

# Prevention and Management of Post-Operative Sepsis



HOME OF SIDNEY KIMMEL MEDICAL COLLEGE

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# Disclosures

- Chief Medical Officer, Sepsis Alliance
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- Janssen
- T2 Biosystems

# Objectives

- Employ infection prevention principles pre-operatively and post-operatively to prevent post-operative sepsis.
- Utilize antibiotic stewardship for surgical prophylaxis.
- Determine the source of post-operative sepsis and treat with effective antimicrobials.

# Sepsis

# Sepsis, Defined

- Sepsis is the body's overwhelming response to an infection.
- This is a medical emergency where the root cause should be identified in order to get the appropriate treatment.
- Common causes of sepsis include infections that start from the lungs, urine, skin and gastrointestinal tract.
- Lack of adequate timely treatment can lead to organ injury, damage, hospitalization and even death.

# Signs & Symptoms of Sepsis

- Fever, chills - high or low temperature -> temperature
- Breathing too fast -> respirations
- Heart rate is too fast -> heart rate
- Dizziness/cold, clammy skin -> blood pressure
- Confusion -> mental status
- Shortness of breath -> oxygen level
- Pain -> scale, where, acuity

## Sepsis Screen Positive (new) -> Sepsis Bundle

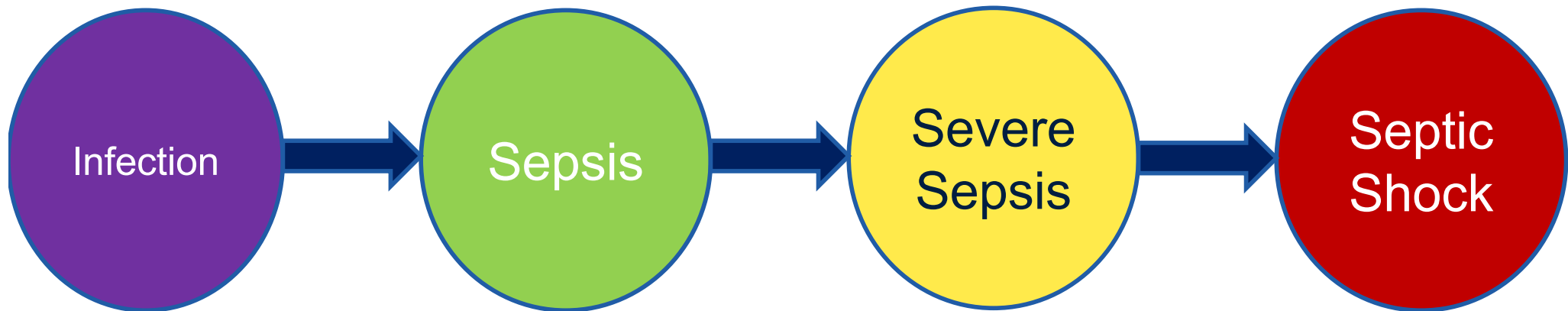
- Try to find those new sepsis screening criteria.
- Does the patient screen **POSITIVE** with the sepsis screening criteria **AND** is there a suspected/proven infection?
- If completely new, look for an infection on history and exam.
- If screens positive (new):
  - Blood cultures x 2, then
  - Give antibiotic
  - Lactate protocol panel
  - If hypotension or lactate > 4, then 30 cc/kg IVF bolus

## Sepsis can cause organ dysfunction & damage.

- Brain - confusion = encephalopathy due to sepsis.
- Kidneys - reduced urine output, injury to kidneys = acute kidney injury (AKI) due to sepsis
- Lactic acidosis due to sepsis.
- Lungs - shortness of breath -> oxygen requirements as severe as intubation (being on the ventilator).
- And more.
- Potential to prevent.



# Infection to Septic Shock



## Sepsis Classification

○ Sepsis

○ Severe Sepsis

○ Septic Shock

### Severe sepsis

(requires sepsis and any of the below)

### Sepsis

(requires both)

Suspected or proven infection

**AND**

2+ Screening criteria

- Temperature > 100.4°F (38.0°C) or < 96.8°F (36.0°C)
- Heart rate > 90 beats per minute
- Respiratory rate > 20 per minute or PCO<sub>2</sub> < 32 mmHg
- WBC > 12k or < 4k or > 10% bands
- SBP ≤ 100 mmHg
- GCS < 15 (or subjective altered mental status)
- SpO<sub>2</sub> < 90% on room air

### Acute end-organ dysfunction criteria



- GCS < 15 (or subjective altered mental status)



- SBP < 90 mmHg or 40 mmHg below baseline
- MAP < 65 mmHg
- MI Type 2 or Demand Ischemia



- Lactate > 2 mmol/L



- New O<sub>2</sub> to maintain SpO<sub>2</sub> > 90%
- PaO<sub>2</sub>/FiO<sub>2</sub> ratio < 300
- A-a Gradient > 300



- Creatinine > 0.5 mg/dL above baseline
- Urine output < 0.5 mL/kg/hr for 2 hours



- Total bilirubin > 2 mg/dL
- INR > 1.5 or PTT > 60 sec



- Platelet count < 100,000  $\mu$ L

### Septic shock

(requires severe sepsis and any of the below)

### Shock criteria

- **Refractory hypotension despite 30 mL/kg fluid bolus**
  - SBP < 90 mmHg
  - SBP > 40 mmHg below baseline
  - MAP < 65 mmHg
- **Lactate ≥ 4 mmol/L**

# Surgical Site Infection Guidelines: selected recommendations

<https://jamanetwork.com/journals/jamasurgery/fullarticle/2623725>

August 2017

# Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017

Sandra I. Berríos-Torres, MD<sup>1</sup>; Craig A. Umscheid, MD, MSCE<sup>2</sup>; Dale W. Bratzler, DO, MPH<sup>3</sup>; et al

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*JAMA Surg.* 2017;152(8):784-791. doi:10.1001/jamasurg.2017.0904

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# Defined

- Surgical site infections (SSIs) - impact incision, organ, or space.
- Comorbidities/resistant pathogens = > difficulty in treatment and higher costs.
- Prevention is paramount.
- Public reporting in the United States.
- Evidence-based medicine - potentially prevent 50% of SSI.

## Figures and Costs

- 2006 (US): inpatient surgical procedures = 46 million, ambulatory/free-standing = 32 million.
- 2006-2009: SSI = 1.9% of all surgeries.
- Underestimate = 50% SSI found post-discharge.
- Costs:
  - Estimated mean attributable costs: \$10,443 to \$25,546 per infection but based on 2005 and 2002 US dollars, respectively.
  - Costs >90K if prosthetic joint infection or resistant pathogen.

# Antimicrobial Prophylaxis (parenteral)

- IV antibiotics using clinical guidelines and ensure bactericidal concentration to the serum/tissues at incision time.
- For C-sections, give IV prophylactic antimicrobials before incision.
- If clean/clean-contaminated OR procedures, after closure (even if drain is present), no further antibiotics needed.
- Nonparenteral - No antimicrobials (ointment, solution, powder) to surgical incision for SSI prevention.

# Glycemic Control

- Perioperative blood sugar control to < 200 mg/dL in patients with and without diabetes mellitus.
- No specific recommendation for optimal target HbA1c to prevent SSI with and without diabetes mellitus.
- **Normothermia**: Keep temperature consistent - perioperative normothermia.



# Oxygenation

- Situation where patient has normal pulmonary function at baseline.
  - If general anesthesia + endotracheal intubation,  $>O_2$  for surgery and post-op (after extubated).
  - Perioperative normothermia and ensure volume replacement where needed.

# Antiseptic Prophylaxis


- Shower/bathe with soap (antimicrobial or nonantimicrobial) or an antiseptic agent one night before OR.
- Intraoperative skin prep - alcohol-based antiseptic.

# Systemic Immunosuppressive Therapy

- If patients are on systemic steroids or other immunosuppressives, if clean/clean-contaminated procedures, after closure (even if drain), no additional antimicrobial prophylaxis.

# 2020 National and State HAI Progress Report

- Acute care hospitals
- 5% decrease in SSI.
- 9% decrease in abdominal hysterectomy SSIs
- 5% decrease in colon surgery SSIs

- Surgical site infection (SSI) prevention practices
  - **Core Strategies:**
    - Follow evidence-based guidance for the prevention of SSIs
      - Available guidance:
        - [CDC Guidelines for the Prevention of Surgical Site Infection, 2017](#)
        - [SHEA Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update](#) 
    - Specifically, for patients undergoing high risk surgeries (e.g. cardiothoracic (CT), orthopedic, and neurosurgery), use an intranasal antistaphylococcal antibiotic/antiseptic (e.g. mupirocin or iodophor) and chlorhexidine wash or wipes prior to surgery.\*
      - Possible Regimens
        - Intranasal antistaphylococcal antibiotic/antiseptic
          - Mupirocin twice daily to each nare for the 5 days prior to day of surgery
          - OR**
          - 2 applications of nasal Iodophor (at least 5%) to each nare within 2 hours prior to surgery
        - Chlorhexidine
          - Daily chlorhexidine wash or wipes for up to 5 days prior to surgery
  - **Supplement Strategy**
    - Consider chlorhexidine bathing or wipes for up to 5 days prior to surgery for all surgical patients\*, not just those undergoing high risk surgeries

\* Facilities can choose to apply the selected pre-operative source control regimen universally to all patients or can screen patients undergoing a high-risk surgery with a test that detects both MSSA and MRSA and provide the decolonization regimen only to those from whom S. aureus is identified.

<https://www.cdc.gov/hai/prevent/staph-prevention-strategies.html>

# SSI Prevention and Sepsis Education for Patients

# Patient Education

## *What is a Surgical Site Infection (SSI)?*

A surgical site infection is an infection that occurs after surgery in the part of the body where the surgery took place. Most patients who have surgery do not develop an infection. However, infections develop in about 1 to 3 out of every 100 patients who have surgery.

Some of the common symptoms of a surgical site infection are:

- Redness and pain around the area where you had surgery
- Drainage of cloudy fluid from your surgical wound
- Fever

## *Can SSIs be treated?*

Yes. Most surgical site infections can be treated with antibiotics. The antibiotic given to you depends on the bacteria (germs) causing the infection. Sometimes patients with SSIs also need another surgery to treat the infection.

# Hospitals for Prevention of SSI

*What are some of the things that hospitals are doing to prevent SSIs?*

To prevent SSIs, doctors, nurses, and other healthcare providers:

- Clean their hands and arms up to their elbows with an antiseptic agent just before the surgery.
- Clean their hands with soap and water or an alcohol-based hand rub before and after caring for each patient.
- May remove some of your hair immediately before your surgery using electric clippers if the hair is in the same area where the procedure will occur. They should not shave you with a razor.
- Wear special hair covers, masks, gowns, and gloves during surgery to keep the surgery area clean.
- Give you antibiotics before your surgery starts. In most cases, you should get antibiotics within 60 minutes before the surgery starts and the antibiotics should be stopped within 24 hours after surgery.
- Clean the skin at the site of your surgery with a special soap that kills germs.

[https://www.cdc.gov/hai/pdfs/ssi/ssi\\_tagged.pdf](https://www.cdc.gov/hai/pdfs/ssi/ssi_tagged.pdf)



# What can patients do to prevent SSI?

*What can I do to help prevent SSIs?*

## ***Before your surgery:***

- Tell your doctor about other medical problems you may have. Health problems such as allergies, diabetes, and obesity could affect your surgery and your treatment.
- Quit smoking. Patients who smoke get more infections. Talk to your doctor about how you can quit before your surgery.
- Do not shave near where you will have surgery. Shaving with a razor can irritate your skin and make it easier to develop an infection.

## ***At the time of your surgery:***

- Speak up if someone tries to shave you with a razor before surgery. Ask why you need to be shaved and talk with your surgeon if you have any concerns.
- Ask if you will get antibiotics before surgery.

[https://www.cdc.gov/hai/pdfs/ssi/ssi\\_tagged.pdf](https://www.cdc.gov/hai/pdfs/ssi/ssi_tagged.pdf)

# After surgery prevention

## *After your surgery:*

- Make sure that your healthcare providers clean their hands before examining you, either with soap and water or an alcohol-based hand rub.

If you do not see your providers clean their hands, please ask them to do so.

- Family and friends who visit you should not touch the surgical wound or dressings.
- Family and friends should clean their hands with soap and water or an alcohol-based hand rub before and after visiting you. If you do not see them clean their hands, ask them to clean their hands.

[https://www.cdc.gov/hai/pdfs/ssi/ssi\\_tagged.pdf](https://www.cdc.gov/hai/pdfs/ssi/ssi_tagged.pdf)

# Discharge from the hospital

## *What do I need to do when I go home from the hospital?*

- Before you go home, your doctor or nurse should explain everything you need to know about taking care of your wound. Make sure you understand how to care for your wound before you leave the hospital.
- Always clean your hands before and after caring for your wound.
- Before you go home, make sure you know who to contact if you have questions or problems after you get home.
- If you have any symptoms of an infection, such as redness and pain at the surgery site, drainage, or fever, call your doctor immediately.

*If you have additional questions, please ask your doctor or nurse.*

[https://www.cdc.gov/hai/pdfs/ssi/ssi\\_tagged.pdf](https://www.cdc.gov/hai/pdfs/ssi/ssi_tagged.pdf)

# 4 WAYS TO GET AHEAD OF SEPSIS

## GET AHEAD OF SEPSIS

KNOW THE RISKS. SPOT THE SIGNS. ACT FAST.

**Infections put you and your family at risk for a life-threatening condition called sepsis.**

Sepsis is the body's extreme response to an infection. It is life-threatening, and without timely treatment, sepsis can rapidly lead to tissue damage, organ failure, and death. Sepsis happens when an infection you already have—in your skin, lungs, urinary tract or somewhere else—triggers a chain reaction throughout your body.

Anyone can get an infection, and almost any infection can lead to sepsis.

### 1 PREVENT INFECTIONS

Talk to your doctor or nurse about steps you can take to prevent infections.



Take good care of chronic conditions



Get recommended vaccines

### 2 PRACTICE GOOD HYGIENE

Remember to wash your hands and keep cuts clean and covered until healed.



Handwashing



Keep cuts clean and covered until healed.

### 3 KNOW THE SYMPTOMS

Symptoms of sepsis can include any one or a combination of these:



Confusion or disorientation



Shortness of breath



High heart rate



Fever, or shivering, or feeling very cold



Extreme pain or discomfort



Clammy or sweaty skin

### 4 ACT FAST

Get medical care IMMEDIATELY if you suspect sepsis or have an infection that's not getting better or is getting worse.

**Sepsis is a medical emergency. Time matters.**

To learn more about sepsis and how to prevent infections, visit [www.cdc.gov/sepsis](http://www.cdc.gov/sepsis).



[https://www.cdc.gov/sepsis/pdfs/Consumer\\_infographic\\_four-ways-to-get-ahead-of-sepsis\\_print-only\\_508.pdf](https://www.cdc.gov/sepsis/pdfs/Consumer_infographic_four-ways-to-get-ahead-of-sepsis_print-only_508.pdf)

# SEPSIS AND SURGERY

Surgery is a procedure that affects your body in many ways aside from the actual reason for the operation. Any type of surgery, from an appendectomy to a face lift to a Cesarean section, exposes your body to infection and other complications, some of which could develop into sepsis.

Sometimes incorrectly called blood poisoning, sepsis is the body's often deadly response to infection or injury. Sepsis kills and disables millions and requires early suspicion and rapid treatment for survival.

If left untreated, sepsis can progress to septic shock and death. Like strokes or heart attacks, sepsis is a medical emergency that requires rapid diagnosis and treatment. Worldwide, one-third of people who develop sepsis die. Many who do survive are left with life-changing effects, such as post-traumatic stress disorder (PTSD), chronic pain and fatigue, organ dysfunction (don't work properly), and/or amputations.

## SEPSIS CAUSES

Infection after surgery can cause sepsis. This could be infection in the incision (the opening in the skin), or an infection that develops after the surgery, such as pneumonia or a urinary tract infection (UTI).

When you have surgery, it is important to keep an eye on the incision, watching it for signs of infection. These include:

- Increasing redness around the incision
- Pus or other fluid coming from the incision
- Warmer than usual skin around the incision
- Increased pain around the incision
- Fever
- Fatigue

SEPSIS INFORMATION GUIDE – SEPSIS AND SURGERY

<https://www.sepsis.org/education/resources/sepsis-information-guides/download/?sig=17474>



Pneumonia is not uncommon after surgery, which is why it is important to get up and about as quickly as is possible after the operation. Deep breathing and coughing exercises are also helpful in keeping your lungs clear. Patients who needed a ventilator to help them breathe are also at higher risk for developing pneumonia.

Other infections, such as UTIs, may develop if you had to be catheterized (a tube inserted into your bladder). The longer the catheter remains in place, the higher the risk of infection.

### WHAT IS SEPSIS?

SEPSIS is the body's overwhelming and life-threatening response to infection, which can lead to tissue damage, organ failure, and death.

#### What are the signs and symptoms of sepsis?

Sepsis is a toxic response to an infection. There is no single sign or symptom of sepsis. It is, rather, a combination of symptoms.

#### What should I do if I think a loved one or I have sepsis?

If you suspect sepsis, call 9-1-1 or go to a hospital and tell your medical professional, "I AM CONCERNED ABOUT SEPSIS."

Symptoms can include ANY of the following:

- T** **Temperature:** Higher or lower than normal
- I** **Infection:** May have signs and symptoms of an infection
- M** **Mental Decline:** Confused, sleepy, difficult to rouse
- E** **Extremely Ill:** Severe pain, discomfort, shortness of breath

**SEPSIS IS A MEDICAL EMERGENCY. IF YOU SUSPECT SEPSIS, CALL 9-1-1 OR GO TO A HOSPITAL RIGHT AWAY.**

**To learn more about sepsis, or to read tributes and survivor stories, visit us online at [Sepsis.org](http://Sepsis.org)**



Sepsis Information Guides are supported in part by an educational grant from Merck & Co., Inc.

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# UCSF Antimicrobial surgical prophylaxis guidelines

Version 1.3

UCSF Medical Center  
UCSF Benioff Children's Hospitals

Antimicrobial surgical prophylaxis guidelines  
Approved 8.19.2021

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## INTRODUCTION

The antimicrobial surgical prophylaxis guideline establishes evidence-based standards for surgical prophylaxis at UCSF Medical Center and UCSF Benioff Children's Hospital San Francisco. The protocol has been adapted from published consensus guidelines from the American Society of Health-System Pharmacists (ASHP), Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), Centers for Disease Control and Prevention (CDC), and the Surgical Infection Society (SIS) for use at UCSF with input from the Antimicrobial Stewardship Program, the Infectious Diseases Management Program, the Department of Anesthesiology, and the surgical departments.

[https://idmp.ucsf.edu/sites/g/files/tkssra4251/f/Surgical%20ppx%20guideline%20v1.3\\_update%208\\_2021.pdf](https://idmp.ucsf.edu/sites/g/files/tkssra4251/f/Surgical%20ppx%20guideline%20v1.3_update%208_2021.pdf)

# UCSF Surgical Prophylaxis Guidelines

## PRINCIPLES OF ANTIMICROBIAL SURGICAL PROPHYLAXIS

- This guideline is focused on clean and clean-contaminated surgeries
- Prophylaxis should be targeted against most likely pathogens, taking into consideration type of surgery and local epidemiology
- Administer correctly—goal is for adequate tissue concentration at the time of risk
  - Administer within 60 minutes before the incision
  - For vancomycin and fluoroquinolones, the ideal timing is to start the infusion 60-120 minutes prior to incision
- Give dose before the tourniquet goes up, if applicable
- Confirm with the surgeon at the Time-out or earlier since occasionally antibiotics need to be delayed until after culture
- In clean and clean-contaminated surgeries, discontinue antibiotics after the surgical incision is closed unless the patient has a documented or suspected infection. In pancreatic transplantation, continuation of antibiotics until duodenal cultures result is an exception.

[https://idmp.ucsf.edu/sites/g/files/tkssra4251/f/Surgical%20ppx%20guideline%20v1.3\\_update%202021.pdf](https://idmp.ucsf.edu/sites/g/files/tkssra4251/f/Surgical%20ppx%20guideline%20v1.3_update%202021.pdf)



# UCSF: If has an infection

## Patients with existing infections

- The appropriate antibiotic to treat the underlying infection should be chosen on a case-by-case basis
- Continue the antibiotic to treat infection
- If spectrum of activity does not cover the usual organisms covered by routine prophylaxis for that type of case, add the routine prophylactic agent
  - Antibiotic spectrum guidance: [idmp.ucsf.edu/antibiotic-spectrum-guide](https://idmp.ucsf.edu/antibiotic-spectrum-guide)
- Ensure dose is given at appropriate time to achieve maximal tissue levels at time of incision
- Duration should be determined by the duration for the existing infection

[https://idmp.ucsf.edu/sites/g/files/tkssra4251/f/Surgical%20ppx%20guideline%20v1.3\\_update%208\\_2021.pdf](https://idmp.ucsf.edu/sites/g/files/tkssra4251/f/Surgical%20ppx%20guideline%20v1.3_update%208_2021.pdf)

# UCSF: Colonized with MRSA

## Patients known to be colonized with methicillin-resistant *Staphylococcus aureus* (MRSA)

- Can consider addition of vancomycin to prophylaxis, especially if implant is being placed. Standard prophylaxis (e.g. cefazolin) should still be provided as this affords superior surgical site infection prevention for methicillin-sensitive *Staphylococcus aureus* (MSSA).

Owner, UCSF Antimicrobial Stewardship Program (Sarah Doernberg, MD, MAS and Rachel Wattier, MD, MHS)

# UCSF: Recent history of resistant organisms

## Patients with recent history of resistant organisms

- Data is limited
- Take into account:
  - Timing of infection
  - Location of infection
  - Prior treatment
  - Planned procedure
  - Organism

[ip.ucsf.edu/sites/g/files/tkssra4251/f/Surgical%20ppx%20guideline%20v1.3\\_update%208\\_2021.pdf](http://ip.ucsf.edu/sites/g/files/tkssra4251/f/Surgical%20ppx%20guideline%20v1.3_update%208_2021.pdf)

# UCSF: PCN allergy

## Patients with penicillin allergy

- Take an antibiotic history
  - Exact details of reaction, description of rash (if present)
  - Timing of reaction
  - Reason for antibiotic prescription
  - Other antibiotics received since then (also review the EMR to see whether the patient has received other antibiotics)
- Severe beta-lactam allergy: Do not re-challenge
  - Immediate-type hypersensitivity: Hives, angioedema, wheezing, anaphylaxis
  - Late reactions: Hemolytic anemia, thrombocytopenia, serum sickness, drug reaction with eosinophilia, Stevens Johnson syndrome (SJS)/Toxic epidermal necrolysis (TEN)
- When to re-challenge or use alternative  $\beta$ -lactam
  - Okay if patient had history of maculopapular rash (no hives, wheezing, anaphylaxis)
  - Okay if history of other drug intolerances like nausea

[https://idmp.ucsf.edu/sites/g/files/tkssra4251/f/Surgical%20ppx%20guideline%20v1.3\\_update%202021.pdf](https://idmp.ucsf.edu/sites/g/files/tkssra4251/f/Surgical%20ppx%20guideline%20v1.3_update%202021.pdf)

# Nebraska Medicine: Antimicrobial Surgical Prophylaxis



## Antimicrobial Surgical Prophylaxis

The antimicrobial surgical prophylaxis protocol establishes evidence-based standards for surgical prophylaxis at Nebraska Medicine. The protocol was adapted from the recently published consensus guidelines from the American Society of Health-System Pharmacists (ASHP), Society for Healthcare Epidemiology of America (SHEA), Infectious Disease Society of America (IDSA), and the Surgical Infection Society (SIS) and customized to Nebraska Medicine with the input of the Antimicrobial Stewardship Program in concert with the various surgical groups at the institution. The protocol established here-in will be implemented via standard order sets utilized within One Chart. Routine surgical prophylaxis and current and future surgical order sets are expected to conform to this guidance. **[Click here](#)** to jump to antibiotic recommendations for specific surgery types.

### Antimicrobial Surgical Prophylaxis Initiation

- **Optimal timing:** Within 60 minutes before surgical incision
  - **Exceptions:** Fluoroquinolones and vancomycin (within 120 minutes before surgical incision)
- Successful prophylaxis necessitates that the antimicrobial agent achieve serum and tissue concentrations above the MIC for probable organisms associated with the specific procedure type at the time of incision as well as for the duration of the procedure.

<https://www.unmc.edu/intmed/divisions/id/asp/surgical-prophylaxis-protocol/docs/antimicrobial-surgical-prophylaxis.pdf>

### Renal Dose Adjustment Guidance

The following table can be utilized to determine if adjustments are needed to antimicrobial surgical prophylaxis for both pre-op and post-op dosing.

**Table 1 Renal Dosage Adjustment**

Antimicrobial	Dosing Regimen with Normal Renal Function	Dosing Regimen with CrCl less than 50 ml/min	Dosing Regimen with CrCl less than 10 ml/min
Ampicillin/Sulbactam	3 g IV q6h	3 g IV q8h (CrCl 30-50) 3 g IV q12h (CrCl <30)	Only administer preop dose 3 g
Aztreonam	2 g IV q 8h	2 g IV q 12h (CrCl <30)	Only administer preop dose 2 g
Cefazolin <120 kg ≥120kg	2 g IV q8h 3 g IV q8h	2 g IV q12h 3 g IV q12h	Only administer preop dose 2 g Only administer preop dose 3 g
Cefoxitin	2 g IV q6h	2 g IV q12h (CrCl <30)	Only administer preop dose 2 g
Clindamycin	900 mg IV 8h	900 mg IV 8h	900 mg IV 8h
Gentamicin ♦ use actual body weight (ABW) unless the patient is > 20% over their ideal body weight (IBW), then use dosing body weight (DBW=IBW+[0.4(ABW-IBW)])	Only administer preop dose 5mg/kg IV once	Only administer preop dose 5mg/kg IV once	Only administer preop dose <b>3mg/kg</b> IV once
Levofloxacin	500mg IV q24h	Only administer pre-op dose	Only administer pre-op dose
Metronidazole	500 mg IV q8h	500 mg IV q8h	500 mg IV q8h
Trimethoprim / Sulfamethoxazole	Trimethoprim component 160mg IV q12h	Only administer preop dose Trimethoprim 160mg	Only administer preop dose Trimethoprim 160mg
Vancomycin	15mg/kg IV q12h	Only administer preop dose (15mg/kg x 1)	Only administer preop dose (15mg/kg x 1)

¥ Dose adjustments based on renal dosage adjustments in antimicrobial guidebook

<https://www.unmc.edu/intmed/divisions/id/asp/surgical-prophylaxis-protocol/docs/antimicrobial-surgical-prophylaxis.pdf>

# Nebraska Medicine: Currently on antimicrobials

## **Patients Currently Receiving Antimicrobials:**

Patients who are currently receiving therapeutic antimicrobials for infections remote to the site of surgery also need surgical prophylaxis to ensure adequate tissue levels at time of surgery. If the spectrum of the therapeutic regimen is appropriate for surgical prophylaxis based on the site of surgery then an additional dose should be given within 60 minutes before surgical incision. Therapeutic agents should be redosed per intra-operative redosing guidance (Table 2). Special attention must be paid to patients on dialysis or with renal failure who are receiving intermittent dosing of therapeutic antimicrobials such as vancomycin and aminoglycosides. Depending on recent doses and drug levels, an additional pre-operative dose may not be necessary. Questions regarding the need for an additional pre-operative dose of these agents should be discussed with the pharmacist.

<https://www.unmc.edu/intmed/divisions/id/asp/surgical-prophylaxis-protocol/docs/antimicrobial-surgical-prophylaxis.pdf>

# Nebraska Medicine: Re-dose

## **Intraoperative Antimicrobial Readministration Guidelines**

In general, antimicrobials should be re-administered at intervals of 1-2 times the half-life of the drug. The following chart can be utilized to determine appropriate re-dosing intervals for antimicrobial surgical prophylaxis.

Note:

- Intraoperative redosing is needed to ensure adequate serum and tissue concentrations of the antimicrobial if the duration of the procedure exceeds two half-lives of the drug (see Table 2) or there is excessive blood loss during the procedure<sup>1</sup>
  - Excessive blood loss classified as >1500mL.
- Redosing interval should be measured from the time of administration of the preoperative dose, not from the beginning of the procedure<sup>1</sup>

<https://www.unmc.edu/intmed/divisions/id/asp/surgical-prophylaxis-protocol/docs/antimicrobial-surgical-prophylaxis.pdf>

# Nebraska Medicine: Redosing

**Table 2 Intraoperative Redosing Guidance**

Antimicrobial	Half-life with Normal Renal Function (h)	Half-life with End-stage Renal Disease (h)	Recommended Redosing Interval in Individuals with NORMAL Renal Function*
Ampicillin/sulbactam	0.8-1.3	unavailable	2 hours
Aztreonam	1.3-2.4	6-8	4 hours
Cefazolin	1.2-2.5	40-70	4 hours

Cefepime	2		4 hours
Cefoxitin	0.5-1.1	6.5-23	2 hours
Ceftriaxone	5.4-10.9		NA
Clindamycin	2-4	3-5	6 hours
Ertapenem	3-5		NA
Gentamicin	2-3	50-70	NA
Levofloxacin	6-8		NA
Meropenem	1-1.5		4 hours
Metronidazole	6-8	7-21; no change	8 hours
Piperacillin/tazobactam	0.7-1.2		2 hours
Trimethoprim/sulfamethoxazole	8-12	20-30	12 hours
Vancomycin	4-6	44.1-406.4	NA

\*Recommended redosing intervals marked as "not applicable" (NA) are based on typical case length; for unusually long procedures, redosing may be needed

<https://www.unmc.edu/intmed/divisions/id/asp/surgical-prophylaxis-protocol/docs/antimicrobial-surgical-prophylaxis.pdf>



# Nebraska Medicine: Antimicrobial Prophylaxis by Procedure

**Back to beginning**

## Recommendations by Procedure

Procedure	Recommendation
<b>Cardiac:</b> Coronary artery bypass graft (CABG), CABG with valve implant, valve replacement, other cardiac procedures	<input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV q8h x 24h  <u>Known MRSA colonization:</u> <input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV q8h x 24h + vancomycin 15 mg/kg IV q12h x 24h  <u>Severe beta-lactam allergy:</u> <input type="checkbox"/> vancomycin 15 mg/kg IV q12h x 24h + gentamicin 5 mg/kg IV once <input type="checkbox"/> vancomycin 15 mg/kg IV q12h x 24h + levofloxacin 750 mg IV once
<b>Cardiac:</b> Pacemaker and cardiac device implants	<input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV once  <u>Known MRSA colonization:</u> <input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV + vancomycin 15 mg/kg IV once  <u>Severe beta-lactam allergy:</u> vancomycin 15 mg/kg IV once
<b>Ventricular Assist Device (LVAD/RVAD/BiVAD), Heart Transplant, or Total Artificial Heart</b>	<input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV q8h x 48h + vancomycin 15 mg/kg IV q12h X 48h  <u>Severe beta-lactam allergy:</u> <input type="checkbox"/> vancomycin 15 mg/kg IV q12h x 48h + levofloxacin 750 mg IV q24h X 48h

<https://www.unmc.edu/intmed/divisions/id/asp/surgical-prophylaxis-protocol/docs/antimicrobial-surgical-prophylaxis.pdf>

<p><b>Orthopedic:</b> Clean procedures of hand, knee, and foot</p> <p>Internal fixation of fracture, total joint replacement, any implanted foreign body</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> No prophylaxis indicated</li> <li><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV q8h x 24h**</li> </ul> <p><u>Known MRSA colonization:</u></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV q8h x 24h + vancomycin 15 mg/kg IV q12h X 24h**</li> </ul> <p><u>Severe beta-lactam allergy:</u></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Vancomycin 15 mg/kg IV q12h x 24h**</li> <li><input type="checkbox"/> Clindamycin 900 mg IV X 24h**</li> </ul> <p>**initial infusion should be completed before tourniquet is inflated if used</p>
<p><b>Neurosurgery:</b> Craniotomy</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV once</li> </ul> <p><u>Known MRSA colonization:</u></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV + vancomycin 15 mg/kg IV once</li> </ul> <p><u>Severe beta-lactam allergy:</u></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Vancomycin 15 mg/kg IV once</li> </ul>
<p>Complex craniotomy or placement of prosthetic material (shunts, intrathecal pumps, deep-brain stimulators, etc.)</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV q8h x 24h</li> </ul> <p><u>Known MRSA colonization:</u></p>

	<ul style="list-style-type: none"> <li><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV q8h x 24h + vancomycin 15 mg/kg IV q12h x 24h</li> </ul> <p><u>Severe beta-lactam allergy:</u></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Vancomycin 15 mg/kg IV q12h x 24h</li> </ul>
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<p><b>Vascular:</b> brachiocephalic procedures without prosthetic material, angiogram, vascular stenting, thrombolysis, IVC filter and CVC placement</p> <p>Amputation (lower extremity for ischemia), arterial surgery, graft placement or repair</p>	<p><input type="checkbox"/> None</p> <p><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV q8h x 24h</p> <p><u>Known MRSA colonization:</u></p> <p><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV q8h x 24h + vancomycin 15 mg/kg IV q12h X 24h</p> <p><u>Severe beta-lactam allergy:</u></p> <p>Vancomycin 15 mg/kg IV q12h x 24h + gentamicin 5 mg/kg IV once</p>
<p><b>Abdominal:</b> Biliary procedures including high risk laparoscopic cholecystectomy, small bowel surgery, uncomplicated appendicitis, colorectal surgery</p>	<p><input type="checkbox"/> ceftiofur 2 g IV once</p> <p><u>Severe beta-lactam allergy:</u></p> <p><input type="checkbox"/> Levofloxacin 500 mg IV once + Metronidazole 500 mg IV once</p>
<p><b>Gastrointestinal:</b> PEG placement, bariatric procedures, gastroduodenal procedures</p>	<p><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV once</p> <p><u>Known MRSA colonization:</u></p> <p><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV once + vancomycin 15 mg/kg IV once</p> <p><u>Severe beta-lactam allergy:</u></p> <p><input type="checkbox"/> Vancomycin 15 mg/kg IV once OR</p>



	<p><input type="checkbox"/> Clindamycin 900 mg IV + gentamicin 5 mg/kg IV once</p>
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<p><b>General:</b> any implanted foreign body (e.g. hernia patch)</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV once</li> </ul> <p><u>Known MRSA colonization:</u></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV once + vancomycin 15 mg/kg IV once</li> </ul> <p><u>Severe beta-lactam allergy:</u> Vancomycin 15 mg/kg IV once</p>
<p><b>Gynecological:</b> hysterectomy (abdominal, vaginal, or laparoscopic), oncologic procedures not entering the bowel (procedures which involve resection of bowel should use “abdominal”)</p> <p>Suction D and C</p> <p>Urogynecologic procedures</p> <p>Cesarean section [antibiotics should be administered as for other procedures (within 60 minutes prior to incision); <i>before</i> cord clamping]</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV once</li> </ul> <p><u>Severe beta-lactam allergy:</u></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> clindamycin 900 mg IV + gentamicin 5 mg/kg once</li> </ul> <ul style="list-style-type: none"> <li><input type="checkbox"/> doxycycline 100 mg IV once and 200 mg orally 2 hours after procedure</li> </ul> <ul style="list-style-type: none"> <li><input type="checkbox"/> clindamycin 900 mg IV + gentamicin 5 mg/kg once</li> </ul> <ul style="list-style-type: none"> <li><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV once</li> <li><input type="checkbox"/> add azithromycin 500mg for non-elective C-section <b>only</b></li> </ul> <p><u>Severe beta-lactam allergy:</u></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> clindamycin 900 mg IV + gentamicin 5 mg/kg once</li> <li><input type="checkbox"/> add azithromycin 500mg for non-elective C-section <b>only</b></li> </ul>

<https://www.unmc.edu/intmed/divisions/id/asp/surgical-prophylaxis-protocol/docs/antimicrobial-surgical-prophylaxis.pdf>

<p><b>Head and Neck:</b> Clean procedures (thyroidectomy, etc.)</p>	<p><input type="checkbox"/> None</p>
<p>Clean with prosthesis placement (neck dissections, parotidectomy)</p>	<p><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV once <u>Severe beta-lactam allergy:</u> <input type="checkbox"/> clindamycin 900 mg IV once</p>
<p>Clean-contaminated procedures (oropharyngeal mucosa is compromised)</p>	<p><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV q8h + metronidazole 500 mg IV q8h x24h <input type="checkbox"/> Ampicillin/sulbactam 3g IV q6h x 24h</p>
<p>Skull base with dural resection</p>	<p><input type="checkbox"/> Ceftriaxone 2 g IV q12h + metronidazole 500 mg IV q8h x24h</p>
	<p><u>Known MRSA colonization:</u> <input type="checkbox"/> Ceftriaxone 2 g IV q12h + metronidazole 500 mg IV q8h + vancomycin 15 mg/kg IV q12h x 24h</p>
	<p><u>Severe beta-lactam allergy:</u> <input type="checkbox"/> Aztreonam 2 g IV q8h + metronidazole 500 mg IV q8h + vancomycin 15 mg/kg IV q12h x 24h</p>

<p><b>Urologic:</b> Cystoscopy with risk factors for infection or significant manipulation (biopsy, resection, dilation, stent placement, lithotripsy)</p> <p>Trans-rectal Prostate Biopsy</p>	<p><input type="checkbox"/> Levofloxacin 500 mg PO/IV once</p> <p><input type="checkbox"/> Ceftriaxone 1g IV once</p> <p><u>Severe beta-lactam allergy:</u></p> <p><input type="checkbox"/> Levofloxacin 500 mg PO/IV once</p>
<p><b>Urologic:</b> Clean without entry into urinary tract (nephrectomy, radical prostatectomy, prostate brachytherapy)</p> <p>Prosthetic material placed (i.e. penile prosthesis, etc.)</p>	<p><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV once</p> <p><u>Severe beta-lactam allergy:</u></p> <p><input type="checkbox"/> Vancomycin 15 mg/kg IV once</p> <p><input type="checkbox"/> cefazolin 2 g (3 g if greater than 120 kg) IV + gentamicin 5 mg/kg once</p> <p><u>Known MRSA colonization:</u></p> <p><input type="checkbox"/> vancomycin 15 mg/kg IV once + gentamicin 5 mg/kg once</p> <p><u>Severe beta-lactam allergy:</u></p> <p><input type="checkbox"/> vancomycin 15 mg/kg IV once + gentamicin 5 mg/kg once</p>
<p><b>Urologic:</b> Clean contaminated procedures with entry into urinary tract (radical cystectomy, ileal conduit, cystoprostatectomy)</p>	<p><input type="checkbox"/> cefoxitin 2 g IV once</p> <p><u>Severe beta-lactam allergy:</u></p> <p><input type="checkbox"/> clindamycin 900 mg IV + gentamicin 5 mg/kg once</p>

# Post-operative Sepsis



# History & Physical Examination

- From the patient, family, and providers
- Review prior records, nursing notes
- New or old symptoms
- Reliability of historian(s)
- Vital signs
- Change in vital signs
- Altered mental status = encephalopathy of sepsis?
- Head to toe examination
- Devices, or sites of old devices
- Surgical site - redness, warmth, pain, dehiscence
- Limb swelling
- Respiratory status, new symptoms - cough

## Laboratory/tests to order

- CBC with differential
- CMP
- Blood cultures x 2, lactic acid
- Reflex culture (urinalysis +, then urine culture)
- CXR
- Ultrasound imaging
- CT scan imaging

# Treatment depends on the source of the infection and causative agent(s) of sepsis

- Bacterial - urinary tract infection (UTI), bacterial pneumonia, skin infections such as cellulitis and abscess, gastrointestinal infection, and more.
- Viral - COVID19, influenza, and more.
- Fungal, and parasitic as examples
- History - fever, chills, cough, shortness of breath, abdominal pain, diarrhea, burning with urination, leg redness or warmth, pain.
- Medical problems, surgeries (consider splenectomy).
- Sick contacts.
- Vaccination status.

# Treatment of Sepsis

- Depends on various factors:
  - What is the cause (= site of infection).
  - If bacterial, appropriate antibiotic - tailored dose, frequency, weight, age, prior organisms (resistance), without causing more harm.
  - Source control.
- Opportunistic pathogens.
- Exposure to healthcare settings/hospitalizations = potential / at risk for multidrug resistant organism (MDRO).
- Prior prophylactic antimicrobials.

# Antimicrobials

- If bacterial, broad-spectrum antibiotic or antibiotics.
- Examples: vancomycin, cefepime.
- If already on prophylaxis prior to arrival, such as levofloxacin, what bacteria are excluded?
- If fungal, consider anti-fungal agents, eg. Echinocandin such as micafungin, anidulafungin.
- If viral, is it a virus that has antiviral or is it that one that only requires supportive care?

# Appropriate Therapy

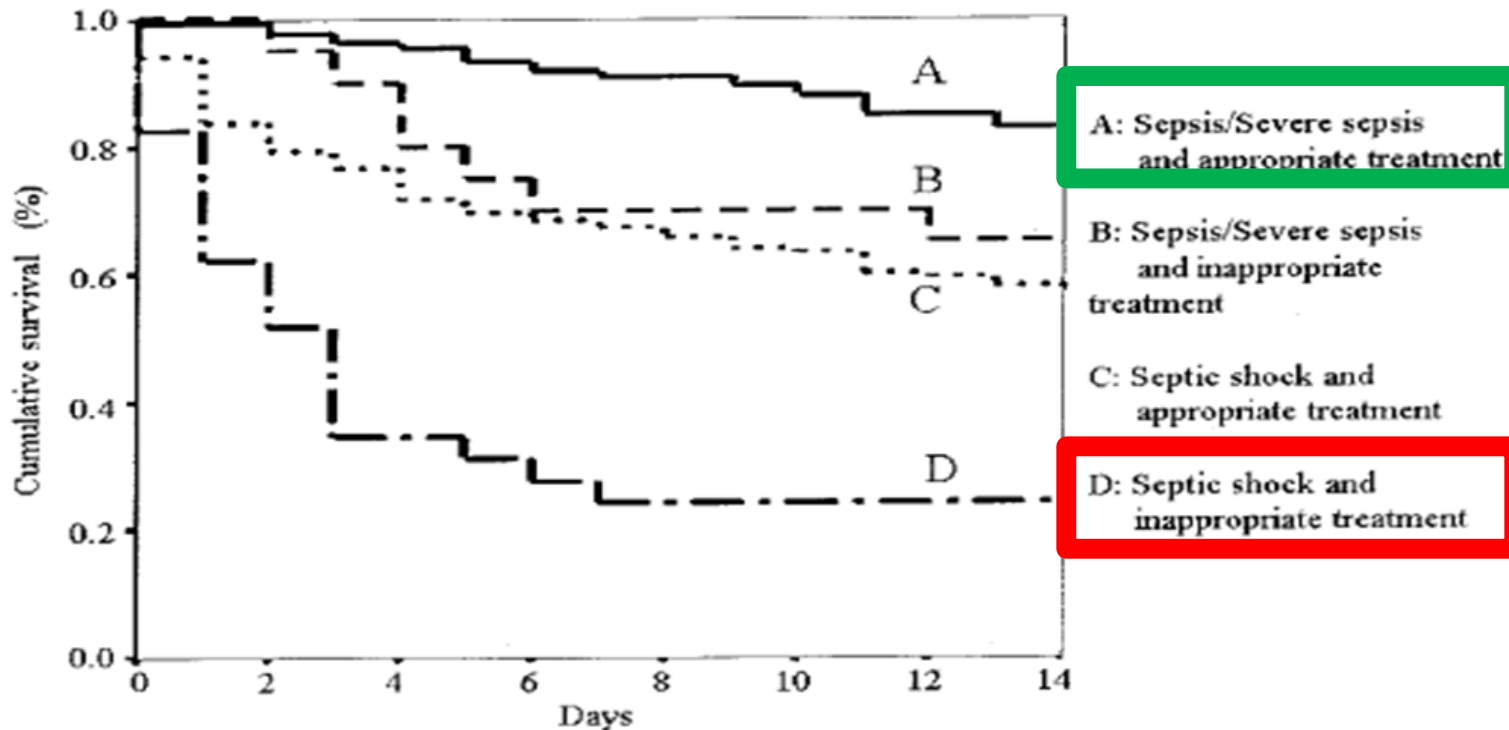


FIGURE 2. Survival rate according to the presence of shock and empiric antibiotic treatment (log-rank test,  $p < 0.001$ ).

*CHEST 2003; 123:1615-1624,*

# Sepsis Treatment: Supportive Care

- For acute kidney injury, intravenous fluids.
- For low blood pressure, intravenous fluids, measurement of volume status, potential for invasive temporary device such as a central line for pressor support; and arterial line for blood pressure support.
- For extremely low oxygen, support for the ventilator.
- For being in line with the patient's wishes, continued assessment of goals of care.
- For subspecialty care/continuity of care, transfer to patient's usual institution (eg. If transplant center).

# More Resources



## A few resources for additional reading

- <https://sepsistrust.org/wp-content/uploads/2018/06/updatedSepsis-Post-Op-RD.pdf>
- <https://jamanetwork.com/journals/jamasurgery/fullarticle/2623725>
- <https://www.idsociety.org/practice-guideline/practice-guidelines/>

# Thank you for your attention

- Stay safe!

May 19, 2022

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Speaker: **Prof. Yves Longtin**, McGill University, Montreal

*(South Pacific Teleclass)*

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