Do all bacterial infections need antibiotics? Rethinking the Management of Common Pediatric Infections

Dipa Saha MD, FAAP

DRIVING CHANGE 2023
THE URGENT CARE CONVENTION

URGENT CARE ASSOCIATION®

COLLEGE OF URGENT CARE MEDICINE

The Pediatric Urgent Care Conference
PUCC @ UCA
By PM Pediatric Care

Financial Disclosures

DRIVING CHANGE 2023
THE URGENT CARE CONVENTION

I have no financial disclosures

The Pediatric Urgent Care Conference
PUCC @ UCA
By PM Pediatric Care

Learning objectives

DRIVING CHANGE 2023
THE URGENT CARE CONVENTION

- Review basics of Antimicrobial Stewardship
- Review how to optimize antibiotic treatment for some common bacterial infections
- Review tools on how to apply above concepts in the Urgent Care setting

The Pediatric Urgent Care Conference
PUCC @ UCA
By PM Pediatric Care

Why should we care about prescribing antibiotics?

Courtesy of Stan Shulman

"Don't forget to take a handful of our complimentary antibiotics on your way out."

Antibiotic Resistance

CDC estimates that at least 2.8 million infections due to AR pathogens and 35,900 attributable deaths each year

In children, reactions from antibiotics are the most common cause of medication-related emergency department visits

Kadri, Crit Care Med. 2020
Shehab et al, JAMA, 2016

Audience participation question

Does antibiotic use even when warranted contribute to resistance

YES

NO

NATIONAL ACTION PLAN FOR COMBATING ANTIBIOTIC-RESISTANT BACTERIA

- Establishment of antibiotic stewardship programs in all acute care hospitals and improved antibiotic stewardship across all healthcare settings.
- Reduction of inappropriate antibiotic use by 50% in outpatient settings and by 20% in inpatient settings.

CDC's 2019 AR Threats Report:

PREVENTION WORKS.

↓18% fewer deaths from antibiotic resistance overall since 2013 report

↓28% fewer deaths from antibiotic resistance in hospitals since 2013 report

AND DECREASES IN INFECTIONS CAUSED BY:

- **↓41%** Vancomycin-resistant *Enterococcus*
- **↓33%** Carbapenem-resistant *Acinetobacter*
- **↓29%** Multidrug-resistant *Pseudomonas aeruginosa*
- **↓25%** Drug-resistant *Candida*
- **↓21%** Methicillin-resistant *Staphylococcus aureus* (MRSA)
- **STABLE** Carbapenem-resistant Enterobacteriaceae (CRE) & drug-resistant tuberculosis (TB disease cases)

Decreasing Beneficial Bacteria in Children

- Inflammatory bowel disease
- Juvenile arthritis
- Asthma
- Food or other allergies
- Weight Gain

Pediatric Antimicrobial Stewardship

DRIVING CHANGE 2023
THE URGENT CARE CONVENTION

Duration of antibiotic therapy - critical, underexamined

In the past, duration of antibiotic therapy was largely based on **convention and expert opinion**, with little scientific evidence supporting

Research suggests - acute otitis media, community-acquired pneumonia, and urinary tract infections can with reduced courses of antibiotic therapy.

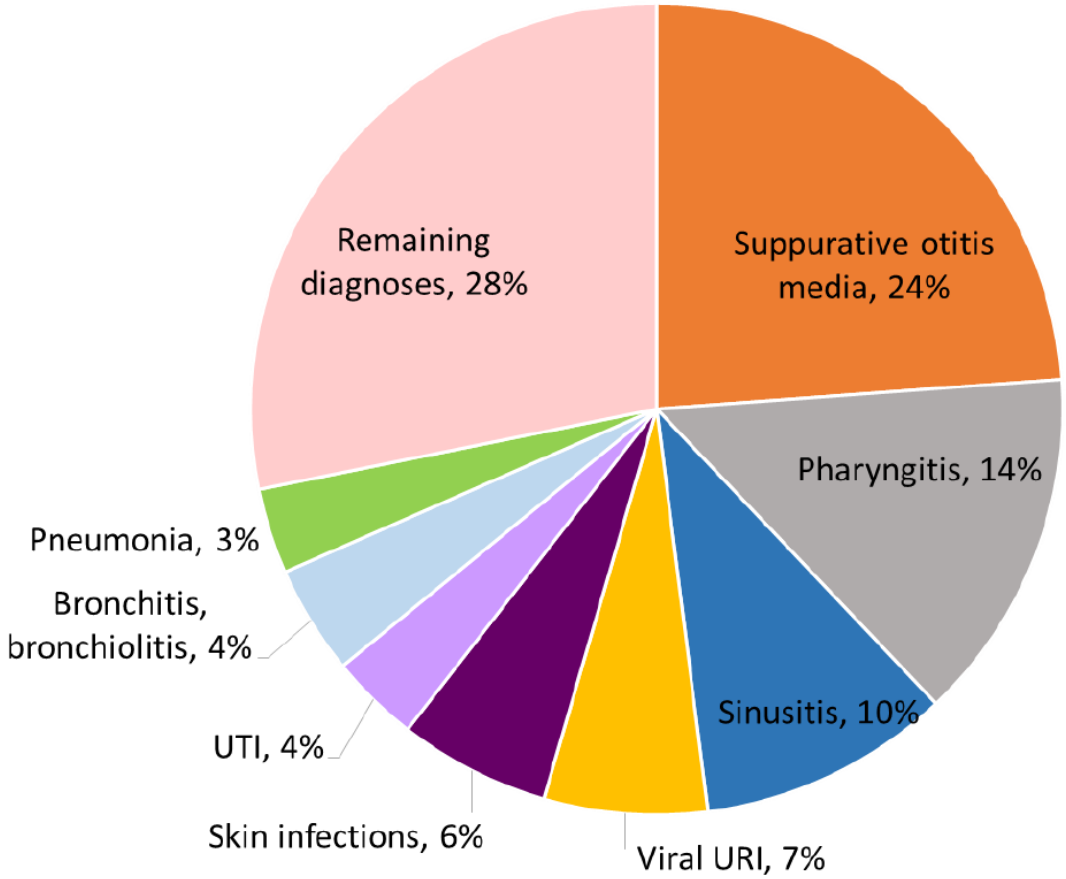
The Pediatric Urgent Care Conference
PUCC @ UCA
By PM Pediatric Care

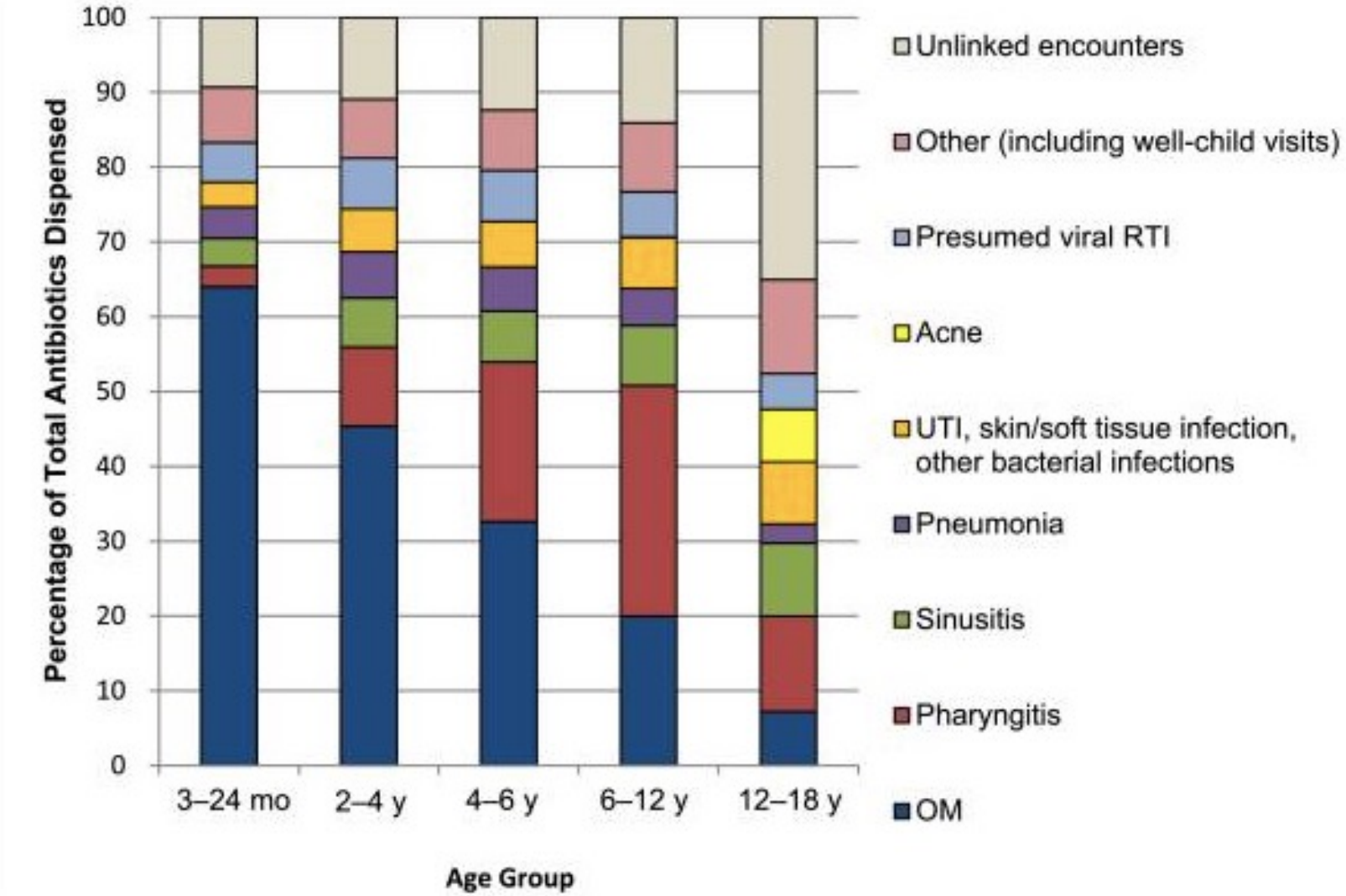
Good et al J Nursing 2021

COVID rears its ugly head again

BMJ Jan 2022

Diagnoses leading to antibiotics in children <20 years — United States 2010-11





Le Vaz et al 2014

Ear infections and antibiotic prescribing

- 10 million antibiotic prescriptions annually
- 2.5 million parent-reported adverse drug events annually
- Ear Infections By Age 3
  - 60% have had ≥ 1 infection
  - 24% have had ≥ 3 infections
  - More than 95% of children with AOM are prescribed an antibiotic of which more than 95% are immediate and 94% are for a duration of 10 days, including for those 2 years or older

Case study

3 year-old with runny nose, cough, congestion for 2 days, fever for 1 day to 102 F.

Vitals: 38 C, HR 150 (crying), RR 30

Exam:

Gen: Uncomfortable

Ears: Left TM: Bulging, opaque, erythematous Right TM: pink, normal light reflex

No known allergies

What would you do?

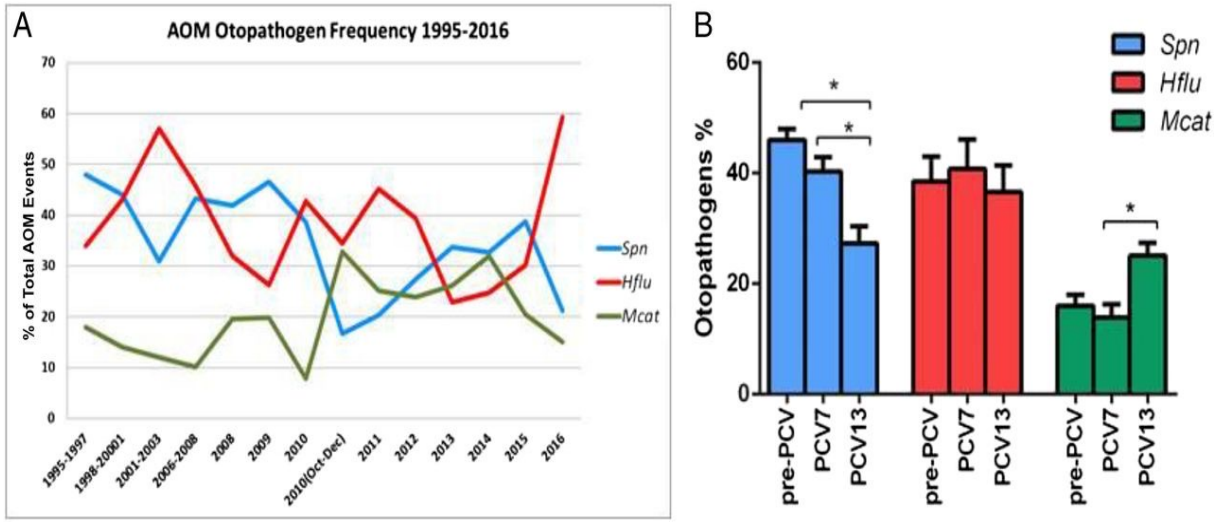
Audience participation:

A. Treat with Amoxicillin at visit for 10 days

B. Don’t treat

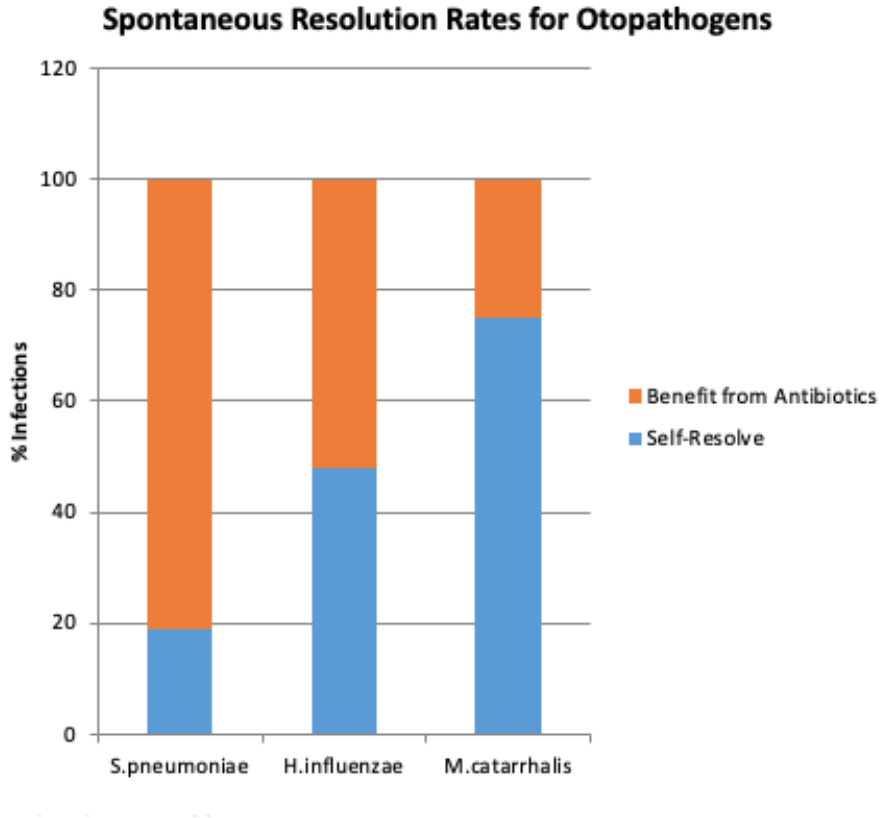
C. Give watch and wait prescription

What causes AOM in children?



- Up to 55% are viral (more likely in older children)
- Reduced overall AOM incidence
- More infections caused by *H.influenzae* and *M.catarrhalis* and fewer *S.pneumoniae*

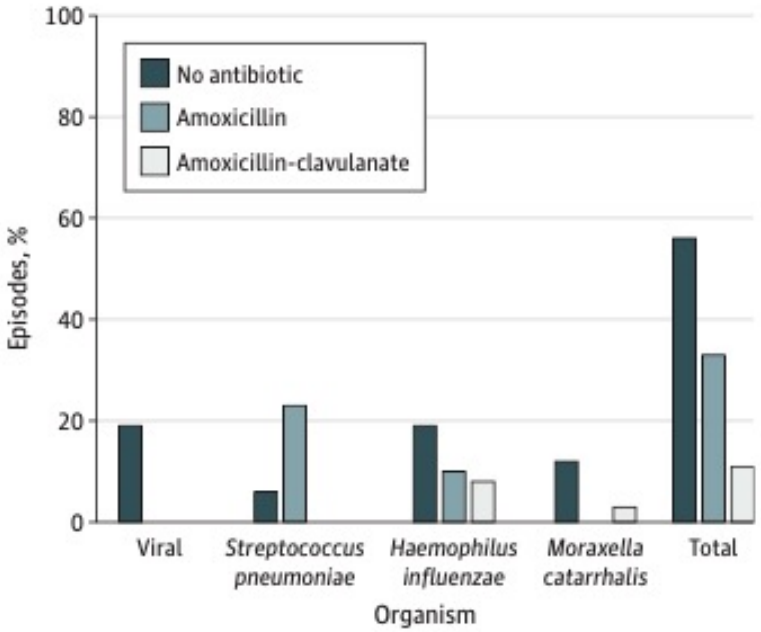
Do we actually need to treat AOM?



JAMA, March 2022

Do we actually need to treat AOM?

Figure. Percentage of Acute Otitis Media Episodes Expected to Be Best Treated by No Antibiotic, Amoxicillin, and Amoxicillin-Clavulanate



Percentages are based on the otopathogen distribution and spontaneous resolution rates for children 2 years and younger. For older children, the percentage expected to resolve without an antibiotic is higher than shown here.

JAMA, March 2022

When is treatment with antibiotics needed?

These children often need antibiotics right away:

- VERY painful and lasts more than a few days
- Infants ≤ 6 months
- 6 months to 2 years w/ moderate to severe ear pain, for at least 48 hours, B/L or Unilateral AOM AND Fever of 102.2 F/39 C
- Age ≥ 2 years who also meet the above criteria
- Children with another condition that could make it harder to heal, including children with:
  - Cleft palate, Down syndrome, an immune disorder, cochlear implant
- Recurrent AOM: ≥ 3 episodes in 6 months, ≥ 4 episodes in 12 months (with at least 1 in last 6 months)

Dosing

Oral/IM Antibiotic Therapy		
Indications	**Antibiotic**	**Dose**
First line for most	Amoxicillin	45mg/kg/dose twice daily MAX 2000mg/dose, 4000mg/day
First line if: Amoxicillin within 30 days Concurrent purulent conjunctivitis or Amoxicillin failure	Amoxicillin-clavulanate ES or XR Formulations	45mg/kg/dose of Amoxicillin twice daily MAX 2000mg/dose, 4000mg/day
Penicillin Allergy	Cefdinir	14mg/kg/dose once daily MAX 600mg/dose
Penicillin AND Cephalosporin Allergy	Clindamycin	10mg/kg/dose three times daily MAX 600mg/dose
Amoxicillin-clavulanate or oral Cephalosporin failure	Ceftriaxone OR	50mg/kg IM once daily for 3 days MAX 1g/dose
	Levofloxacin (consider with barriers to follow up for IM CTX)	6 months to <5 years: 10 mg/kg/dose twice daily ≥5 years: 10 mg/kg/dose once daily MAX 750mg/day

Where do we the get the duration from?

Treat for 10 days: Several studies favor standard 10-day therapy over shorter courses for children younger than 2 years

- Children ≥ 6 months with severe signs or symptoms (moderate/severe otalgia, otalgia for 48 h, temperature 39°C [102.2°F])
- Bilateral AOM in children 6 months - 23 months of age w/o severe signs or symptoms

A 7-day course of antibiotic effective in children 2 to 5 years of age with mild or moderate AOM

For children ≥ 6 years w/ mild to moderate symptoms, a 5- to 7-day course is adequate

Number needed to treat

- Symptomatic benefit was evident for 1/15 children treated in the pre- PCV era
- Benefit is evident for only 1/20 children in the post-PCV era (25% relative increase)
- Data indicate that 78% to 85% of AOM episodes in the post-PCV era self-resolve
- Nearly 75% of antibiotics currently prescribed for AOM in the United States may be potentially unnecessary

Why isn’t a longer duration better?

- Most AOM cases do not require antibiotics
- Antibiotics may clear the infection in as few as 3 days (range 3-6)
- As inflammation decreases there is reduced penetration into the ear
- A contingency plan is part of good communication on respiratory infections
- Increases pharyngeal *S.pneumoniae* resistance

What others are doing

CHOP: < 6 months treat for 10 days, 6-24 months treat for the AAP criteria for 10 days, > 2 treat for 7 days

Nationwide Childrens: < 2 years of age, treat for AAP criteria and B/L AOM, watchful waiting for unilateral less severe but all for 10 days. For greater than 2 years: Treat for 10 days for AAP criteria, but for AOM nonsevere/unilateral non severe and watchful waiting and eventual treat but for 5-7 days.

Denver Health: 6-24 months 10 days, 2-5 years - 5 days, 6-12 - 5 days

DURATION

< 2 years – do 10 days

2-5 years – 7 days

> 6 years – 5 days

The Pediatric Urgent Care Conference
PUCC @ UCA
By PM Pediatric Care

Case study 2

5 year-old girl comes in with 2 days of worsening dysuria, urinary frequency, urinary incontinence. No fever, no back pain, no vomiting.

Exam: Normal

UA: Cloudy, Sp Grav 1.025, Neg Glu, Neg Pro, Neg Ketone, Large LE

What antibiotics would you treat with and for how long?


Yes! A UTI!
Let's Call
This U/A
Positive!

Audience participation (5 yo female with UTI):

A: Treat with cephalexin for 5 days

B: Treat with cefdinir for 10 days

C: Treat with cephalexin for 10 days

D: Treat with cefdinir for 5 days

Doctors treat female UTIs with wrong antibiotics nearly half the time, study finds

By Sandee LaMotte, CNN

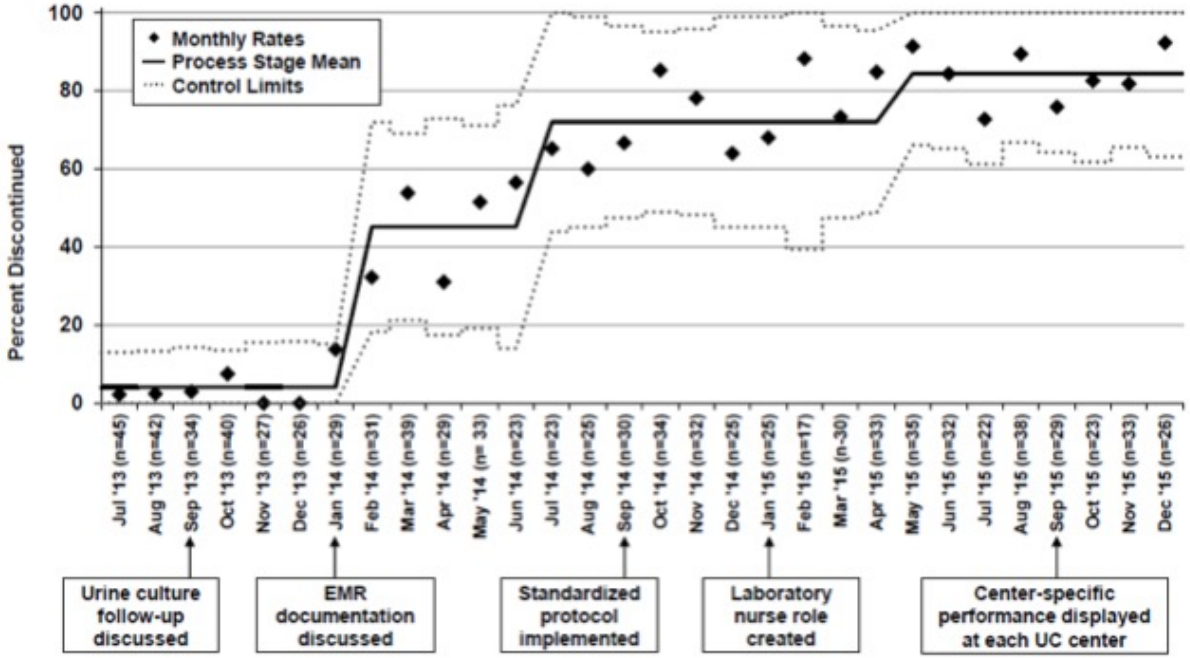
Updated 10:00 AM ET, Wed February 24, 2021

Now, a new study has found that doctors gave the wrong antibiotics to nearly half of 670,400 people diagnosed with a UTI.

In addition, over three-quarters of those women received antibiotic prescriptions for longer than medically necessary

Butler et al,*Infection Control & Hospital Epidemiology,* 2021

Approximately 50% of children we start therapy in ED for presumed UTI don't have one



Watson et al 2018 Saha et al 2017

WHY CEPHALEXIN

Rationale for Narrow spectrum (1st generation) cephalosporin, such as cephalexin
~80% of first-time UTIs are due to *E. coli*

•Most *E. coli* are susceptible to cephalexin (=cefazolin) in the urine even when susceptibility report intermediate
•or resistant

•**Cephalexin is highly concentrated in the urine (~100 fold)**

•Response seen w/ cephalexin - urinary isolate was reported intermediate or resistant to cefazolin

•Cephalexin is ~ 10 X less expensive than 2nd and 3rd generation cephalosporins

WHY CEPHALEXIN

DRIVING CHANGE 2023
THE URGENT CARE CONVENTION

- 3rd generation cephalosporins NOT recommended as first-line empiric therapy
- Cephalosporins should not be used where enterococci: intrinsic resistance
- If cephalexin allergy concern, use other narrow spectrum antibiotics
- Antibiotic therapy should always be targeted to the sensitivities, if known

The Pediatric Urgent Care Conference
PUCC @ UCA
By PM Pediatric Care

Narrow spectrum antibiotics:
Amoxicillin (high resistance), TMP-sulfa, Cephalexin, Nitrofurantoin

Broad spectrum antibiotics: *Cefdinir, Ciprofloxacin*

1

Stop antibiotics, when urine culture is negative

2

Choose narrow spectrum antibiotics, if you choose to treat (review culture and sensitivities)

3

Choose short duration if appropriate

4

Wait to treat if appropriate

What are others doing?

1. <u>Shorter course (3-5 days) supported by:</u>
    1. Children's national: 3 days
    2. SCOUT Study NIH: 5 days
    3. UpToDate: 3-5 days if not pyelo (supported by Cochrane review)
    4. Seattle Childrens: 3 days if teenager
    5. NICE (UK): 3 days if not pyelo
2. <u>Longer course (7-10) supported by:</u>
    1. AAP: 7-14 days
    2. CHOP: 7 days
    3. Seattle Childrens: 7 if toilet trained but not teen, 10 if not toilet trained

CHOP's UTI pathway

Antibiotic Recommendations

Empiric Antibiotic Treatment Based on Urinalysis Results

Ill-appearing children should be treated **immediately**, obtain urine for culture prior to treatment when possible.

- Use the following criteria to empirically treat for UTI:

Dipstick	Positive nitrite ***OR*** LE 2+ moderate
Standard UA	>5 WBC / hpf ***AND*** bacteria

- For other patients, strongly consider waiting for results of the urine culture

Other Pathways

- Febrile Young Infant (0-56 Days Old)
- Abdominal Pain, Lower, in Post-pubertal Girls

IV vs PO

Consider initial IV treatment if:

- Infants < 6 months of age
- Moderate / Severe Dehydration
- Vomiting, inability to tolerate oral fluids, antibiotics
- Concern for follow-up

Other Testing

- Routine Blood culture, CBC, CRP, BMP are NOT recommended

Recommended Antibiotics*

Outpatient

- 1st choice
  - Cephalexin
- Second line for cephalosporin and/or severe penicillin allergy (includes any of the following: anaphylaxis, angioedema, cardiac arrest, respiratory distress, severe cutaneous reaction (for example, Stevens-Johnson syndrome, erythema multiforme, DRESS and TEN). Patients who experience hives with penicillin can receive cephalosporins as recommended. All other reactions considered non-severe and should receive the recommended antibiotic).
  - Trimethoprim-sulfamethoxazole

DRIVING CHANGE 2023
THE URGENT CARE CONVENTION

So how can we turn the tide?

- Stop antibiotics if UCx negative
- If you decide to treat, choose **narrow spectrum.**
- Remember you can wait to treat, if appropriate
  - **Cephalexin (50-100mg/kg/day div BID-TID),** Nitrofurantoin, TMP-Sulfa
- Trust your H&P and clinical skills if needed.

The Pediatric Urgent Care Conference
PUCC @ UCA
By PM Pediatric Care

When to consider empiric treatment

Factors to consider:

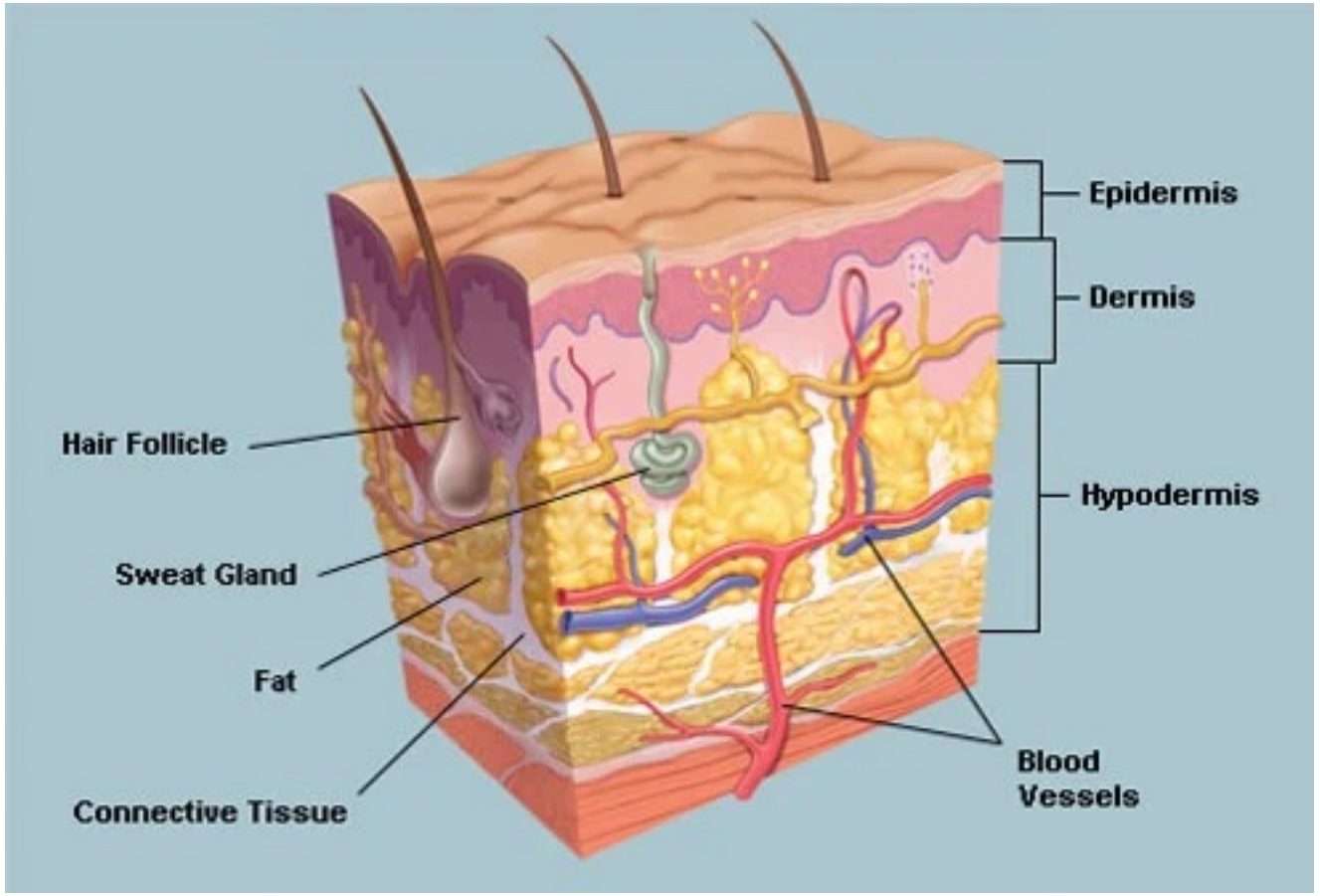
- Patient age
- History of GU anomaly, VUR
- Likeliness of UTI, history of frequent UTIs
- Severity of discomfort (? Pain scale), urinary incontinence
- Safety of delay in treatment
  - Signs/symptoms of pyelonephritis ->Increased risk for renal scarring?

Therapy Delay & Scarring in Febrile UTI

Shaikh et al. *JAMA Pediatrics* 2016

- Retrospective cohort study of children 2-72 mo old with 1st or 2nd **febrile** UTI
- Data from 2 prior studies:
  - RIVUR: children with VUR (78%)
  - CUTIE: children without VUR (22%)
- Therapy delay = time from fever onset to start of antibiotic therapy
- Outcome: New renal scarring on DMSA at 24-mo f/u
- Results:
  - Median therapy delay in those with scar: 72 hrs
  - Median therapy delay in those without scar: 48 hrs

Skin layers


Epidermis
Dermis
Hypodermis
Hair Follicle
Sweat Gland
Fat
Connective Tissue
Blood Vessels

Recent PM Pediatrics Case

- 3 year-old girl brought on day 1 for honey crusted lesions around her mouth. Erythematous tender blanchable plaques to bilateral axilla. No hx of MRSA, boils. No fever. Vaccinations UTD.
- Vitals: Temp 37 C, HR 109, O2 Saturation: 99
- Exam: perioral honey crusted lesions, B/L axilla erythema
- A/P Impetigo – multiple, started on cephalexin and mupirocin.

Recent PM Pediatrics Case

DRIVING CHANGE 2023
THE URGENT CARE CONVENTION

- Day 2: Mom brings child back. Still no fever. But now rash has spread to neck, chest, perineum. Sloughing?Peeling? No mucosal involvement.
- Vitals: Temp 36 C, HR 113, O2 Saturation: 99
- Exam: Child uncomfortable looking. Continued with honey colored crusted lesion below right lip; 2-3mm areas of denuded skin with wet base scattered to forehead, nose, neck, one lesion to upper back and left upper chest that had sloughing skin; bilateral eyelids, axilla, labia majora/perineal area with erythematous tender plaques, sloughing skin present to perineal mucosa
- A/P: What would you do? What do you think is going on?

The Pediatric Urgent Care Conference
PUCC @ UCA
By PM Pediatric Care

Audience Participation

A: Staph Scalded Skin

B: Toxic Shock Syndrome

C: Impetigo

D: Scarlet fever

ORAL antibiotics vs or no: size (CHOP)

Antibiotic Recommendations

	Non-purulent Cellulitis Pathogen: *S. pyogenes* (most likely)	Purulent Cellulitis/Abscess Pathogen: *S. aureus* (most likely)		Duration of Tx/Comments
		Drained abscess ≥ 2 cm with or without cellulitis	**No cellulitis and single drained abscess < 2 cm**	
ED/Outpatient/Transition from IV Therapy[1]	**First-line Therapy** **Oral Cephalexin:** 50 mg/kg/day divided q 8 hrs or divided 3x/day Max: 500 mg/dose Treatment failure > 48 hrs **Cephalexin:** **Oral Clindamycin:** 10 mg/kg/dose q 8 hrs or 3x/day Max: 1800 mg/day PO or 600 mg/dose **Cephalosporin allergy:** **Oral Clindamycin:** 10 mg/kg/dose q 8 hrs or 3x/day Max: 1800 mg/day PO or 600 mg/dose	**Oral Cephalexin** 50 mg/kg/day divided q 8 hrs or divided 3x/day Max: 500 mg/dose OR **Oral Clindamycin if:** **Cephalosporin** allergy Failed **cephalexin** Presence of any MRSA risk factors: History of prior MRSA infection or carriage (please confirm **clindamycin** susceptibility if prior cultures are available; tailor antibiotics to past sensitivity) Known close/household contact with history of MRSA and/or with recurrent skin abscess Use of IV drugs OR **Oral Co-trimoxazole** (appropriate independent of MRSA risk factors and can be used for **cephalosporin-allergic** patients and for **cephalexin** treatment failures): 6 mg TMP/kg/dose q 12 hrs or 2x/day Max: 160 mg TMP/dose (1 double-strength tablet)	No antibiotics	5 days If previous culture information for patient available, tailor antibiotics to past sensitivity **Cephalexin:** ~75% of S. *aureus* at CHOP are susceptible (100% of MSSA isolates, 0% of MRSA isolates) **Clindamycin:** ~78% of *S.aureus* at CHOP are susceptible (77% of MSSA, 80% MRSA) **Co-trimoxazole:** 95% of all *S. aureus* (MRSA and MSSA) are susceptible

Antibiotics DONTs

-Paronychia (less than 2 cm usually)

-Uncomplicated impetigo

-Small abscesses that you drained well

Abscess	I and D (don't culture) unless complicated situation	Use Cephalexin (unless known MRSA hx or family hx) – usually caused by staph. Use abx if size > 2 cm, multiple, complicated, fever If MRSA – use Clindamycin	5 days **Cephalexin dosing:** 15-25mg/kg/dose, 3-4 times/day (most institutions do TID), max 500mg/dose **Clindamycin dosing:** 10 mg/kg/dose, 3 times/day, max 300mg/dose (600mg/dose for undrained abscess or bigger kids/severe infection)
Cellulitis/Erysipelas	N/A	Use Cephalexin – usually called caused by GAS	5 days
Impetigo	Don't culture	Mupirocin usually enough, unless multiple	5 days
Paronychia	Don't culture	Mupirocin usually enough	5 days
For peri-rectal abscess and pilonidal cysts	Don't culture unless complicated situation	Amoxicillin-clavulanic acid (Augmentin) oral of 20-30mg amoxicillin/kg/dose, 3 times/day	7 days

To culture or not to culture

- Lot of evidence - definitely no CBC, blood culture/inflammatory markers on regular SSTIs

Show citation

The Limited Role of Microbiological Culture and Sensitivity in the Management of Superficial Soft Tissue Abscesses

Muhammad N. Khan,[1] Raghavan Vidya,[2] and Richard E. Lee[3]

Show more

Received	Revised	Accepted
08 Jun 2006	28 Aug 2006	28 Aug 2006

Community Acquired Pneumonia

DRIVING CHANGE 2023
THE URGENT CARE CONVENTION

Viruses >>> Bacteria in ALL AGE GROUPS especially 3m-5y

- High dose Amoxicillin still recommended
- Cefdinir: Poorly absorbed, Highly protein bound – not recommended for CAP

SAFER study: 2-center, parallel-group, noninferiority RCT

- Children 6m-10y with fever, respiratory symptoms, CXR c/w pneumonia, 5 days amox + 5 d placebo vs 10 d amox. n= 281.
- Clinical cure: 88.6% vs 90.8% in control group

SCOUT-CAP study

- Randomized double-blind placebo-controlled clinical trial in outpatient settings in 8 US cities: 5 days antibiotics + 5 d placebo vs 10 days antibiotics. N=380
- < 10% of children in either strategy had an inadequate clinical response

The Pediatric Urgent Care Conference
PUCC @ UCA
By PM Pediatric Care

1. Use the narrowest antibiotic for the infection suspected

2. Use your local antibiogram to make empiric antibiotic choices

3. Reduce antibiotic duration when possible

https://players.brightcove.net/70829860001/S1MDI8LJZ_default/index.html?videoId=6160065427001

Why not just treat?

Decreases Beneficial Bacteria in Children:

Increased association with autoimmune disease in children and dose related exposures and increased risk of RA in adults

Dose-response effects and stronger effects with broad-spectrum antibiotic were often reported

- Inflammatory bowel disease, Juvenile arthritis, Asthma, Food or other allergies, Weight Gain

Decreased vaccine response in kids

Antibiotic use in children <2 years of age is associated with lower vaccine-induced antibody levels to several vaccines (Dtap, PCV, IPV)

Sultan et al 2019

Duong at el 2022

Chapman et al 2022

JAMA editorial

- Perhaps, these beliefs stem from an assumption that if all viral infections do not benefit from antibiotics that all bacterial infections require one (similar to treatment of gram-negative sepsis where mortality is high)
- A cultural reset among clinicians and parents is needed to amend this assumption because it has implication for other diagnoses such as sinusitis, which is caused by the same pathogens and often resolves without an antibiotic.

RESOURCES to help you

DRIVING CHANGE 2023
THE URGENT CARE CONVENTION

- CDC
- Choosewisely.org
- https://www.uwimtr.org/dart/

Dialogue Around Respiratory Illness Treatment

The Pediatric Urgent Care Conference
PUCC @ UCA
By PM Pediatric Care

Thank you!
Questions?
Concerns?
Suggestions?

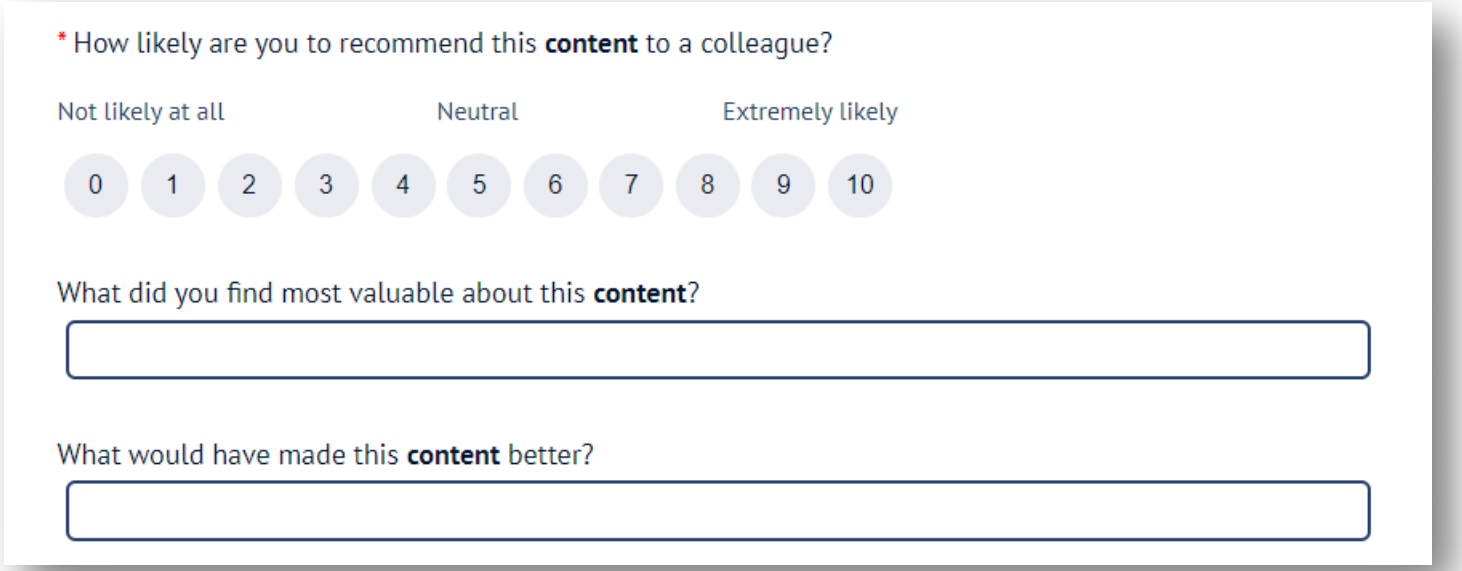
dsaha@pmpediatrics.com

The Pediatric Urgent Care Conference
PUCC @ UCA
By PM Pediatric Care

Session Evaluation

DRIVING CHANGE 2023
THE URGENT CARE CONVENTION

- Your feedback is valuable, take a moment to complete the survey for this session.
- To claim CME, you must complete a separate survey available after the convention.



Bibliography

Hoberman A, Paradise JL, Rockette HE, et al. Shortened antimicrobial treatment for acute otitis media in young children. N Engl J Med 2016;375:2446-56
Duong QA, Pittet LA, Curtis, N et al. Antibiotic exposure and adverse long-term health outcomes in children: A systematic review and meta-analysis. Journal of Infection 2022; ;16:27
Sultan, A.A., Mallen, C., Muller, S. et al. Antibiotic use and the risk of rheumatoid arthritis: a population-based case-control study. BMC Med 17, 154 (2019
LieberthalAS,CarrollAE,ChonmaitreeT,etal. The diagnosis and management of acute otitis
media. Pediatrics. 2013;131(3):e964-e999. doi:10. 1542/peds.2012-3488
VenekampRP,SandersSL,GlasziouPP,DelMar CB, Rovers MM. Antibiotics for acute otitis media in children. Cochrane Database Syst Rev. 2015;(6): CD000219.
doi:10.1002/14651858.CD000219.pub4
KaurR,MorrisM,PichicheroME.Epidemiology of acute otitis media in the postpneumococcal conjugate vaccine era. Pediatrics. 2017;140(3): e20170181. doi:10.1542/peds.2017-0181
KleinJO.Otitismedia.ClinInfectDis.1994;19(5): 823-833. doi:10.1093/clinids/19.5.823
GerberJS,RossRK,BryanM,etal.Associationof broad- vs narrow-spectrum antibiotics with treatment failure, adverse events, and quality of life
in children with acute respiratory tract infections. JAMA. 2017;318(23):2325-2336. doi:10.1001/jama. 2017.18715
SanchezGV,Fleming-DutraKE,RobertsRM, Hicks LA. Core elements of outpatient antibiotic stewardship. MMWR Recomm Rep. 2016;65(6):1-12. doi:10.15585/mmwr.rr6506a1
Kenna, M. Acute Otitis Media — The Long and the Short of It. 2016; n engl j med 2016 375;25
Frost, H, Hersh, A. Rethinking Our Approach to Management of Acute Otitis Media . JAMA Pediatr. 2022;176(5):439-440
Chapman T, P. M., Bajorski P, Pichichero M. Antibiotic Use and Vaccine Antibody Levels. Pediatrics 149, 1-17
Tähtinen PA, Laine MK, Huovinen P, Jalava J,Ruuskanen O, Ruohola A. A placebo-controlled
trial of antimicrobial treatment for acute otitismedia. N Engl J Med. 2011;364(2):116-126.
Rovers MM, Glasziou P, Appelman CL, et al. Antibiotics for acute otitis media: a meta-analysis with individual patient data. Lancet.2006;368(9545):1429-1435.
Shaikh N, Dando EE, Dunleavy ML, et al. A Cost-Utility Analysis of 5 Strategies for theManagement of Acute Otitis Media in Children. J Pediatr. 2017;189:54-60.e3.
Siegel RM, et al.; Treatment of otitis media with observation and a safety-net antibiotic prescription. Pediatrics. 2003;112:527-31.

Bibliography:

- https://www.childrenscolorado.org/49e72a/globalassets/healthcare-professionals/clinical-pathways/ed-uc-abscess.pdf
- Stevens, DL, Bisno AL et al. 2014. Practice guidelines for the diagnosis and management of skin and soft tissue infections: 2014 update by the infectious diseases society of America. Clinical Infectious Disease. 59(2):147
- Breen, E. and Bleday, R. Perianal and perirectal abscess. In: UpToDate, Post, TW (Ed), UpToDate, Waltham, MA, 2014.
- https://www.texaschildrens.org/sites/default/files/uploads/documents/outcomes/standards/Skin%20and%20Soft%20Tissue%5B1%5D.pdf
- Swartz, M. N. (2004). Cellulitis. New England Journal of Medicine, 350(9), 904-912.
- Children's Hospital of Philadelphia. (2015)
- Cellulitis/Abscess, suspected. 13. Seattle Children's Hospital. (2013)
- Korownyk C, Allan GM. Evidence-based approach to abscess management. Can Fam Physician. 2007 Oct;53(10):1680-4. PMID: 17934031; PMCID: PMC2231432
- https://www.hopkinsallchildrens.org/getattachment/49d9dcc0-ab78-45aa-86dc-dc908d5f53ec/Pediatric-Skin-Soft-Tissue-Infections
- https://www.seattlechildrens.org/globalassets/documents/healthcare-professionals/clinical-standard-work/cellulitis-and-abscess-org-pathway.pdf
- https://www.chop.edu/clinical-pathway/cellulitis-abscess-suspected-skin-infections
- Hepburn MJ, Dooley DP, Skidmore PJ, Ellis MW, Starnes WF, Hasewinkle WC. Comparison of Short-Course (5 Days) and Standard (10 Days) Treatment for Uncomplicated Cellulitis. *Arch Intern Med.* 2004;164(15):1669–1674. doi:10.1001/archinte.164.15.1669
- Chen AE, Carroll KC, Diener-West M, Ross T, Ordun J, Goldstein MA, Kulkarni G, Cantey JB, Siberry GK. Randomized controlled trial of cephalexin versus clindamycin for uncomplicated pediatric skin infections. Pediatrics. 2011 Mar;127(3):e573-80. doi: 10.1542/peds.2010-2053. Epub 2011 Feb 21. PMID: 21339275; PMCID: PMC3387913.
- Gottlieb M, DeMott JM, Hallock M, Peksa GD. Systemic Antibiotics for the Treatment of Skin and Soft Tissue Abscesses: A Systematic Review and Meta-Analysis. Ann Emerg Med. 2019 Jan;73(1):8-16. doi: 10.1016/j.annemergmed.2018.02.011. Epub 2018 Mar 9. PMID: 29530658.

Bibliography:

https://www.chop.edu/clinical-pathway/urinary-tract-infection-uti-febrile-clinical-pathway

M Michael 1, E M Hodson, J C Craig, S Martin, V A Moyer, Short versus standard duration oral antibiotic therapy for acute urinary tract infection in children, Cochrane Database Syst Rev. 2003;(1):CD003966. doi: 10.1002/14651858.CD003966.

https://www.seattlechildrens.org/globalassets/documents/clinics/urology/algorithm-uti.pdf

Beus et al, Cephalexin for Outpatient Urinary Tract Infections in Children, *Open Forum Infectious Diseases*, Volume 2, Issue suppl_1, December 2015, 1572, https://doi.org/10.1093/ofid/ofv133.1124

https://www.nice.org.uk/guidance/ng109

https://clinicaltrials.gov/ct2/show/study/NCT01595529

Shaikh N, Hoberman A, Keren R, et al. Recurrent Urinary Tract Infections in Children With Bladder and Bowel Dysfunction. Pediatrics. 2016;137(1).

National Collaborating Centre for Women's and Children's Health. Urinary tract infection in children: diagnosis, treatment and long-term management. London, UK: National Institute for Health and Clinical Excellence;2007.

Shaikh N, Mattoo TK, Keren R, et al. Early Antibiotic Treatment for Pediatric Febrile Urinary Tract Infection and Renal Scarring. JAMA Pediatr. 2016;170(9):848-854.

Roberts KB, Subcommittee on Urinary Tract Infection, Steering Committee on Quality Improvement and Management. Urinary Tract Infection: Clinical Practice Guideline for the Diagnosis and Management of the Initial UTI in Febrile Infants and Children 2 to 24 Months. Pediatrics. 2011;128(3):595-610.

Shaikh N, Morone NE, Lopez J, et al. Does this child have a urinary tract infection? JAMA. 2007;298(24):2895-2904.

Montini G, Tullus K, Hewitt I. Febrile urinary tract infections in children. N Engl J Med. 2011;365(3):239-250.

Elaine, Vaz et al. Recent Trends in Outpatient Antibiotic Use in Children, Pediatrics. 2014 Mar; 133(3): 375–385.

Watson et al, Urinary Tract Infection and Antimicrobial Stewardship in the Emergency Department. Pediatr Emerg Care 2018 Feb;34(2):93-95.

https://www.cdc.gov/drugresistance/solutions-initiative/

https://www.seattlechildrens.org/globalassets/documents/healthcare-professionals/clinical-standard-work/urinary-tract-infection-uti-pathway.pdf

Saha et al. Urine Culture Follow-up and Antimicrobial Stewardship in a Pediatric Urgent Care Network. PEDIATRICS (ISSN Numbers: Print, 0031-4005;