Cook Children's Medical Center

Clinical Excellence Committee and Antibiotic Stewardship Committee

Evidence-based pathway for antibiotic management and duration of therapy (DOT) for common pediatric infectious diseases

Antibiotic Stewardship Programs (ASP) are dedicated to assist with the judicial use of antibiotics by using the appropriate dose, route and duration of therapy optimizing clinical outcomes while minimizing potential adverse events.[1] Evidence is mounting across a multitude of bacterial infections that "less is more"[2] [3] [4]. The intent of this guideline is to standardize, to the extent possible, the DOT for common pediatric infectious diseases treated throughout Cook Children's Health Care System. This guideline is for the inpatient and outpatient settings. [5] [6] [7]

This is a guide and does not replace clinical judgement. Always consider the individual patient. If the patient has more than one diagnosis (example osteomyelitis with bacteremia), choose the longest duration. There are guidelines on the ASP webpage and clinical guidelines site for some infections (e.g. community-acquired pneumonia, urinary tract infections, skin and soft tissue infections and *Staphylococcus aureus* bacteremia). Suggested duration of therapy assumes that adequate source control has been achieved (e.g. abscess drainage).
Ranges of duration are given to providers, for them to make a decision based on individual patients' characteristics. Serial procalcitonin measurements can be useful to guide antibiotic duration in patients with documented infection [8]. **Pediatric Infectious Disease consultation is recommended if the diagnosis is not established or if the patient does not respond to recommended therapies.**

Goals:

-To deliver high quality, evidence-based care using the latest literature and national guidelines
-To decrease antimicrobial resistance
-To reduce unnecessarily long duration of antibiotics that may cause harm, increased cost and/or increased length of stay
-To decrease variation in care between providers
-To improve drug compliance
-To have more judicious and appropriate use of antibiotics

Inclusion Criteria:

- Patients from birth to 18 years of age with common pediatric infectious diseases responding to empiric or targeted therapy

Exclusion Criteria:

-Immunocompromised patients
-Infections not clinically improving
-Atypical infections such as *Mycobacterium, Nocardia* and fungus
-Presence of prosthetic or foreign material at the site of infection

If navigating electronically, you can utilize the links in the Table of Contents by holding down the "Ctrl" button on the keyboard and clicking on the destination.

Table of Contents (Table 1):

Table 1: Suggested Duration of Therapy for Common Pediatric Infectious Diseases

INFECTION	TARGETED DURATION	COMMENTS	GUIDELINES AND REFERENCES
BLOOD STREAM INFECTIONS- UNCOMPLICATED			
Gram Positive except *Staphylococcus Aureus (S. pneumoniae, Streptococcus pyogenes)*	7 -10 days	IV to PO conversion if good clinical progress (Afebrile for 48 hours, negative repeat blood cultures and able to take oral medications with no absorption issues).	[9]
Staphylococcus aureus	10-14 days	**ID consult highly recommended** IV to PO conversion in cases of osteomyelitis after 3-4 days, if good source control, negative repeat blood cultures, afebrile for 48 hours, inflammatory markers trending down.	CCMC Clinical Guidelines - *Staphylococcus Aureus* Bacteremia
Moraxella catarrhalis	7-10 days	IV to PO if afebrile for at least 48 hours and rapid improvement.	[9]
Most gram negative except *pseudomonas or E. coli.* (See *Salmonella sp,* infections in AGE section)	10 days	No IV to PO	[9]
Pseudomonas a	14 days		

E. coli	10-14 days 7 days with good source control in adults.	Can consider IV to PO conversion after 3-5 days in BSI with UTI if mildly symptomatic at presentation and good clinical progress with negative repeat blood cultures. For patients <2 months, shorter IV courses ≤ 3-7 days can be considered if no ill appearing on presentation and negative repeat blood cultures with no other focal signs of infection. (This means that the antibiotic course can be completed with oral antibiotics)	[9] [10] [11] [12] [13] [14]
CARDIOVASCULAR			
Endocarditis	2-6 weeks based on pathogen, therapy and prosthesis.	**ID consult highly recommended** Duration of treatment starts from first negative blood culture.	[15] Data extrapolated from adult data.
CENTRAL NERVOUS SYSTEM INFECTIONS			
Bacterial Meningitis, Non-Neonates (> 3 months)			
Neisseria meningitides	4-5 days	**ID consult highly recommended** Repeat lumbar puncture to document CSF clearance with aerobic gram-negative infections and *S. pneumoniae* infections if • Dexamethasone given or • No improvement or • Organism is not penicillin susceptible by oxacillin disk or MIC testing	[16]
Haemophilus influenzae	7-10 days		
Streptococcus pneumoniae	14 days		
Listeria monocytogenes	21 days (may be longer in immunosuppressed patients)		
Aerobic gram negative	14 days after negative CSF culture, minimum of 21 days		
Brain Abscess **Subdural Abscess/Empyema** **Epidural Abscess**	Surgically treated: 4-6 weeks. Aspirated lesions (less than optimal drainage): 6-8 weeks	**ID consult** for duration. Final duration determined by clinical response and imaging. (CT, MRI). Neuroimaging mean time to resolution is 4 months but it may take longer. IV to PO conversion after 2 weeks of IV therapy if good clinical progress and on certain antibiotics (TMP/SMX, linezolid, metronidazole, fluoroquinolones, rifampin) but paucity of data in pediatric and adults.	[9] No recent RCT.
Ventriculitis	Minimum 4 weeks (up to 6 weeks)		
GASTROINTESTIONAL/ABDOMINAL			
Intra-Abdominal Abscess or Abdominal Infection	4 -7 day with source control	ID consult when poor source control or no clinical improvement.	[17] [18] [19] [20] [21] [22] [23]
Appendicitis			
Acute Appendicitis Non-Perforated (S/P Appendectomy)	24 hours after surgery		
Acute Appendicitis Non-Perforated (No Appendectomy)	7-10 days	IV to PO transition depending on clinical progress and antibiotic choices (Fluoroquinolones + flagyl)	

Perforated Appendicitis	4 days from source control. 2 days of post operative intravenous antibiotic for complex appendicitis was not inferior to 5 days in a recent publication [21]	If poor source control or no clinical improvement, ID consult recommended. Oral step down could be considered when appropriate (Afebrile, tolerating oral intake and benign abdominal exam)	
Perforated Appendicitis with Bacteremia	7 days (IV or oral quinolone)	7 days are not inferior to 14 days; If good source control, transient bacteremia (single day), rapid clinical improvement (<72 hrs), not polymicrobial or bacteremic with *Pseudomonas,* hemodynamically stable, afebrile for 48 hours (at day 7) and no immunosuppressed. ID consult recommended. IV to PO transition with oral quinolone can be considered to complete the 7 days. If above criteria are not met, then longer courses would be necessary.	
Peritonitis			
Spontaneous Bacterial Peritonitis	5-7 days	Therapy may need to be longer if documented bacteremia or slow clinical response.	
Secondary Peritonitis	14-21 days based on clinical improvement		
***Clostridium Difficile* Infection**			
C. Difficile Infection First Episode Or First Recurrence	10 days (oral antibiotics preferred)	Discontinue offending antibiotic if possible. Do not order test of cure.	[16]
C. Difficile Infection Second Episode Or Subsequent Recurrence	Depends	ID Consult +/- GI consult	
Non-Typhoid Salmonella AGE +/- Bacteremia	No antibiotics for asymptomatic or uncomplicated AGE. **Antibiotic recommended for persons at increased risk of invasive disease, including younger than 3 months, people with chronic gastrointestinal tract disease, immunosuppression and or hemoglobinopathies and patients with bacteremia.** -IV ceftriaxone if clinically ill -PO azithromycin if well appearing and low risk disseminated infection. 7-10 days	Blood and urine culture should be obtained prior to starting antibiotics. If positive blood culture, should be repeated until negative. Transition from IV to PO after blood culture has been cleared and focal disease has been excluded (meningitis, osteomyelitis)(azithromycin or fluoroquinolone) If focal disease, ID consult recommended.	[24]

	"Hospitalization, by itself, is not a reason by itself for antibiotic therapy, unless patient has severe disease."		
MUSCULOSKELTAL			
Pyomyositis	3-4 weeks If bacteremia with *Staph Aureus*: 28 days	IV to PO switch with clinical improvement. Patient with extensive, multifocal or poorly drained infection, may need longer courses.	[9]
Bacterial Arthritis			
Staphylococcus aureus (MRSA, MSSA) Group A Strep *Kingella kingae*	Short as 10 to 14 days for common pathogens (*S. aureus, S. pyogenes, S. pneumoniae, and H. influenzae type b*), rather than longer courses of 21 to 28 days for uncomplicated presentations. Longer courses (21-28 days) may be required with MRSA and gram negative rod infections with slower improvement and inadequate source control with persistent elevated CRP	**Consult ID and Ortho.** Early switch to oral therapy encouraged with clinical improvement and inflammatory markers trending down, even in patients with **transient** bacteremia.	[25]
Osteomyelitis			
Staphylococcus aureus (MRSA, MSSA) *Kingella Kingae* *S. pyogenes*	3-4 weeks for cases with uncomplicated course and rapid response to therapy. Longer duration maybe necessary with more virulent infections, e.g. severe MRSA infections and more complicated courses.	**Consult ID and Ortho.** Early switch to oral therapy encouraged with clinical improvement even in patients with **transient** bacteremia.	[26]
Vertebral osteomyelitis	6 weeks for low risk patients	Longer courses (> 8 weeks) if risk factors for relapse or worse outcome (ESRD, undrained paravertebral abscess, or MRSA infection). Maybe able to switch to oral therapy after 2-4 weeks if using an equivalent bioavailable agent and clinical improvement.	[27] [28] Limited data.
Osteomyelitis complicating sacral pressure ulcers	Some authors recommend 2 weeks of therapy if osteomyelitis is limited to cortical bone. No data to support longer antibiotic durations.	The goal of therapy is local wound care and assessment for the potential of wound closure	[29]
NEONATAL INFECTIONS			
Neonatal Group B Streptococcal Infections (0-2 months)			
UTI without meningitis	10 days	**ID consult highly recommended**. Meningitis must be ruled out to use shorter durations.	[16]
Bacteremia without a focus	10 days		
Meningitis	14-21 days		

Septic arthritis	14-21 days	If original CSF culture positive, repeat lumbar puncture to document CSF clearance and determine duration of therapy from negative culture.	
Osteomyelitis	21-28 days		
Neonatal Gram Negative Infections (Other Than *Haemophilus Influenza* and *Salmonella* Species)			
UTI without meningitis	7-10 days	IV to PO conversion can be considered in infants with uncomplicated UTI	[30] [11] [31]
Bacteremia without meningitis	10 – 14 days		
Meningitis	14 days after negative CSF culture, minimum 21 days Longer duration may be required with complicated courses (6-8 weeks): abscess, ventriculitis, multiple infarcts	Repeat lumbar puncture to document CSF clearance and determine duration of therapy from negative culture.	[16]
Neonatal HSV Infection			
Skin, eyes, mucous membranes (SEM)	14 days	**ID consult highly recommended**. For CNS disease, documentation of HSV clearance from CSF is recommended prior to antiviral discontinuation.	[32]
Disseminated (Ill appearing, abnormal LFT in addition to positive HSV PCR I serum)	21 days		
Central nervous system (CNS)	21 days		
RESPIRATORY TRACT (LOWER)			
Community-Acquired Pneumonia (CAP)			
Uncomplicated CAP	5 -7 days (5 days is reasonable for children hospitalized with uncomplicated pneumonia)	Consider switch to PO if afebrile, good oral intake, no oxygen requirements. Remember that in children <2 years, the most common cause of CAP is viral and they may not need antibiotic therapy at all.	CCMC Clinical Guidelines – CAP [4] [33]
Mycoplasma pneumoniae	Azithromycin: 3-5 days Doxycycline or levofloxacin: 7 days		
Parapneumonic Effusion Empyema Necrotizing Pneumonia	1-4 weeks after hospital discharge	**Consider ID consult.** Duration dependent on adequacy of drainage and clinical response. Transient *S. pneumoniae* bacteremia does not warrant prolong or IV antibiotic therapy.	CCMC Clinical Guidelines – Empyema
Lung Abscess	14 to 28 days	**Consider ID consult** Duration dependent on adequacy of drainage and clinical response.	CCMC Clinical Guidelines - CAP
Aspiration Pneumonia	5-7 days if suspect infection	Consider IV to PO conversion if clinical improvement, afebrile and able to tolerate oral antibiotics.	[34]

Hospital-Associated Pneumonia (HAP)	7 days	IV to PO conversion with clinical improvement and decreased CRP and procalcitonin compared with initial measurements.	[35] Extrapolated from adults.
Ventilator-Associated Pneumonia (VAP)	7-8 days, including *Pseudomonas Aeruginosa*	Ultra short courses up to 3 days in patients with stable and minimal ventilator settings may be appropriate.	[35] [36] Extrapolated from adults.
RESPIRATORY TRACT (UPPER)			
Otitis Media			
Less than 2 years old or Severe symptoms	10 days	Consider observation without antibiotics for ≥ 2 year old with mild symptoms. OM with effusion no antibiotics.	[16]
≥2-5 years old	7 days		
Older than 6 years old	5 days		
Streptococcal Pharyngitis	Penicillin Benzathine IM x1 Beta-lactams or clindamycin: 10 days Azithromycin: 5 days	Beta-lactams (penicillin and amoxicillin) are first line therapies.	[16]
Tonsillar or Peritonsillar Abscess	10-14 days	IV to PO conversion if good clinical progress and successful drainage. Longer duration maybe necessary if complex infection with insufficient source control.	[37]
Retro- or Parapharyngeal Abscess	14 days		
Sinusitis (Non-complicated)			
Acute sinusitis -mild	10 days or at least 5-7 days beyond clinical improvement (patient begin to feel better)		[16] [38] Duration has not been investigated systematically.
Chronic sinusitis (>12 weeks duration)	14 to 21 days. At least 7 days after symptoms improve for acute exacerbations		
Acute Mastoiditis	2-4 weeks	Depends on adequate debridement, intracranial extension, osteomyelitis extent, associated thrombosis. Transition to oral with clinical improvement, **ID consult with intracranial complications.**	[39]
Periorbital Cellulitis	7-10 days	Switch to oral therapy after 24 hours of improvement in fever, swelling and erythema.	[16] [9] [40]

Orbital Cellulitis	21 days 14 days could be appropriate therapy for uncomplicated cases	May require surgical intervention if fluid collections. A longer course may be required. Transition to oral therapy with improvement.	[40] [41]
Acute Cervical Lymphadenitis	5-7 days	Maybe longer if slow progress or abscess formation.	[16]
SKIN & SOFT TISSUE			
Non-Purulent			
Erysipelas/Cellulitis	5-7 days		CCMC Clinical Guidelines - Skin and Soft Tissue Infection
Impetigo	5 days		
Purulent			
Abscess	Incision and drainage +/- antibiotics for 5-7 days	Incision and drainage alone if <2 cm, complete drainage and no systemic symptoms.	
Recurrent abscess Abscess with systemic symptoms	5 to 10 days after incision and drainage		
Staphylococcus Scalded Skin Syndrome	7 days	May switch to oral therapy with clinical improvement	
Necrotizing Fasciitis	Varies	**Consult surgery and ID.** Start broad spectrum empiric therapy.	
Prophylaxis for Cat, Dog or Human Bite Wound	3 days		
Infected Bite Wound Treatment	10 days		
URINARY TRACT INFECTION			
Asymptomatic Bacteriuria	treatment not required		CCMC Clinical Guidelines – UTI [42]
Cystitis **Acute, uncomplicated**	3 days with TMP/SMX 5 days with nitrofurantoin 5 days with beta-lactam		

Pyelonephritis	-5 or 7 days with fluoroquinolones. No FQ is approved for use in children <16 years based on joint cartilage injury in immature animals. One of the exception is complicated UTI -7-10 days with beta-lactam or TMP/SMX -10-14 days if slow clinical improvement (7 days of antibiotic can be effective in complicated pyelonephritis when antibiotic with comparable IV and oral bioavailability are administered. 10 days may be needed for all other patients)	IV to PO conversion with clinical improvement. Shorter courses for febrile UTI (1-3d) are inferior to longer courses. No need to repeat urine culture. Longer duration should be necessary for complicated cases such as renal abscess without drainage.	[43] [44] [45]
UTI with Bloodstream Infection	7 -14 days	IV to PO conversion if good clinical progress and tailor therapy based on urine culture (does not apply to newborns)	[31] [11] [14]

***Abbreviations:**

AGE: acute gastro enteritis
BSI: blood stream infection
CNS: central nervous system
CSF: cerebro spinal Fluid
CT: cat scan
ESRD: End stage renal disease
HSV: Herpes simplex virus
ID: infectious Disease consult
IM: intra muscular
IV: intravenous
MRI: magnetic resonance imaging
MRSA: Methicillin resistant *Staphylococcus aureus*
MSSSA: Methicillin sensitive *Staphylococcus aureus*
OM: otitis media
PO: per oral route
TMP-SMX: trimethoprim Sulfa methoxasole
UTI: urinary tract infections

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