge to hospice)}}{\text{(Total HO events)}} \times 100$	May reflect results of care in multiple settings (emergency room, ward, intensive care unit), thus may not be a reliable measure of care in a single unit

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APPENDICES

Appendix A. Antimicrobials Qualifying for Adult Sepsis Event

For purposes of case finding criteria, the antimicrobials are divided into parenteral (IV) and oral (PO) antimicrobials (where antimicrobial refers to antibacterial, antifungal, or antiviral agents). All PO and IV antimicrobials are considered identical for purposes of determining whether an antimicrobial is "new" or not (meaning that a switch from IV to PO or vice versa does not count as a "new antimicrobial.") The one exception is IV vs PO Vancomycin (meaning that a switch from IV to PO vancomycin, or initiation of PO vancomycin while still on IV vancomycin, and vice versa, all count as "new" antimicrobials). Intramuscular (IM) antimicrobials were treated equivalently as IV antimicrobials. "Oral" antibiotics include those given by any enteral route, for example via nasogastric tube. The generic names of the antimicrobials included are listed below. This list represents antimicrobials commercially available in the U.S. in 2017, and users should update the list as new antimicrobials are introduced into clinical care.

Antimicrobial					
IV Antibacterials					
amikacin	cefotaxime	cephapirin	gentamicin	minocycline	streptomycin
ampicillin	cefotetan	chloramphenicol	imipenem	moxifloxacin	tedizolid
ampicillin/ sulbactam	cefoxitin	ciprofloxacin	kanamycin	nafcillin	telavancin
azithromycin	ceftaroline	clindamycin	levofloxacin	oritavancin	ticarcillin
aztreonam	ceftazidime	cloxacillin	lincomycin	oxacillin	ticarcillin/ clavulanate
cefamandole	ceftazidime/ avibactam	colistin	linezolid	penicillin	tigecycline
cefazolin	ceftizoxime	dalbavancin	meropenem	piperacillin	tobramycin
cefepime	ceftolozane/ tazobactam	daptomycin	meropenem/ vaborbactam	piperacillin/ tazobactam	trimethoprim/ sulfamethoxazole
cefmetazole	ceftriaxone	doripenem	methicillin	polymyxin B	vancomycin
cefonicid	cephalothin	doxycycline	metronidazole	quinupristin/ dalfopristin	
cefoperazone		ertapenem	mezlocillin		
		gatifloxacin			
PO Antibacterials					
amoxicillin/ clavulanate	cefixime	cinoxacin	fosfomycin	norfloxacin	sulfamethoxazole
amoxicillin	cefpodoxime	ciprofloxacin	levofloxacin	ofloxacin	sulfisoxazole
ampicillin	cefprozil	clarithromycin	lincomycin	penicillin	tedizolid
azithromycin	ceftibuten	clindamycin	linezolid	pivampicillin	tetracycline
cefaclor	cefuroxime	cloxacillin	metronidazole	rifampin	trimethoprim
cefadroxil	cephalexin	dicloxacillin	minocycline	sulfadiazine	trimethoprim/ sulfamethoxazole
cefdinir	cephradine	doxycycline	moxifloxacin	sulfadiazine-trimethoprim	vancomycin
cefditoren	chloramphenicol	fidaxomicin	nitrofurantoin		
IV Antifungals					
amphotericin B	caspofungin	isavuconazonium	micafungin	posaconazole	voriconazole
anidulafungin	fluconazole	itraconazole			
PO Antifungals					
fluconazole	isavuconazonium	itraconazole	posaconazole	voriconazole	
IV Antivirals					
acyclovir	ganciclovir	cidofovir	foscarnet	peramivir	
PO Antivirals					
oseltamivir					

Appendix B: Vasopressors Included in Adult Sepsis Event Definition

Eligible vasopressors must have been administered via continuous intravenous infusion. Vasopressors administered in an operating room or other procedural area are excluded as these are frequently needed to counteract hypotension induced by sedative medication administration. Since the location of administration may be challenging to identify in an EHR, single bolus injections of vasopressors (a frequent method of delivering perioperative vasopressors) are generally excluded. The following medications are included:

Norepinephrine

Vasopressin

Epinephrine

Phenylephrine

Dopamine

Appendix C: Data Specifications for Direct Sepsis Determination from Electronic Health Records

The following data specifications were adopted from the study by Rhee et al. to assist hospitals with extracting, cleaning, and organizing data during the original study. Some updates have been made to reflect updates in ICD coding, streamlining, or other improvements in the surveillance definition.

Use of a common specification minimized variability in data across hospitals and facilitated analysis across multiple hospitals using a common analytic code. Use of this data specification is optional, but may be useful if your hospital wishes to compare unadjusted data to other hospitals using this toolkit.

Population:

All adult patients (≥18 years old) who were **hospitalized, or died in the Emergency Department (ED).**

The **"denominator"** of hospitalized patients includes:

1. Inpatient hospitalizations
2. "Observation" or "24 Hour" stays (we are also counting this functionally the same as "Inpatient")

Different EHR systems may have different ways of identifying hospitalizations. Possible strategies include looking for patients with inpatient encounter flags or encounters with valid DRG codes. Some datasets include encounters without clinical data (shell encounters) – for this protocol each encounter should have some minimum clinical data to be an eligible encounter (i.e. at least one laboratory procedure, at least one medication, and possibly at least one diagnosis code).

The **"numerator"** definitions for counts of septic patients per different criteria are summarized in the toolkit (page12). In terms of which patients are eligible for inclusion in the numerator please note the following:

1. Include **patients with evidence of sepsis who died in the ED**. (If a patient otherwise meets criteria for this EHR sepsis definition, i.e. IV antibiotic, blood culture, and organ dysfunction) and dies in the ED, the patient would count as a case. (These will not be included in the denominator ("per 100 hospitalizations"); however, it is expected that the number of sepsis patients who die in the ED will be extremely low.

For the purposes of generating denominator counts, use a dataset that includes all inpatient encounters. For numerators (i.e. cases), you can limit the size of the patient level analytic dataset in order to decrease file size and increase efficiency. In particular, the analytic dataset for numerators can be limited in the following way:

1. **EHR Clinical Data Starting Points (use either a. or b.):**
   a. All inpatients who received a **systemic antibiotic, antifungal, or antiviral (PO or IV) for ≥1 calendar day.** If a patient was only seen in the ED and was never admitted, but received antibiotics, they should be included if they died in the ED. Please see appendix for a list of antibiotics, antifungals, and antivirals included in this definition.

OR

   b. All inpatients who had at least one blood culture obtained. If a patient was only seen in the ED and was never admitted, but had a blood culture obtained, they should be included if they died in the ED.

For all patients, data should be provided for their ED stay (if applicable) as well as their inpatient hospitalization. This means that some patients may have data for a "day 0" or "day 1", since day 1 will refer to the inpatient admission date.

Notes:

- For convention, label the day of admission as "day 1".
- Change all dates from actual dates to relative dates. Relative dates are defined relative to date of admission. For example, if a patient is admitted on Monday, and discharged on Wednesday, discharge day would = 3.

Overview of Tables (Files)

Table Name	Description of Contents
Basic	Demographics and basic hospital summary characteristics (i.e. admission source, LOS, discharge disposition)
Diagnosis_Codes	All diagnosis codes and DRGs
Procedure_Codes	All procedure codes
Medications	Medications (Emergency Department and Inpatient meds only)
Laboratory	Laboratory values
Blood_culture	Blood culture dates (and results, if available)
Vent	Dates of mechanical ventilation
Location	Location of patient on each hospitalization day (e.g. ER, ward, ICU)
Hospital	Summary statistics on each hospital

I. Basic

Data Field	Description	Output
Patient_ID	A unique dummy ID that can identify the same patient across different hospitalizations	Number
Admission_ID	A unique identifier for every unique hospitalization ***Note –this should be unique for each hospitalization, i.e. even if the same patient is hospitalized again later in the year, they should have another unique_ID**	Number
Hospital_ID	Unique Hospital Identifier	Number
Age	Age in years on Day 0	Whole Number
Gender		M or F
Race	*Note, Hispanic is often listed as a race. If listed separately as Ethnicity, this takes precedence over any other race. i.e. White Race + Hispanic Ethnicity = Hispanic	White Black Asian Hispanic Other . =Not Identified / Missing
Admit_source	Admission Source (if available)	1=ER from community 2=Direct Admit to ward or ICU 3=Outside hospital (OSH) transfer to ER 4=OSH transfer to ward or ICU
Prior_location	Residence prior to hospitalization (if available)	1= Home 2= Long-term facility
Discharge_date	Date of hospital discharge, relative to admission	Integer Number
Discharge dispo	Discharge disposition	1=Home 2=Transfer to Another Acute Care Hospital 3=DC to Subacute Facility 4=Death 5=Hospice
Year	Calendar Year of Hospitalization (Based on Date of Admission)	4-digit year
Season	Season of Hospitalization (Based on Date of Admission)	**Winter** (December, January, February) **Spring** (March, April, May) **Summer** (June, July, August) **Fall** (September, October, November)
ICU_admitdate	Date of first admission to ICU (relative to admission date)	Whole Number
ICU_LOS	Total number of calendar days in the ICU	Whole number (partial days counted as whole day)
Service_line	A Primary Service Line for Admission *There may be multiple ways to impute this. Specialty of admitting physician is probably best; if not available, specialty of discharging physician.	Medical Surgical Cardiac Oncology Obstetrics Neuro Other *See next page for more details about classification

- Obstetrics includes maternal and fetal medicine
- Surgery includes: Surgical critical care, Anesthesiology, Cardiac Surgery, Neurosurgery, gynecology, gynecologic oncology, Surgical oncology, Ophthalmology, Otolaryngology, Urology, Podiatry, Oral Surgery
- Cardiac includes Cardiology and Cardiac Critical Care
- Neurology includes Neuro critical care
- All other types of critical care (Non-surgical/Neuro/Cardiac) is Medical
- Other includes Emergency Medicine, Radiology, Pathology, Dermatology, and anything else

Example Format for Basic File:

Patient_ID	Admission _ID	Hospital _ID	Age	Gender	Race	Admit_ Source	Discharge _Date	ETC.
12345678	1234567890	100	65	M	White	1	7	
22221234	1234567891	105	53	F	Asian	2	10	

II. Diagnosis_Codes

This file should include admitting diagnosis, primary diagnosis, all discharge diagnoses, the sequence number (i.e. numerical order of the code) and DRG codes. If present-on-admission (POA) flags are available for each diagnosis, please include those as well.

Data Field	Description
Diagnosis_Codes	Diagnosis code – either ICD-10 or DRG. No decimal points
CodeType	DRG or ICD10
Sequence No	Sequence of codes at discharge (for ICD-10 codes). 1=Primary diagnosis, 2 and above = all secondary diagnosis
POA	Present on admission flag (for ICD-10 codes) – 1 = yes, 0 = No
Primary_Dx	Primary (or Principal) Diagnosis at discharge.
Admit_Dx	Admitting Diagnosis (if available)

The "Long" Format (one diagnosis per line) is preferred:

Patient_ID	Admission _ID	Diagnosis Code	Code Type	Sequence No	POA	Primary Dx	Admit Dx
12345678	1234567890	R6520	ICD10	1	1	1	1
22221234	1234567891	020	DRG	.	.	.	.
22221234	1234567891	R6521	ICD10	1	1	1	1
22221234	1234567891	I509	ICD10	2	0	0	0

III. Procedure_Codes

This file should include all procedure codes (CPT and ICD10), the day relative to admission on which the procedure occurred, and the procedure specialty code (if available; this refers to Medicare provider/supplier specialty codes). The "Long" format is preferred (one line per procedure).

Example Format for Procedure_Codes:

Patient_ID	Admission _ID	Procedure _Code	ICD10 or CPT	Day	Proc_Specialty _Code
12345678	1234567890	5A1935Z	ICD10	1	99
22221234	1234567891	5A1935Z	ICD10	3	A3
22221234	1234567891	00100	CPT	3	A3

IV. Medications

The medications we are interested in are:

1. Vasopressors = IV norepinephrine, epinephrine, phenylephrine, dopamine, and vasopressin
2. Systemic Antibiotics (see Appendix C for list) including Antibacterials, Antifungals, and Antivirals

(see below for preferred format for cleaned Medications file)

Note: "PO" refers to any enteral route – PO, per NG Tube, per G tube, etc.

Format for Cleaned Med File:

Patient_ID	Admission _ID	Day	Med	Route	Med Type
11111111	1234567890	0	Norepinephrine	IV	Vasopressors
11111111	1234567890	0	Vancomycin	IV	Antibacterial
11111111	1234567890	0	Cefepime	IV	Antibacterial
11111111	1234567890	1	Vasopressin	IV	Vasopressors
11111111	1234567890	1	Vancomycin	IV	Antibacterial
11111111	1234567890	2	Cefepime	IV	Antibacterial
22222222	1234567891	0	Ceftriaxone	IV	Antibacterial
22222222	1234567891	1	Ceftriaxone	IV	Antibacterial
22222222	1234567891	2	Ceftriaxone	PO	Antibacterial
22222222	1234567891	2	Oseltamivir	PO	Antiviral
22222222	1234567891	3	Caspofungin	IV	Antifungal

V. Laboratory

We are interested in daily values of each of the laboratory values, in the units specified.

- Cr_max and Cr_min = daily min and max Creatinine (mg/dL)
- eGFR_max and eGFR_min = daily min and max estimated glomerular filtration rate (mL/min/1.73m2). This is generally reported as part of the Basic Metabolic Panel along with the creatinine. Note that a lab reporting "Creatinine Clearance" can be used interchangeably with eGFR.
- Tbili_max and Tbili_min = daily min and max Total Bilirubin (mg/dL)
- Plt_max and Plt_min = daily min and max Platelets (10^9/L)
- Lactate_max = daily max Lactate (mmol/L)

Format for cleaned lab file:

Patient_ID	Admission _ID	Day	Cr _max	Cr _min	Tbili _max	Tbili _min	Plt _max	Plt _min	Lactate _max
12345678	1234567890	1	1.2	1.2	2.1	2.1	125	125	2.1
12345678	1234567890	2	1.4	1.3	2.5	2.5	110	90	1.9
12345678	1234567890	3	1.5	1.4	.	.	70	70	.
12345678	1234567890	4	1.5	1.5	3.1	3.1	60	60	.
22221234	1234567891	1	2.5	2.5	.	.	400	400	4.2
22221234	1234567891	2	2.7	2.7	3.6	3.6	248	200	3.6

VI. Blood _Culture

Provide a list of all days when a blood culture was ordered, dates of results (optional), and final microbiologic results (optional). There are several ways of identifying a blood culture order, depending on what your EHR system captures, which may have different date stamps if they occur close to midnight:

a. Date and Time the blood culture was ordered

b. Date and Time the blood culture was drawn (same as time collected)

c. Date and Time the blood culture was logged/received by micro lab

Format for cleaned lab file:

Patient_ID	Admission _ID	Specimen _ID	Bcx _order _Day	Bcx _order _time	Bcx _drawn _day	Bcx _drawn _time	Bcx _log _day	Bcx _log _time	Result
22221234	1234567890	5555555	1	01:00	0	01:15	0	01:45	No growth
22221234	1234567890	5555556	3	05:15	3	05:20	3	05:35	Staphylococcus aureus
22221234	1234567890	5555557	3	05:15	3	05:21	3	05:35	Staphylococcus aureus
12345678	1234567890	3333333	1	12:15	1	12:20	1	12:40	E.coli
12345678	1234567891	3333334	7	03:30	7	03:35	7	03:45	No growth

VII. Vent

Create a clean table with yes/no vent exposure per day, where 1 = yes patient received mechanical ventilation and 0 = no, patient did not receive mechanical ventilation that day

Method of identifying mechanical ventilation may differ depending on your EHR data.

Although actual respiratory therapy data is optimal, identifying mechanical ventilation by ICD-10 and CPT procedure codes is our default option.

ICD-10 Vent Codes: 5A1935Z, 5A1945Z, 5A1955Z
CPT Vent Codes: 94002, 94003, 94004, 94656, 94657

Patient_ID	Admission_ID	Day	Mech _vent**
12345678	1234567890	1	0
12345678	1234567890	2	0
12345678	1234567890	3	0
12345678	1234567890	4	1
12345678	1234567890	5	1
12345678	1234567890	6	0
22221234	1234567891	1	0
22221234	1234567891	2	1
22221234	1234567891	3	1
22221234	1234567891	4	1
22221234	1234567891	5	0

****Mech_vent refers to invasive mechanical ventilation.**

Option 2. If only the date of initiation of mechanical ventilation is available, please include this.

Patient_ID	Admission_ID	Vent_Initiation_Day
12345678	1234567890	3
78123456	1234567890	2
78123456	1234567890	6

VIII. Location

Option 1. Create a day-by-day location guide for the patient.

Please list the highest level of care on a given day: ex: if a patient is admitted to an ICU on a given day from the hospital ward, please list ICU rather than ward. Hierarchy = ICU > Stepdown Unit > Ward > ER. (An alternative is to use a midnight census to define the patient location for the day.)

Patient_ID	Admission_ID	Day	Location
12345678	1234567890	0	ER
12345678	1234567890	1	Ward
12345678	1234567890	2	Ward
12345678	1234567890	3	ICU
12345678	1234567890	4	ICU
12345678	1234567890	5	ICU
12345678	1234567890	6	Ward
12345678	1234567890	7	Ward
12345678	1234567890	8	ICU
22221234	1234567891	1	Ward
22221234	1234567891	2	Ward
22221234	1234567891	3	Ward

Option 2. If day-by-day location is not available, please provide date of first ICU admission and total ICU length of stay in the Basic Info File (File #1).

IX. Hospital

The following hospital information was extracted in the study by Rhee et al. to analyze sepsis across many hospitals. If you are using this toolkit in multiple hospitals it may be worthwhile to obtain this data.

Variable	Description	Description 2
Hospital_ID	Hospital identifier (can be linked to each patient via the Basic file)	
State	State	2-digit state code
Urban	Urban vs Suburban vs Rural	1=Urban 2=Suburban 3=Rural
Beds	Total number of inpatient beds	
ICU_beds	Total number of ICU beds	
Teaching	Teaching status	1=Teaching hospital 2=Non-teaching hospital
Annual_discharges	Total number of adult discharges per year	

Appendix D: Adult Sepsis Event (ASE) Manual Case Report Template

(* = optional)

Hospital ID: _____ Event #: _____

Patient ID: _____ Social Security #: _____

Secondary ID:_____ Medicare #: _____

Patient Name, Last: _____ First: _____ Middle: _____

Gender: F M Other_____ Date of Birth: _____

Ethnicity (Specify): _____ Race (Specify): _____

Date Admitted to Hospital: _____

Sepsis Onset Date: _____ *Location at Onset Date: _____

Event Details *(must meet Criteria #1 AND #2)*

CRITERIA #1: Presumed Infection

☐ Blood culture obtained **AND**

☐ ≥ 4 Qualifying Antimicrobial Days (starting within ± 2 days of blood culture day)

CRITERIA #2: Organ Dysfunction: (*Any one of the following within ± 2 days of blood culture***)**

☐ Initiation of a new vasopressor infusion[1]

☐ Initiation of invasive mechanical ventilation[2]

☐ Acute renal failure (*only for patients without end-stage renal disease*), defined as **EITHER**:

a. Doubling of serum creatinine compared to baseline[3], **OR**

b. Decrease in estimated glomerular filtration rate (eGFR) by ≥ 50% compared to baseline[4]

☐ Hyperbilirubinemia, defined as **BOTH**:

a. Total bilirubin ≥ 2 mg/dL, **AND**

b. Total bilirubin increase of ≥ 50% compared to baseline[5]

☐ Thrombocytopenia (*only for patients with baseline platelet count > 100 cells/μL*) defined as **BOTH**:

a. Platelet count < 100 cells/μL, AND

b. Decrease in platelet count ≥ 50% compared to baseline[6]

☐ *Serum lactate ≥ 2 mmol/L[7]

[1] Vasopressor must not have been administered in prior calendar day. Qualifying vasopressors include: norepinephrine, dopamine, epinephrine, phenylephrine, vasopressin. Single vasopressor doses or those given in an operating room or other procedural area do not quality.

[2] Must be > 1 calendar days after previous invasive mechanical ventilation episode

[3] Baseline creatinine defined as: 1) Community-onset: lowest value during hospitalization, 2) Hospital Onset- lowest value in ± 2 days of blood culture

[4] Baseline eGFR is defined as 1) Community-onset: highest value during hospitalization, 2) Hospital Onset- highest value in ± 2 days of blood culture

[5] Baseline total bilirubin defined as 1) Community-onset: lowest value during hospitalization, 2) Hospital Onset- lowest value in ± 2 days of blood culture

[6] If all platelet counts are < 100, then platelet count should not be used to satisfy organ dysfunction criteria. Baseline platelets defined as 1) Community-onset: highest value during hospitalization, 2) Hospital Onset- highest value in ± 2 days of blood culture AND must be ≥ 100.

[7] Optional criteria

Died: Yes ☐ No ☐ *Sepsis Contributed to Death: Yes ☐ No ☐

Discharge or Death Date:

*Discharge Location: _____

☐ Private residence ☐ Long-term care/Skilled nursing facility (SNF)

☐ Acute care hospital ☐ Homeless

☐ Long-term acute care hospital (LTACH) ☐ Incarcerated

☐ Hospice ☐ Other

*Pathogens Identified: Yes ☐ No ☐ *If Yes, option to specify on next page*

*Pathogens Identified: Yes ☐ No ☐ *If Yes, option to specify on next pages*

Pathogen #	Gram-positive Organisms							
_____	**Staphylococcus coagulase-negative** (specify species if available):	**VANC** S I R N						
_____	**Enterococcus faecium**	**DAPTO** S N S N	**GENTHL**§ S R N	**LNZ** S I R N	**VANC** S I R N			
_____	**Enterococcus faecalis**							
_____	**Enterococcus spp.** (Only those not identified to the species level)							
_____	**Staphylococcus aureus**	**CIPRO/LEVO/MOXI** S I R N	**CLIND** S I R N	**DAPTO** S N S N	**DOXY/MINO** S I R N	**ERYTH** S I R N	**GENT** S I R N	**LNZ** S R N
_____		**OX/CEFOX/METH** S I R N	**RIF** S I R N	**TETRA** S I R N	**TIG** S I R N	**TMZ** S I R N	**VAC** S I R N	

Pathogen #	Gram-negative Organisms							
_____	**Acinetobacter** (specify species) _____	**AMK** S I R N **GENT** S I R N **TMZ** S I R N	**AMPSUL** S I R N **IMI** S I R N **TOBRA** S I R N	**AZT** S I R N **MERO/DORI** S I R N	**CEFEP** S I R N	**CEFTAZ** S I R N **PIP/PIPTAZ** S I R N	**CIPRO/LEVO** S I R N	**COL/PB** S I R N
_____	**Escherichia coli**	**AMK** S I R N **CEFTAZ** S I R N **ERTA** S I R N **TIG** S I R N	**AMP** S I R N **CEFUR** S I R N **GENT** S I R N **TMZ** S I R N	**AMPSUL/ AMXCLV** S I R N **CEFOX/ CETET** S I R N **IMI** S I R N **TOBRA** S I R N	**AZT** S I R N **CIPRO/ LEVO/MOXI** S I R N **MERO/DORI** S I R N	**CEFAZ** S I R N **PIPTAZ** S I R N	**CEFEP** S I/S-DD R N **COL/PB**† S R N **TETRA/ DOXY/ MINO** S I R N	**CEFOT/ CEFTRX** S I R N
_____	**Enterobacter** (specify species) _____	**AMK** S I R N **CEFTAZ** S I R N **ERTA** S I R N **TIG** S I R N	**AMP** S I R N **CEFUR** S I R N **GENT** S I R N **TMZ** S I R N	**AMPSUL/ AMXCLV** S I R N **CEFOX/ CETET** S I R N **IMI** S I R N **TOBRA** S I R N	**ATZ** S I R N **CIPRO/ LEVO/MOXI** S I R N **MERO/DORI** S I R N	**CEFAZ** S I R N **GENT** S I R N **PIPTAZ** S I R N	**CEFEP** S I/S-DD R N **COL/PB**† S R N **TETRA/ DOXY/ MINO** S I R N	**CEFOT/ CEFTRX** S I R N
_____ _____	**Klebsiella pneumonia** **Klebsiella oxytoca**	**AMK** S I R N **CEFTAZ** S I R N **ERTA** S I R N **TIG** S I R N	**AMP** S I R N **CEFUR** S I R N **GENT** S I R N **TMZ** S I R N	**AMPSUL/ AMXCLV** S I R N **CEFOX/ CETET** S I R N **IMI** S I R N **TOBRA** S I R N	**AZT** S I R N **CIPRO/ LEVO/MOXI** S I R N **MERO/DORI** S I R N	**CEFAZ** S I R N **PIPTAZ** S I R N	**CEFEP** S I/S-DD R N **COL/PB**† S R N	**CEFOT/ CEFTRX** S I R N **CEFTAZ** S I R N **TETRA/ DOXY/** MINO
_____	**Pseudomonas aeruginosa**	**AMK** S I R N **IMI** S I R N	**AZT** S I R N **MERO/DORI** S I R N	**CEFEP** S I R N	**CEFTAZ** S I R N **PIP/PIPTAZ** S I R N	**CIPRO/LEVO** S I R N **TOBRA** S I R N	**COL/PB** S I R N	**GENT** S I R N

Pathogen #	Fungal Organisms							
_______	Candida (specify species) ___________	ANIND S I R N	CASPO S I R N	FLUCO S I R N	FLUCY S I R N	ITRA S I R N	MICA S I R N	VORI S I R N

Pathogen #	Other Organisms									
_______	Organism 1 (specify) ___________	____ Drug 1 S I R N	____ Drug 2 S I R N	____ Drug 3 S I R N	____ Drug 4 S I R N	____ Drug 5 S I R N	____ Drug 6 S I R N	____ Drug 7 S I R N	____ Drug 8 S I R N	____ Drug 9 S I R N
_______	Organism 1 (specify) ___________	____ Drug 1 S I R N	____ Drug 2 S I R N	____ Drug 3 S I R N	____ Drug 4 S I R N	____ Drug 5 S I R N	____ Drug 6 S I R N	____ Drug 7 S I R N	____ Drug 8 S I R N	____ Drug 9 S I R N
_______	Organism 1 (specify) ___________	____ Drug 1 S I R N	____ Drug 2 S I R N	____ Drug 3 S I R N	____ Drug 4 S I R N	____ Drug 5 S I R N	____ Drug 6 S I R N	____ Drug 7 S I R N	____ Drug 8 S I R N	____ Drug 9 S I R N

Results Codes

S = Susceptible I = Intermediate R = Resistant NS = Non-susceptible S-DD = Susceptible-dose dependent
N = Not tested

§ GENTHL results: S = Susceptible/Synergistic and R = Resistant/Not Synergistic

† Clinical breakpoints have not been set by FDA or CLSI, Sensitive and Resistant designations should be based upon epidemiological cutoffs of Sensitive MIC ≤ 2 and Resistant MIC ≥ 4

Drug Codes

AMK = amikacin
AMP = ampicillin
AMPSUL = ampicillin/sulbactam
AMXCLV = amoxicillin/clavulanic acid
ANID = anidulafungin
AZT = aztreonam
CASPO = caspofungin
CEFAZ= cefazolin
CEFEP = cefepime
CEFOT = cefotaxime
CEFOX= cefoxitin
CEFTAZ = ceftazidime
CEFTRX = ceftriaxone
CEFUR= cefuroxime
CETET= cefotetan
CIPRO = ciprofloxacin
CLIND = clindamycin
COL = colistin
DAPTO = daptomycin
DORI = doripenem
DOXY = doxycycline
ERTA = ertapenem
ERYTH = erythromycin
FLUCO = fluconazole
FLUCY = flucytosine
GENT = gentamicin
GENTHL = gentamicin –high level test
IMI = imipenem
ITRA = itraconazole
LEVO = levofloxacin
LNZ = linezolid
MERO = meropenem
METH = methicillin
MICA = micafungin
MINO = minocycline
MOXI = moxifloxacin
OX = oxacillin
PB = polymyxin B
PIP = piperacillin
PIPTAZ = piperacillin/tazobactam
RIF = rifampin
TETRA = tetracycline
TIG = tigecycline
TMZ = trimethoprim/sulfamethoxazole
TOBRA = tobramycin
VANC = vancomycin
VORI = voriconazole

Appendix E: Adult Bacteremia/Fungemia Shock Event (BSE) Manual Case Report Template

(* = optional)

Hospital ID: _____ Event #: _____

Patient ID: _____ Social Security #: _____

Secondary ID: _____ Medicare #: _____

Patient Name, Last: _____ First: _____ Middle: _____

Gender: F M Other_____ Date of Birth: _____

Ethnicity (Specify): _____ Race (Specify): _____

Date Admitted to Hospital: _____

Sepsis Onset Date: _____ *Location at Onset Date: _____

Event Type:

☐ Community-Onset *(onset date on hospital day 2 or earlier, when date of admission is hospital day 1)*

☐ Hospital-Onset *(onset date on hospital day 3 or later, when date of admission is hospital day 1)*

Event Details *(must meet Criteria #1 AND #2)*

CRITERIA #1: Presumed Infection

☐ Blood or Fungal culture with non-commensal pathogen identified

AND

CRITERIA #2: Organ Dysfunction: *(± 2 days of blood culture)*

☐ Initiation of a new vasopressor infusion[1]

[1] Vasopressor must not have been administered in prior calendar day.
Qualifying vasopressors include: norepinephrine, dopamine, epinephrine, phenylephrine, vasopressin.
Single vasopressor doses or those given in an operating room or other procedural area do not quality.

Died: Yes ☐ No ☐ *Sepsis Contributed to Death: Yes ☐ No ☐

Discharge or Death Date: _____

*Discharge Location: _____

☐ Private residence ☐ Long-term care/Skilled nursing facility (SNF)

☐ Acute care hospital ☐ Homeless

☐ Long-term acute care hospital (LTACH) ☐ Incarcerated

☐ Hospice ☐ Other

*Pathogens Identified: Yes ☐ No ☐ **If Yes, option to specify on next pages*

Pathogen #	Gram-positive Organisms							
_____	**Staphylococcus coagulase-negative** (specify species if available):	**VANC** S I R N						
_____	**Enterococcus faecium**	**DAPTO** S N S N	**GENTHL**[§] S R N	**LNZ** S I R N	**VANC** S I R N			
_____	**Enterococcus faecalis**							
_____	**Enterococcus spp.** (Only those not identified to the species level)							
_____	**Staphylococcus aureus**	**CIPRO/LEVO/ MOXI** S I R N	**CLIND** S I R N	**DAPTO** S N S N	**DOXY/ MINO** S I R N	**ERYTH** S I R N	**GENT** S I R N	**LNZ** S R N
_____		**OX/CEFOX/ METH** S I R N	**RIF** S I R N	**TETRA** S I R N	**TIG** S I R N	**TMZ** S I R N	**VAC** S I R N	

Pathogen #	Gram-negative Organisms							
_____	**Acinetobacter** (specify species) _____	**AMK** S I R N **GENT** S I R N **TMZ** S I R N	**AMPSUL** S I R N **IMI** S I R N **TOBRA** S I R N	**AZT** S I R N **MERO/DORI** S I R N	**CEFEP** S I R N	**CEFTAZ** S I R N **PIP/ PIPTAZ** S I R N	**CIPRO/LEVO** S I R N	**COL/PB** S I R N **TETRA/ DOXY/ MINO** S I R N
_____	**Escherichia coli**	**AMK** S I R N **CEFTAZ** S I R N **ERTA** S I R N **TIG** S I R N	**AMP** S I R N **CEFUR** S I R N **GENT** S I R N **TMZ** S I R N	**AMPSUL/ AMXCLV** S I R N **CEFOX/ CETET** S I R N **IMI** S I R N **TOBRA** S I R N	**AZT** S I R N **CIPRO/ LEVO/ MOXI** S I R N **MERO/ DORI** S I R N	**CEFAZ** S I R N **PIPTAZ** S I R N	**CEFEP** S I/S-DD R N **COL/PB**[†] S R N **TETRA/ DOXY/MINO** S I R N	**CEFOT/ CEFTRX** S I R N
_____	**Enterobacter** (specify species) _____	**AMK** S I R N **CEFTAZ** S I R N **ERTA** S I R N **TIG** S I R N	**AMP** S I R N **CEFUR** S I R N **GENT** S I R N **TMZ** S I R N	**AMPSUL/ AMXCLV** S I R N **CEFOX/ CETET** S I R N **IMI** S I R N **TOBRA** S I R N	**ATZ** S I R N **CIPRO/ LEVO/ MOXI** S I R N **MERO/ DORI** S I R N	**CEFAZ** S I R N **PIPTAZ** S I R N	**CEFEP** S I/S-DD R N **COL/PB**[†] S R N **TETRA/ DOXY/MINO** S I R N	**CEFOT/ CEFTRX** S I R N
_____	**Klebsiella pneumonia**	**AMK** S I R N **CEFTAZ** S I R N **ERTA** S I R N **TIG** S I R N	**AMP** S I R N **CEFUR** S I R N **GENT** S I R N **TMZ** S I R N	**AMPSUL/ AMXCLV** S I R N **CEFOX/ CETET** S I R N **IMI** S I R N **TOBRA** S I R N	**AZT** S I R N **CIPRO/ LEVO/ MOXI** S I R N **MERO/ DORI** S I R N	**CEFAZ** S I R N **PIPTAZ** S I R N	**CEFEP** S I/S-DD R N **COL/PB**[†] S R N	**CEFOT/ CEFTRX** S I R N **CEFTAZ** S I R N **TETRA/ DOXY/** MINO
_____	**Klebsiella oxytoca**							
_____	**Pseudomonas aeruginosa**	**AMK** S I R N **IMI** S I R N	**AZT** S I R N **MERO/ DORI** S I R N	**CEFEP** S I R N	**CEFTAZ** S I R N **PIP/PIPTAZ** S I R N	**CIPRO/ LEVO** S I R N **TOBRA** S I R N	**COL/PB** S I R N	**GENT** S I R N

Pathogen #	Fungal Organisms							
_______	Candida (specify species) ____________	ANIND S I R N	CASPO S I R N	FLUCO S I R N	FLUCY S I R N	ITRA S I R N	MICA S I R N	VORI S I R N

Pathogen #	Other Organisms									
_______	Organism 1 (specify) ____________	______ Drug 1 S I R N	______ Drug 2 S I R N	______ Drug 3 S I R N	______ Drug 4 S I R N	______ Drug 5 S I R N	______ Drug 6 S I R N	______ Drug 7 S I R N	______ Drug 8 S I R N	______ Drug 9 S I R N
_______	Organism 1 (specify) ____________	______ Drug 1 S I R N	______ Drug 2 S I R N	______ Drug 3 S I R N	______ Drug 4 S I R N	______ Drug 5 S I R N	______ Drug 6 S I R N	______ Drug 7 S I R N	______ Drug 8 S I R N	______ Drug 9 S I R N
_______	Organism 1 (specify) ____________	______ Drug 1 S I R N	______ Drug 2 S I R N	______ Drug 3 S I R N	______ Drug 4 S I R N	______ Drug 5 S I R N	______ Drug 6 S I R N	______ Drug 7 S I R N	______ Drug 8 S I R N	______ Drug 9 S I R N

Results Codes

S = Susceptible I = Intermediate R = Resistant NS = Non-susceptible S-DD = Susceptible-dose dependent N = Not tested

§ GENTHL results: S = Susceptible/Synergistic and R = Resistant/Not Synergistic

† Clinical breakpoints have not been set by FDA or CLSI, Sensitive and Resistant designations should be based upon epidemiological cutoffs of Sensitive MIC ≤ 2 and Resistant MIC ≥ 4

Drug Codes

AMK = amikacin
AMP = ampicillin
AMPSUL = ampicillin/sulbactam
AMXCLV = amoxicillin/clavulanic acid
ANID = anidulafungin
AZT = aztreonam
CASPO = caspofungin
CEFAZ= cefazolin
CEFEP = cefepime
CEFOT = cefotaxime
CEFOX= cefoxitin
CEFTAZ = ceftazidime
CEFTRX = ceftriaxone
CEFUR= cefuroxime
CETET= cefotetan
CIPRO = ciprofloxacin
CLIND = clindamycin
COL = colistin
DAPTO = daptomycin
DORI = doripenem
DOXY = doxycycline
ERTA = ertapenem
ERYTH = erythromycin
FLUCO = fluconazole
FLUCY = flucytosine
GENT = gentamicin
GENTHL = gentamicin –high level test
IMI = imipenem
ITRA = itraconazole
LEVO = levofloxacin
LNZ = linezolid
MERO = meropenem
METH = methicillin
MICA = micafungin
MINO = minocycline
MOXI = moxifloxacin
OX = oxacillin
PB = polymyxin B
PIP = piperacillin
PIPTAZ = piperacillin/tazobactam
RIF = rifampin
TETRA = tetracycline
TIG = tigecycline
TMZ = trimethoprim/sulfamethoxazole
TOBRA = tobramycin
VANC = vancomycin
VORI = voriconazole

NOTES

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention