

Antimicrobial Prophylaxis for Prevention of Surgical Site Infection (SSI): Pre-operative Antibiotics

Dr. Laurel A. Robinson DNP APRN FNP-C

APP Nurse Specialist

Norton Infectious Diseases Institute



Kentucky Infection
Prevention
Training Center

KentuckyIPTTraining.org



**KENTUCKY
INFECTION
PREVENTION**

Training Center

KentuckyIPTraining.org

Funding for this presentation provided by the Kentucky Department for Public Health.

Content includes discussion of unlabeled use of products. Presenter has no financial interests or other relationships with the manufacturers of products. No commercial support was provided for this educational activity.

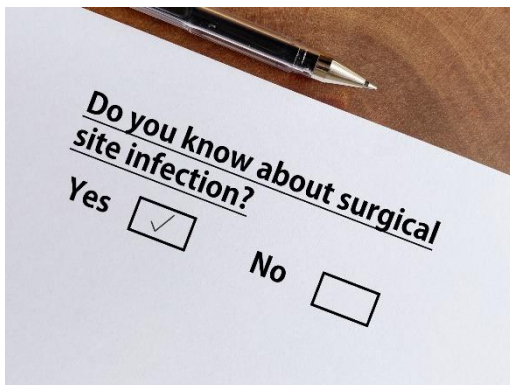
Objectives

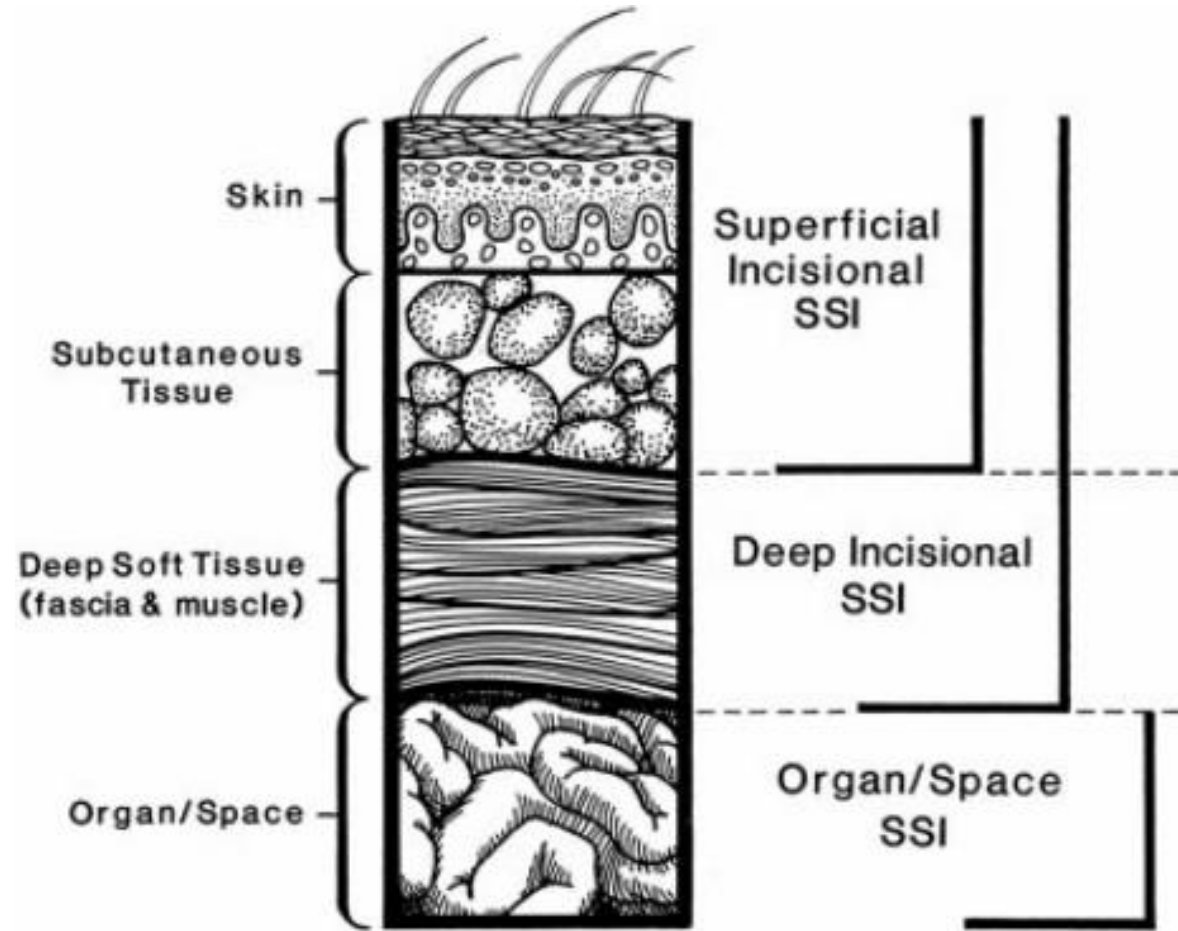
- Define Surgical Site Infection (SSI)
- Identify patient risk factors that contribute to a higher incidence of SSI
- Define the role of antibiotics in the context of antimicrobial prophylaxis
- Identify factors affecting antibiotic choice



Surgical Site Infections (SSIs)

- The United States Centers for Disease Control and Prevention (CDC) has developed criteria that define a surgical site infection (SSI) as an infection related to an operative procedure that occurs at or near the surgical incision (incisional or organ/space) within 30 days of the procedure or within 90 days if prosthetic material is implanted at surgery (CDC, 2019).





(CDC, 1999)



Surgical Site Infections (SSIs)

- SSIs are associated with prolonged duration of hospitalization, readmissions, re-interventions, permanent disability or **even death**.
- Financial costs of treating SSIs are **increasing**.
- Increasingly complex surgical patients and procedures require additional evidence-based interventions for the prevention of SSIs
- It has been estimated that **approximately half of SSIs are preventable** by application of evidence-based strategies.



(CDC, 2019)



More Incentives: No CMS \$ Reimbursement for SSI

- Centers for Medicare and Medicaid Services no longer pays additional amounts for the cost of treating conditions acquired in a hospital
- SSIs have been targeted not only to improve clinical quality, but also to protect hospital reimbursement



(Gnass, 2018)



Risk factors that affect wound healing

- Extremes of age
- Immunosuppression
- Diabetes mellitus
- Perioperative glycemic control
- chronic disease_
- Smoking
- prolonged hospitalization
- MRSA (methicillin-resistant *Staphylococcus aureus*) colonization
- Coexisting infections in other locations
- Poor nutritional status or obesity



Procedure related factors that affect surgical site infection risks

- Skin antisepsis
- Correct surgical technique
- Adequate hemostasis
- Maintenance of body temperature
- Operating time
- Sterilization of surgical equipment
- Positive pressure ventilation in the operating room



VENTILATION IN HEALTHCARE SETTINGS

In healthcare settings, ventilation is important because it helps remove things from the air that we don't want to breathe in – like small virus particles. Good ventilation improves air quality and reduces the risk of germs spreading.

WHAT TO KNOW



Understand what an air change is and why recommended air changes per hour are important in healthcare.

- An air change means the air in a room is replaced with new air.
- Air changes are usually measured by the hour – air changes per hour (ACH).
- In healthcare facilities, nearly every type of room has a recommended number of ACHs to help reduce the risk of germs spreading among patients and staff.



Respect wait times to allow the air in rooms to clear.

- The infection prevention or clinical leaders in your area, like your nurse manager, will use the ACH to figure out how long a room should sit empty after a patient with a possible or confirmed respiratory infection has left.
- It is okay to enter a room before the air is completely cleared, including while the patient is still there, if you use the recommended personal protective equipment (PPE).



Ask before making changes to the ventilation in a room.

- Rooms are often connected in healthcare facilities.
- Making a change to the ventilation in one room – like opening a window or closing vents to adjust temperature – can change the ventilation in other places, too.
- That's why it's important to talk to the person or team at your facility that is responsible for maintaining air filtration and ventilation if you have concerns about the ventilation in a room.



Make sure vents are not blocked.

- A blocked vent could prevent the ventilation system from functioning like it is supposed to.



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



cdc.gov/ProjectFirstline

NCE2ID-PFL-TT-9/9/21



Kentucky Infection Prevention Training Center

What is antimicrobial prophylaxis?

Antimicrobial prophylaxis when is defined as the use of antimicrobial drugs (antibiotics) in the absence of suspected or documented infection to prevent development of infection or disease.

Pre-operative Antibiotic Prophylaxis

This is done ***before surgery*** in order to decrease the risk of postoperative infections. (Red Book, 2021-24)



Why use antimicrobial prophylaxis methods?

- The goal of antimicrobial prophylaxis is to prevent surgical site infection (SSI) by reducing the burden of microorganisms at the surgical site during the operative procedure.
- The efficacy of antibiotic prophylaxis for reducing SSI has been clearly established.
- Patients who receive prophylactic antibiotics within one to two hours before the initial incision have lower rates of SSI than patients who receive antibiotics sooner or later than this window.

(CDC, 2019)



Antibiotic prophylaxis is just part of an SSI prevention plan

Antibiotic prophylaxis does not replace any of the other preventive care of SSI and should not be seen in isolation in preventing it, but rather as part of a set of factors based on both the patient and the surgical procedures (Costa et al., 2021)



Reduce Risk Factors



The key point of its prevention is the combination of several interventions that aim to reduce risk factors, such as:

- compliance with the new guidelines of the Center for Disease Control and Prevention
- the principles of the use of prophylactic antibiotics
- factors and risk index of the surgical site
- administration time; duration and dosage of antibiotics.

(CDC, 2019)



Modifiable Risk Factors

Important Modifiable Risk Factors

- Antimicrobial prophylaxis
 - Inappropriate choice (procedure specific)
 - Improper timing (pre-incision dose)
 - Inadequate dose based on body mass index, procedures >3h, or increased blood loss
- Skin or site preparation ineffective
 - Removal of hair with razors
- Colorectal procedures
 - Inadequate bowel prep/antibiotics
 - Improper intraoperative temperature regulation



Additional Modifiable Risk Factors

Additional Modifiable Risk Factors

- Excessive OR traffic
- Inadequate wound dressing protocol
- Improper glucose control
- Colonization with preexisting microorganisms
- Inadequate intraoperative oxygen levels



For the best protection against SSI:

The antibiotic should:

- Be active against the pathogens most likely to contaminate the surgical site
- Be administered in an appropriate dose and at an appropriate time to ensure adequate serum and tissue concentrations during the period of potential contamination
- Be administered for the shortest effective period to minimize adverse effects, emergence of resistance, and cost

(Crader & Varacallo, 2023)



Common organisms that cause SSI

The most common organisms implicated as causes of surgical site infections include:

- **Staphylococcus aureus**
- **Staphylococcus epidermidis**
- **Aerobic streptococci**
- **Anaerobic cocci**

(Crader & Varacallo, 2023)

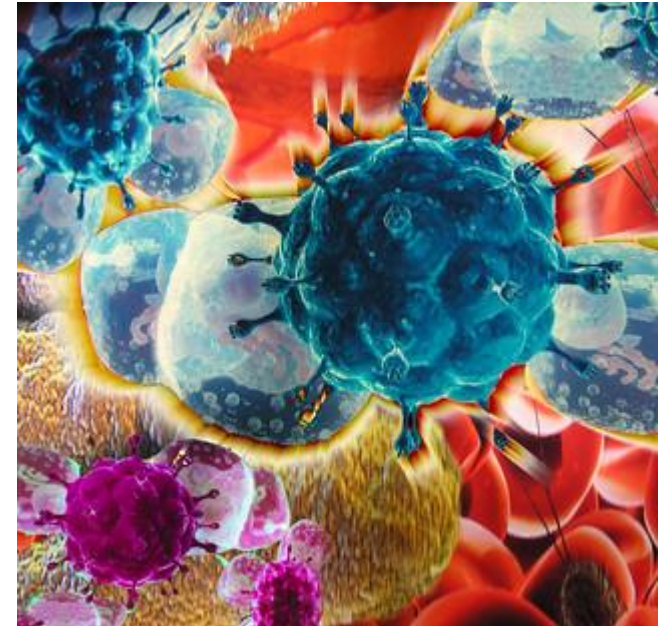


Endogenous Pathogens

Endogenous Pathogens

- Patient flora
 - skin
 - mucous membranes
 - GI tract

(i.e.. *Staphylococcus aureus* in the nares of the nose)



Exogenous Pathogens

- **Exogenous Pathogens**

- Contaminated surgical field, or other break in sterility
- Contaminated surgical instruments
- Air quality in the operating room



External microorganisms can also contaminate the wound at the time of incident, or gain access to the wound following surgery, before the wound has healed.



Allergies and risk for SSI

- Patients that report an **antibiotic allergy** have been observed to have a **higher risk for developing a SSI** (Bratzler et al., 2013)

Clarification of such allergies as part of routine preoperative care may decrease SSI risk.



Potential adverse effects of antibiotic prophylaxis

- Gastrointestinal symptoms (nausea, vomiting, diarrhea)
- Kidney/Liver damage
- Rash/Urticaria (“Hives”)
- **Anaphylaxis**



Urticaria/Hives (raised patches of skin, in various shapes and sizes due to an allergic reaction)

Selecting antibiotic prophylaxis

The choice of antibiotics for prophylaxis depends on several factors including the **type of surgery**, **local antibiotic resistance patterns**, and **patient allergies**.

Broad-spectrum antibiotics are commonly used to cover a wide range of potential pathogens.

- Narrow-spectrum antibiotics may be appropriate for certain procedures.



Selecting antibiotic prophylaxis

.

When determining appropriate antibiotic selection, the goal is to have achieved a relatively narrow spectrum of activity while ensuring the most common organisms are targeted

Additionally, preoperative antibiotics are chosen based on many factors, including:

- cost
- Safety
- ease of administration
- pharmacokinetic profile
- bactericidal activity
- hospital resistance patterns



Cefazolin

Cefazolin is a drug of choice for many procedures; it is the most widely studied antimicrobial agent with proven efficacy for antimicrobial prophylaxis (Bratzler et al., 2013).

Cefazolin has a desirable duration of action, spectrum of activity against organisms commonly encountered in surgery and it has an excellent safety profile and low cost. **It is active against streptococci, methicillin-susceptible staphylococci, and many gram-negative organisms**

It is *not* used for surgical sites in which the most probable organisms are not covered by cefazolin alone (e.g., appendectomy, colorectal).



Mechanism of Action

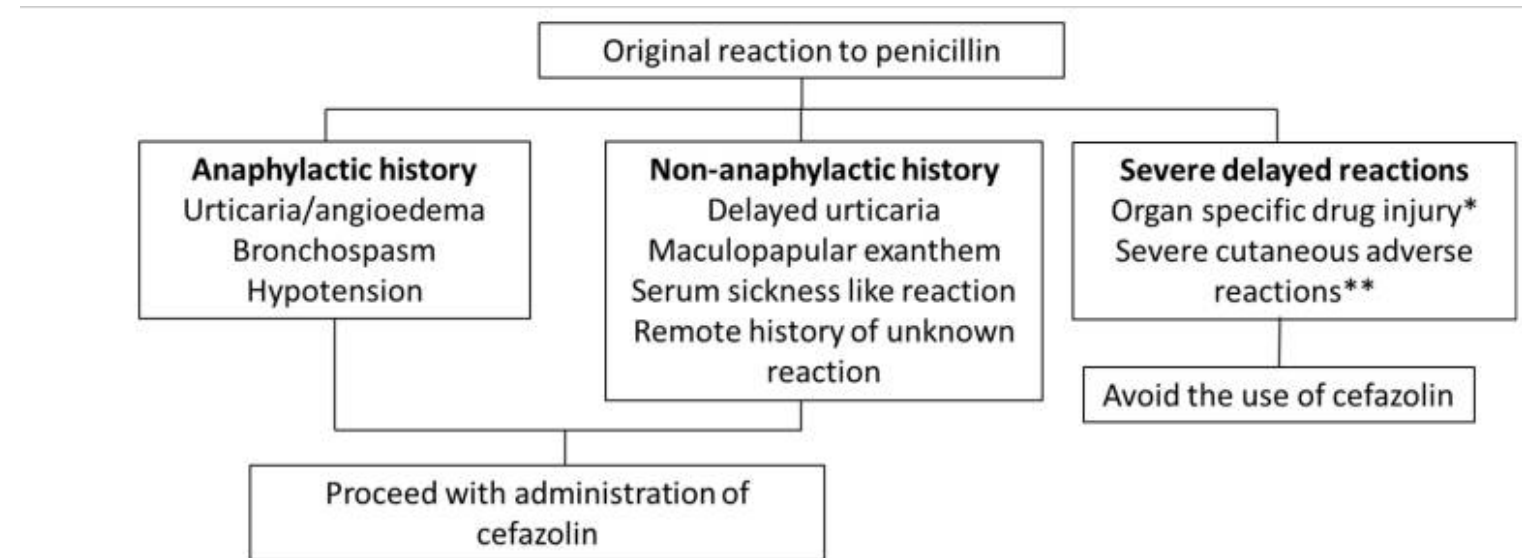
- Multiple antibiotic classes are recommended for use in preoperative antibiotic prophylaxis. The antibiotics utilized are **bactericidal** *instead of bacteriostatic*.
- This means that any of the **targeted organisms are killed** instead of just preventing the multiplication of further growth.

(CDC, 2019)



What if the patient is “allergic” to penicillins?

Penicillin Allergy algorithm



* Including drug-induced liver injury, acute interstitial nephritis, or drug-induced cytopenia (e.g., hemolytic anemia)

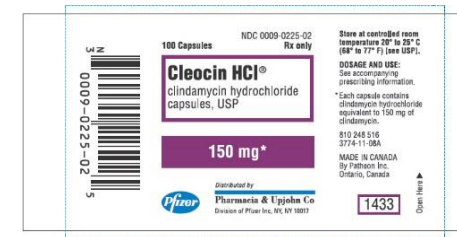
** Examples include Steven's Johnson syndrome, DRESS syndrome, AGEP



Cefazolin (common alternatives)

- In patients *requiring only cefazolin* for preoperative surgical prophylaxis, **clindamycin** or **vancomycin** are often used as alternatives for those with significant allergies to the medication.

(Crader & Varacallo, 2023)



Resistant organisms

Antimicrobial Prophylaxis

An increasing trend toward resistant organisms may undermine the effectiveness of existing recommendations for antimicrobial prophylaxis

(Crader & Varacallo, 2023)



Adherence to Guidelines for the Administration of Intraoperative Antibiotics in a Nationwide US Sample

What are the patterns of intraoperative antibiotic administration across US Hospitals with respect to Infectious Diseases Society of America's guidelines?

- Findings: Multicenter cohort study of 414,851 surgical encounters at 31 institutions, and **more than 1/3 did not adhere to the guidelines.**

The findings suggest that considerable non-adherence to intraoperative antibiotic administration best practices persists, which may be contributory factor to stagnant rates of surgical site infections.

Citation:

Bardia, A., Treggiari, M. M., Michel, G., Dai, F., Tickoo, M., Wai, M., Schuster, K., Mathis, M., Shah, N., Kheterpal, S., & Schonberger, R. B. (2021). Adherence to Guidelines for the Administration of Intraoperative Antibiotics in a Nationwide US Sample. *JAMA network open*, 4(12), e2137296.
<https://doi.org/10.1001/jamanetworkopen.2021.37296>

Kentucky Infection Prevention Training Center



Antibiotic prophylaxis for wound infections in total joint arthroplasty

A study in 2008 examined the effectiveness of the administration of antibiotic prophylaxis during total hip and knee replacement, reducing the absolute risk of wound infection by over 80% compared to patients treated with no antibiotic prophylaxis.

Citation:

AlBuhairan, B., Hind, D., & Hutchinson, A. (2008). Antibiotic prophylaxis for wound infections in total joint arthroplasty. *The Journal of Bone & Joint Surgery British Volume*, 90-B(7), 915-919. <https://doi.org/10.1302/0301-620X.90B7.20498>



Administration

The majority of preoperative prophylactic antibiotics are administered intravenously (IV).

Always practice hand hygiene, sharps safety and aseptic technique when handling medications.

Be especially careful with handling the tubing and lines that medications will be administered through (scrub the hub.)

(Crader & Varacallo, 2023)



Timing of Prophylactic Antibiotics

- **Prophylactic Antibiotics:** Antibiotics are normally administered **before surgical procedures** to prevent surgical site infections (SSIs).
- **Prophylactic antibiotics should be administered within 60 minutes before surgical incision.**
- This timing ensures adequate antibiotic levels in the tissue at the time of incision.

(Crader & Varacallo, 2023)



Duration of Prophylaxis

- **Duration of Prophylaxis:** Prophylactic antibiotics should generally be discontinued within 24 hours after surgery, as prolonged use increases the risk of antibiotic resistance and adverse effects.



(Crader & Varacallo, 2023)



Antibiotic prophylaxis for surgical procedures : a scoping review

- Abstract: **To map the current evidence on surgical antibiotic prophylaxis (SAP) administration and identify knowledge gaps in the literature available in this field.**
- Results: **Findings showed that, overall, SAP may reduce SSIs compared with a placebo or with no SAP. Results suggested that intraoperative SAP may lower SSI, while postoperative SAP did not show a statistically significant difference.**

Citation:

Brocard, E., Reveiz, L., Régnaux, J. P., Abdala, V., Ramón-Pardo, P., & Del Rio Bueno, A. (2021). Antibiotic prophylaxis for surgical procedures: a scoping review. *Revista panamericana de salud publica = Pan American journal of public health*, 45, e62.
<https://doi.org/10.26633/RPSP.2021.62>



Redosing: To repeat or NOT to repeat...

- In general, **repeat antimicrobial dosing** following wound closure is **not necessary** and may **increase** antimicrobial resistance, or the development of ***C. difficile* infection (CDI)** (Cohen et al., 2017).
- For cases in which prophylaxis beyond the period of surgery is warranted, in general, the duration should be **less than 24 hours.**

(Crader & Varacallo, 2023)



Redosing (exceptions)

Redosing (exceptions)

- To ensure adequate antimicrobial serum and tissue concentrations, **repeat intraoperative dosing is warranted for procedures that exceed two half-lives of the drug or for procedures in which there is excessive blood loss (>1500 mL).**
- Redosing may also be warranted in the setting of factors that shorten antimicrobial half-life, such as extensive burns.
- The **dosing interval** should be **measured from the time of the preoperative dose** (not from the beginning of the procedure).
- Redosing may *not* be warranted for patients in whom the antimicrobial half-life is prolonged, such as renal insufficiency.

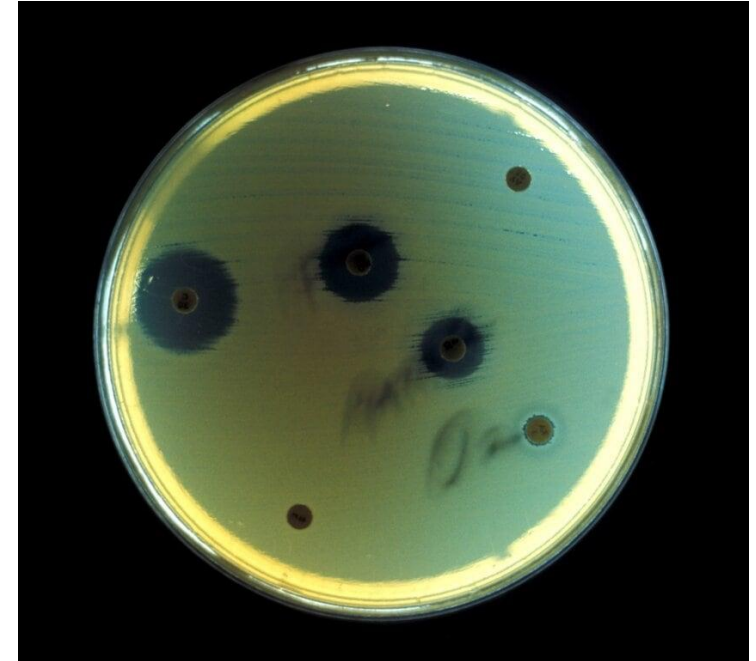
(Crader & Varacallo, 2023)



Culture and Sensitivity Testing

- In some cases of established infection, antibiotics should be selected based on **culture and sensitivity testing** whenever possible.
- This helps to tailor antibiotic therapy to the specific pathogens involved and reduce the risk of antibiotic resistance.

(Crader, Varacallo, 2023)



Take home points

- **Surgical Site Infections (SSI) are....**infections related to an operative procedure that occurs at or near the surgical incision (incisional or organ/space) within 30 days of the procedure or within 90 days if prosthetic material is implanted at surgery (CDC, 2019).
- Antibiotic prophylaxis is defined as the use of antibiotic medications in the absence of suspected or documented infection to prevent development of infection or disease (Red Book, 2021-24)
- The choice of antibiotics for prophylaxis depends on several factors including the **type of surgery, local antibiotic resistance patterns, and patient allergies.**
- Some **patient risk factors** that contribute to and **increased SSI risk** are: **Older age, Poor nutritional status, Obesity, Diabetes Mellitus, Tobacco use, Co-existent infections, Immune Suppression, Known colonization with resistant bacteria**



Follow Us On
Social



References:

AORN (2020, May 13). Patient Skin Antisepsis. AORN Guidelines. Retrieved September 15, 2023, from <https://aornguidelines.org/guidelines/content?sectionid=245924616&view=book>

AlBuhairan, B., Hind, D., & Hutchinson, A. (2008). Antibiotic prophylaxis for wound infections in total joint arthroplasty. *The Journal of Bone & Joint Surgery British Volume*, 90-B(7), 915-919. <https://doi.org/10.1302/0301-620X.90B7.20498>

BD Chloraprep Preoperative antiseptic skin preparation with sterile solution. Accessed May 25, 2023. <https://www.bd.com/en-ca/offering/capabilities/infection-prevention/skin-preparation/bd-chloraprep-patient-preoperative-skin-preparation-products/bd-chloraprep-applicators>.

Berríos-Torres SI, Umscheid CA, Bratzler DW, et al. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. *JAMA Surg.* 2017;152(8):784–791. doi:10.1001/jamasurg.2017.0904

Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Surg Infect (Larchmt)* 2013; 14:73.

Centers for Disease Control and Prevention. Procedure-associated Module. Surgical Site Infection (SSI) Event. Available at: <https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscscssicurrent.pdf> (Accessed on June 16, 2017).



References

Cohen ME, Salmasian H, Li J, et al. Surgical Antibiotic Prophylaxis and Risk for Postoperative Antibiotic-Resistant Infections. *J Am Coll Surg* 2017; 225:631.

Costa AC, Santa-Cruz F, & Ferraz AAB (2021). WHAT'S NEW IN INFECTION ON SRGICAL SITE AND ANTIBIOTICOPROPHYLAXIS IN SURGERY?

Crader MF, Varacallo M. Preoperative Antibiotic Prophylaxis. [Updated 2023 Aug 4]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK442032/>

Gelijns AC, Moskowitz AJ, Acker MA, et al. Management practices and major infections after cardiac surgery. *J Am Coll Cardiol* 2014; 64: 372

Gnass, S Surgical Site Infection Preventive Measures, Riverside University Health System. Powerpoint. 2019.

Global Guidelines for the Prevention of Surgical Site Infection. (2018). World Health Organization

Red Book (2021): Report of the Committee on Infectious Diseases (32nd Edition) ; DOI: <https://doi.org/10.1542/9781610025225> ; ISBN electronic: 978-1-61002-522-5.

Umscheid CA, Mitchell MD, Doshi JA, Agarwal R, Williams K, Brennan PJ. Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. *Infect Control Hosp Epidemiol*. 2011;32(2):101–114. 10.1086/657912

Zucco, R., Lavano, F., Nobile, C. G. A., Papadopoli, R., & Bianco, A. (2019). Adherence to evidence-based recommendations for surgical site infection prevention: Results among Italian surgical ward nurses. *PloS one*, 14(9), e0222825. <https://doi.org/10.1371/journal.pone.0222825>





**KENTUCKY
INFECTION
PREVENTION**

Training Center

KentuckyIPTraining.org

KentuckyIPTraining.org