Guideline: Surgical Prophylaxis Guidelines			Version Number: 3
Department: Pharmacy	**Original System P&T Approval Date:** 01/2016	**Revision System P&T Approval Date:** 02/2016, 11/2020	**Owner:** Kimberly Lapierre, PharmD
Reviewed By: Antibiotic Stewardship Subcommittee			

Revision Date	Revision Description
11/2020	Added: additional procedures; algorithm with steps standardized beta-lactam allergy process consistent with the MedStar Sepsis guidelines, table with antibiotic dosing and intraoperative redosing frequency, post-incision antibiotic duration.

Purpose: These guidelines are intended to serve as standardized, evidence-based practice for antimicrobial prophylaxis to prevent surgical site infections.

Disclaimer: These guidelines are not intended to replace clinical judgment, and deviation from the guidelines may be appropriate based up on patient circumstances.

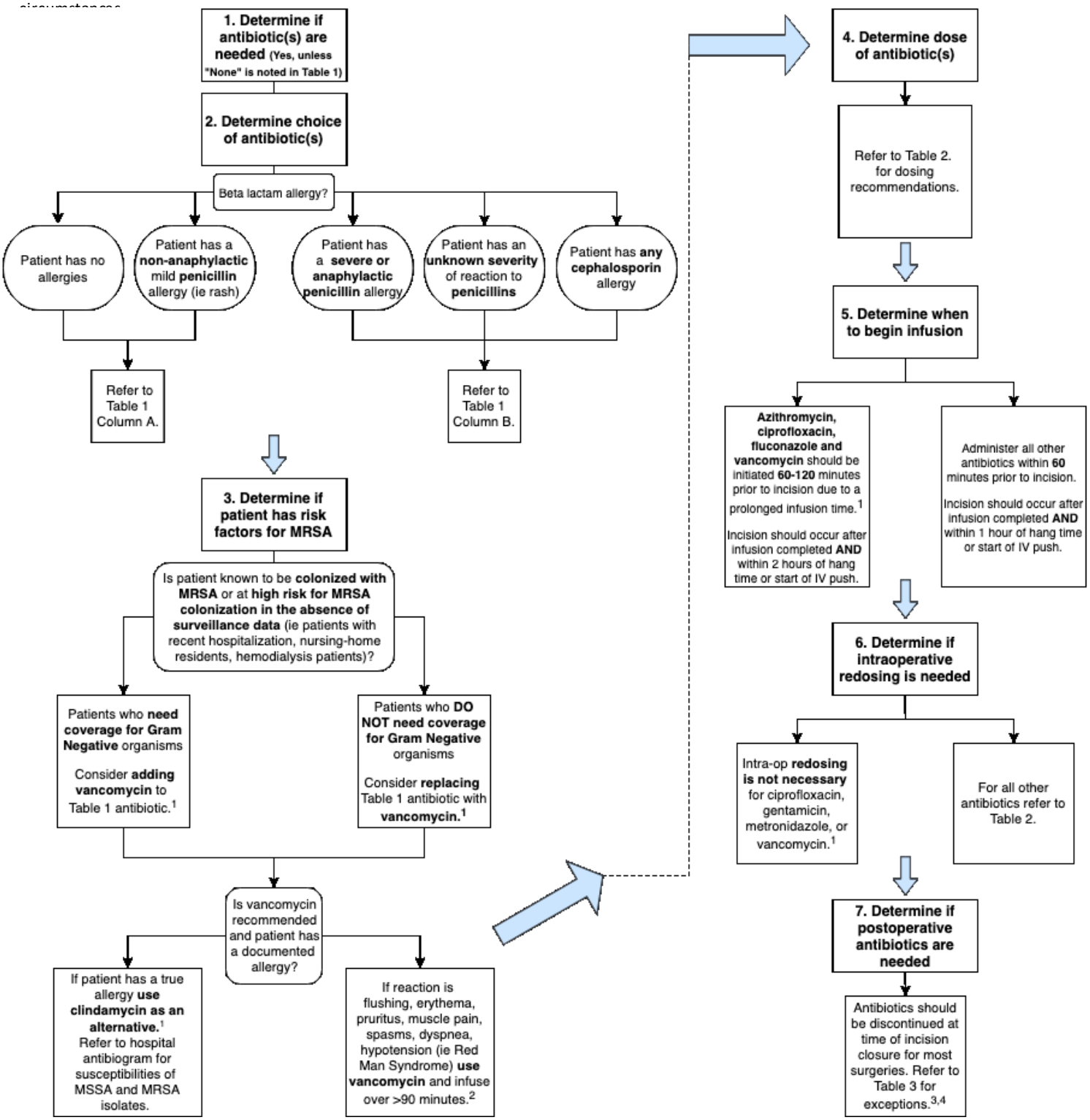

Table 1. Choice of Antibiotics by Type of Procedure[a]

- When discussing antibiotics, the umbrella term "beta-lactam" includes penicillins, cephalosporins, carbapenems, and monobactams.
    - For example (**bolded** items are found in this guideline):
        - Penicillins: Amoxicillin, amoxicillin/clavulanate, **ampicillin**, ampicillin/sulbactam, nafcillin, **piperacillin/tazobactam**
        - Cephalosporins: **Cefazolin**, cephalexin, **cefoxitin**, **cefuroxime**, cefdinir, ceftriaxone, cefepime, ceftaroline
        - Carbapenems: Ertapenem, meropenem
        - Monobactams: Aztreonam
    - Refer to flowchart or table 1 for info on using beta-lactams in patients with penicillin or cephalosporin allergies.
- For patients with true vancomycin allergy (i.e. NOT Red Man Syndrome) use clindamycin as an alternative.
- For patients known to be colonized with MRSA or at high risk for MRSA colonization in the absence of surveillance data (i.e. patients with recent hospitalization, nursing-home residents, hemodialysis patients) consider adding vancomycin to suggested pre-op antibiotic(s) (unless patient is already receiving clindamycin which covers MRSA).

	Description	**Column A** **Suggested abx for patients with:** • No allergies to listed antibiotics • Non-anaphylactic mild penicillin allergy (i.e. rash)	**Column B** **Alternatives for patients with:** • Severe or anaphylactic penicillin allergy • Unknown severity of reaction to penicillins • Any cephalosporin allergy
Cardiac	CABG	Cefuroxime[5] **OR** Cefazolin[6] *Consider adding daptomycin if MRSA colonization and vancomycin allergy*	Vancomycin **AND** Gentamicin
	Pacemaker implantation	Cefazolin	Vancomycin
	Heart transplant, ventricular assist devices	Ciprofloxacin[b] **AND** Vancomycin	**Ciprofloxacin allergy** Vancomycin **AND** Gentamicin
	For more information on pre-incision nasal antibiotics, vancomycin paste, antibiotics in the event of return to OR etc.	Refer to *MWHC- Cardiac Surgery Prophylactic Antibiotic Guideline*	
General	Appendectomy for uncomplicated appendicitis	Cefazolin **AND** Metronidazole	Clindamycin **AND** Gentamicin
	Biliary Tract • Specifically, open **or** high-risk laparoscopic procedures[c] • Use in low-risk laparoscopic procedures may have a benefit[7,8]	Cefazolin *Consider culture targeted antibiotics*[9]	Vancomycin **AND** Gentamicin
	Colorectal *In addition to IV antibiotics, oral bowel preparation is recommended. See below for additional information.*	Cefazolin **AND** Metronidazole *Consider using meropenem for ESBL carriers*[10,11]	Clindamycin **AND** Gentamicin
	Gastroduodenal including PEG • Specifically, entry into lumen of the GI tract (bariatric, pancreaticoduodenectomy) **or** for high-risk patients without entry into the GI tract	Cefazolin	Vancomycin **AND** Gentamicin
	Hernia Repair	Cefazolin	Vancomycin
	Small Intestine obstructed	Cefazolin **AND** Metronidazole	Metronidazole **AND** Gentamicin
	Small Intestine non-obstructed	Cefazolin	Clindamycin **AND** Gentamicin
Head and Neck	**Clean** • Transcutaneous thyroidectomy and lymph node excision	None	None
	Clean with additional risk factors for infection • Clean cancer surgery • Placement of prosthesis or drain	Cefazolin	Clindamycin

	Clean-contaminated
	• Clean-contaminated cancer surgery
	• Procedures involving an incision through the oral or pharyngeal mucosa (except tonsillectomy and functional endoscopic sinus procedures)
	  ○ Parotidectomy, submandibular gland excision, adenoidectomy, rhinoplasty, tumor-debulking, mandibular fracture repair
	  ○ Transoral thyroidectomy
		Cefazolin **AND** Metronidazole
		
		May also use ampicillin/sulbactam[12,13]
			Clindamycin

Neuro	Elective craniotomy, CSF shunting procedures, Implantation of intrathecal pumps	Cefazolin	Vancomycin
OBGYN	IUD Insertion, routine hysteroscopy, urodynamic testing, miscarriage surgery	None[14,15]	None
	Cesarean delivery	Cefazolin *Consider adding azithromycin if nonelective*[16]	Clindamycin **AND** Gentamicin
	Gynecologic including Hysterectomy[17] and Pubovaginal Sling[18]	Cefazolin **AND** metronidazole	Clindamycin **AND** Gentamicin
Ortho-pedics	• Clean operations **WITH** foreign material or requiring repeat instrumentation • Implantation of internal fixation devices (nails, screws, plates) [19] • Spinal procedures with and without instrumentation • Hip fracture repair • Total Joint replacement	Cefazolin	Vancomycin
Plastic	Clean with risk factors or clean-contaminated	Cefazolin	Vancomycin
Thoracic	Noncardiac procedures, including lobectomy, pneumonectomy, lung resection, and thoracotomy, Video-assisted thoracoscopic surgery	Cefazolin	Vancomycin
Trans-plant	Heart	*Refer to* **Cardiac** *Section above*	*Refer to* **Cardiac** *Section above*
	Intestinal	Vancomycin, Piperacillin/tazobactam **AND** Fluconazole	Vancomycin, Ciprofloxacin, Metronidazole **AND** Fluconazole
	Kidney[20]	Cefazolin	Clindamycin
	Liver	Cefoxitin **AND** Ampicillin	Vancomycin, Ciprofloxacin **AND** Metronidazole
	Pancreas, pancreas-kidney	Piperacillin/tazobactam	Clindamycin, Ciprofloxacin **AND** Metronidazole
		For patients at high risk of Candida infection, consider adding fluconazole	
Urologic	**Lower Tract Instrumentation**[18] Cystourethroscopy, Transurethral Cases (including TURP), Prostate brachytherapy or cryotherapy, Transrectal prostate biopsy	Cefazolin **AND** *If transrectal prostate biopsy add* Gentamicin	Clindamycin **AND** Gentamicin
	Upper Tract Instrumentation[18] Percutaneous renal surgery, Ureteroscopy	Cefazolin	Gentamicin **AND** *Percutaneous Nephrolithotomy add* Metronidazole
	Open, Laparoscopic or Robotic Surgery[18] **Surgery not entering urinary tract** Adrenalectomy, lymphadenectomy, retroperitoneal or pelvic	Cefazolin	Clindamycin
	Surgery involving controlled entry into urinary tract Renal surgery, nephrectomy, ureterectomy pyeloplasty, radical prostatectomy, partial cystectomy	Cefazolin	Clindamycin
	Surgery involving small bowel Cystectomy with small bowel conduit, other GU procedures, uretero-pelvic junction repair	Cefazolin	Clindamycin **AND** Gentamicin
	Surgery involving large bowel Colon conduits	Cefazolin **AND** Metronidazole	Clindamycin **AND** Gentamicin
	Urethroplasty Reconstruction anterior urethra, stricture repair, urethrectomy	Cefazolin	Clindamycin
	Inguinal and scrotal cases Radical orchiectomy, vasectomy, reversals, varicocelectomy, hydrocelectomy	Cefazolin	Clindamycin
	Implanted prosthetic devices AUS, IPP, sacral neuromodulators	Cefazolin **AND** Gentamicin	Clindamycin **AND** Gentamicin
Vascular	Surgery involving the abdominal aorta[21] and patients undergoing lower-extremity procedures, delayed procedures, and patients with history of bypass (excluding brachiocephalic procedures)	Cefazolin	Vancomycin

[a]Unless otherwise cited, source of choice of antibiotic is *Am J Health-Syst Pharm*. 2013; 70:195-283.
[b]Based on expert opinion
[c]Factors that indicate a high risk of infectious complications in laparoscopic cholecystectomy include emergency procedures, diabetes, long procedure duration, intraoperative gallbladder rupture, age of >70 years, conversion from laparoscopic to open cholecystecto my, American Society of Anesthesiologists classification of 3 or greater, episode of colic within 30 days before the procedure, reintervention in less than one month for noninfectious complication, acute cholecystitis, bile spillage, jaundice, pregnancy, nonfunctioning gallbladder, immunosuppression, and insertion of prosthetic device. Because a number of these risk factors are not possible to determine before surgical intervention, it may be reasonable to give a single dose of antimicrobial prophylaxis to all patients undergoing laparoscopic cholecystectomy.

Bowel Preparation

For colorectal procedures, in addition to intravenous antibiotic prophylaxis, patients should also receive mechanical bowel preparation **AND** oral antibiotics.[1] The addition of oral antibiotics to mechanical bowel preparation has been shown to reduce the rates of surgical site infection and anastomotic leak.[22-25]

Antibiotic options include:

- Neomycin 1000 mg (500mg tablet x 2) PO **AND** metronidazole 500 mg (500 mg tablet x 1) PO
- Neomycin 1000 mg (500mg tablet x 2) PO **AND** erythromycin 1000 mg (250 mg tablets x 4) PO

Administer medications at 15:00, 16:00, and 22:00 the day before surgery.

Table 2. Dosing and Redosing Intervals[1]

- For antimicrobials with a short half-life used before long procedures, redosing in the operating room is recommended at an interval of approximately 2 times the half-life of the agent in patients with normal renal function.
    - The redosing interval **should be measured from the time of initiation of the pre-operative dose i.e. pre-incision hang time**, not from the beginning of the procedure.
- Redosing should occur from cut time until skin closure.
- Redosing is required when >1500 mL of blood is lost.
- Recommended redosing intervals marked as "not applicable" (N/A) are based on typical case length; for unusually long procedures redosing may be needed.

Drug	Dose	Intra-op redosing interval from pre-incision hang time	Infusion Time
Ampicillin	2g	2 hours	30 minutes
Ampicillin/sulbactam	3g	2 hours	30 minutes
Azithromycin	500mg	N/A	60 minutes
Cefazolin	<120 kg: 2g ≥120 kg: 3g	4 hours *(If used in cardiac surgery, consider every 3 hours for patients with normal renal function)*[26]	IVPB – 30 minutes OR IVP – 5 minutes
Cefoxitin	2g	2 hours	30 minutes
Cefuroxime	1.5g	4 hours	IVPB – 30 minutes OR IVP – 5 minutes
Ciprofloxacin	400mg	N/A	60 minutes
Clindamycin	900mg	6 hours	30 minutes
Daptomycin	<70 kg: 300mg x 1 71-85 kg: 350mg x 1 86-100 kg: 400mg x 1 >100 kg: 450mg x 1	N/A	30 minutes
Fluconazole	400mg	N/A	120 minutes
Gentamicin	50-60 kg: 300mg x 1 60-80 kg: 360mg x 1 >80 kg: 480mg x 1	N/A	30 minutes
Metronidazole	500mg	8 hours	30 minutes
Piperacillin/tazobactam	3.375g	2 hours	30 minutes
Vancomycin[27]	<70 kg: 1g ≥ 70 kg: 1.5g	N/A *(Prolonged cardiopulmonary bypass may require redosing at 6 hours)*	60 minutes for 1 g 90 minutes for 1.5 g

Table 3. Duration of Antibiotics Post Incision Closure

For most procedures, antibiotics used for surgical prophylaxis **must be limited to pre- and intra-op**. The Center for Disease Control and Prevention (CDC), World Health Organization (WHO), American College of Surgeons as well as certain surgical specialties **recommend against administering antibiotics beyond incision closure**.[3,4,14,20,27-31] Exceptions to this include specific cardiac, vascular, and orthopedic procedures. Antibiotics continued beyond 24 hours have been shown to be associated with a > 3-fold increased odds of C*lostridium difficile* infection.[32] Furthermore, antimicrobial courses lasting more than 24 hours have not been shown to reduce rates of surgical site infection and were associated with increasing odds of postoperative AKI and C*lostridium difficile* infection.[33]

Surgery Type	Duration from the time of incision closure	Discussion of evidence
CABG Heart transplant Ventricular assist devices	Discontinue prophylactic antibiotics within 24 – 48 hours after surgery	The Society of Thoracic Surgeons recommends that postoperative prophylactic antibiotics are given for 48 hours or less. However, it is noted that single-dose or 24-hour prophylaxis may be as effective as 48-hour prophylaxis.[34] ASHP/IDSA/SIS/SHEA recommend less than 24 hours of prophylaxis for cardiac procedures.[1] Most recently per CDC guidelines, when comparing single-dose to ≤24-hours, moderate-quality evidence suggested no benefit of antibiotics beyond incision closure. This is based on a meta-analysis of 3 RCTs.[3]
Total Joint Arthroplasty	Discontinue within 24 hours after surgery	The American Association of Hip and Knee Surgeons, in conjunction with the American Academy of Orthopaedic Surgeons, does not agree with the CDC guideline recommendation to avoid postoperative antibiotics citing very low quality of evidence.[35] Since the organization's statement two meta-analyses examining single dose vs multiple doses of prophylactic antibiotics have been published. Ryan et al found that there were no differences in infection risk between groups, but the authors recommend further research given low quality of evidence.[36] Lastly, Siddiqi et also found no benefit with postoperative antibiotic prophylaxis and noted low quality of evidence.[37]
Abdominal aortic aneurysm –endovascular repair or open surgical repair	Discontinue within 24 hours after surgery	The Society of Vascular Surgery recommends to continue prophylactic antibiotics for no more than 24 hours after incision closure for abdominal aortic aneurysm.[21] This recommendation is noted to differ from the CDC guidelines which recommends in clean and clean-contaminated procedures, do not administer additional prophylactic antimicrobial agent doses after the surgical incision is closed in the operating room, even in the presence of a drain.
Pancreas, Pancreas-kidney transplant	Continue up to 5 days	The American Society of Transplantation Infectious Diseases Community of Practice recommends no more than 48 hours of antibiotics postoperatively. There is a lack of studies of duration beyond 48-72 hours.[38] However, they do note that procedures involving enteric drainage are at higher risk of developing SSIs than bladder drainage. Therefore, some teams implement a treatment regimen postoperatively.
All other surgeries and procedures	Discontinue prophylactic antibiotics at time of incision closure	Please refer to paragraph above.

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