Kansas
Department of Health and Environment

ANTIMICROBIAL STEWARDSHIP PROGRAMS

Antimicrobial Stewardship Programs a Toolkit for Dental Clinics in Kansas

March 2023

Healthcare-Associated Infections & Antimicrobial Resistance Program

Kansas Department of Health and Environment
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Kansas Department of Health and Environment

Acknowledgements

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A special thanks to Snehal Gaikwad, DDS, MPH; Dr. Maria Adjemian, DDS, PhD; and Phillip Schindler, BS for their work in creation of this toolkit in collaboration with the KDHE HAI/AR Section and the KS HAI/AR Advisory Group.

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Executive Summary

The purpose of this antimicrobial stewardship program development and start-up workbook is to provide dental practitioners and clinics with the tools and guidance needed to develop and implement practical stewardship programs tailored to their unique population and needs. Antibiotic stewardship aims to ensure antibiotics are prescribed appropriately and is critical in reducing the emergence of antibiotic-resistant pathogens, reducing adverse events, and improving patient safety and outcomes.

The Kansas Department of Health and Environment's Healthcare-Associated Infections and Antimicrobial Resistance Program, along with our partner organizations involved in the Kansas Healthcare-Associated Infections and Antimicrobial Resistance Advisory Group, strive to assist Kansas health care facilities of all types in developing their own stewardship programs. To help Kansas clinics and hospitals achieve these goals, we have joined with our dental colleagues to develop a dental stewardship toolkit to assist facilities in jump-starting stewardship activities. In the following toolkit you will find downloadable antibiotic utilization spreadsheets, downloadable dental-specific educational tools including presentations, customizable clinic posters, editable policies, clinic antibiotic guidelines, prophylaxis decision guides and more.

Thank you for reading and for using these materials in helping us to improve health care and dental care in Kansas!

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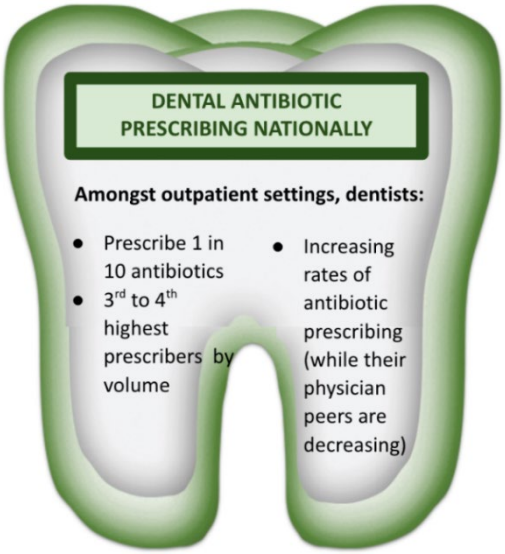
Introduction

Much of the antibiotic stewardship (AS) efforts over the past few decades have been directed towards acute care hospitals, yet up to ninety percent of antibiotics are prescribed in the outpatient setting accounting for fifty-five percent of national antibiotic expenditures.[1,2] It is estimated 30-50% of outpatient antibiotics are likely unnecessary and up to eighty-five percent of dental antibiotic prescriptions are "suboptimal" or not indicated.[4-6]



Recognizing this discrepancy, the Centers for Disease and Control (CDC) released the Core Elements of Outpatient Antibiotic Stewardship November 2016, as a framework to guide outpatient health care facilities in developing stewardship programs.[9] The American Dental Association (ADA) participated in the White House Forum on Antibiotic Stewardship endorsing this as a priority dental endeavor, and professional dental societies including the Organization for Safety, Asepsis, and Prevention, and the International College of Dentists have deemed stewardship a priority.

One in 10 antibiotics in the outpatient setting is prescribed by a dentist, accounting for the third to fourth highest antibiotic prescribers by volume (following family medicine and internal medicine).[3,6] A Journal of American Dental Association study found that while physician antibiotic prescribing decreased eighteen percent from 1996 to 2013, over this same period dentists increased by sixty-two percent (defined daily doses per 1,000 inhabitants per day [DID] amongst dentists increased from 0.98 DID to 1.59 DID vs physicians decreased 17.25 DID to 14.11 DID).[8]

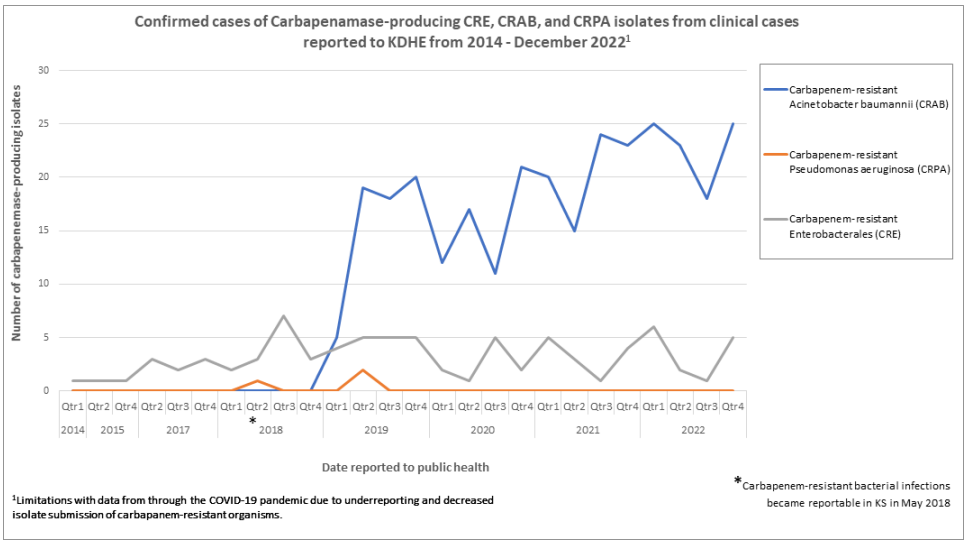
Top 10 Antibiotic Prescribing Provider Specialties in the US (2015)
Ranked by Count of Prescriptions

Rank	Specialty	No. of Prescribers	Percent of Total Prescribers	Count of Rxs*	Percent of Total Rxs	No. of Patients	Rxs Per Prescriber*
1	Family Medicine	96,754	11.16%	5,864,247	26.30%	3,727,615	60.61
2	Internal Medicine	153,893	17.75%	4,202,961	18.85%	2,397,039	27.31
3	Dentist	155,462	17.93%	2,937,494	13.17%	2,085,777	18.90
4	Pediatrics	53,269	6.14%	2,337,232	10.48%	1,415,760	43.88
5	Emergency Medicine	42,698	4.93%	1,309,737	5.87%	1,081,099	30.67
6	Dermatology	10,822	1.25%	724,701	3.25%	322,883	66.97
7	Obstetrics & Gynecology	33,945	3.92%	703,454	3.15%	482,140	20.72
8	Urology	9,210	1.06%	596,529	2.68%	299,768	64.77
9	Otolaryngology	9,146	1.06%	409,820	1.84%	283,154	44.81
10	Surgery	23,842	2.75%	240,370	1.08%	162,968	10.08

Number of antibiotic prescriptions in Express scripts database, 38,988,099 prescriptions examined.
Source: *Durkin M., et al. Journal American Dental Association. 2017;148(12): pp 878-86.*

What is Antibiotic Resistance and Why Does It Matter to Dentists?

Dr. Alexander Fleming's discovery of penicillin in 1928 marked one of the most important milestones in modern medical history. Many of the infections we think of today as relatively benign (e.g., skin and soft tissue infections, pneumonia) were a century ago the leading causes of death.[10] However, Dr. Fleming noted bacteria became resistant to penicillin shortly after use, prompting him to warn "the public will demand [the drug and] then begin an era of abuses".[11] We indeed now find ourselves returning to the pre-antibiotic era. Across Kansas pan-resistant bacteria (i.e., resistance to all commercially available antibiotics) are increasingly frequent occurrences – while just a decade ago these types of infection were virtually nonexistent, in some areas have become endemic.



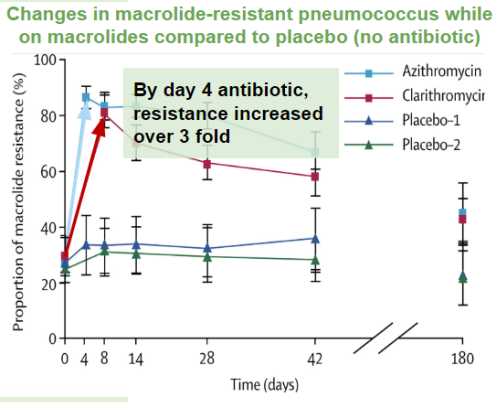
Antibiotic Resistance: Use it AND lose it?

Antibiotic resistance (AR) occurs when bacteria, fungi or viruses resist the effects of drugs meant to stop its function or kill it. AR happens rapidly. In one study, while on macrolide antibiotics (azithromycin or clarithromycin), within four days, there was a 3-fold increase in macrolide-resistant *Streptococcus pneumoniae* swabbed from patient's throats compared to those not exposed to macrolide antibiotics.[12]

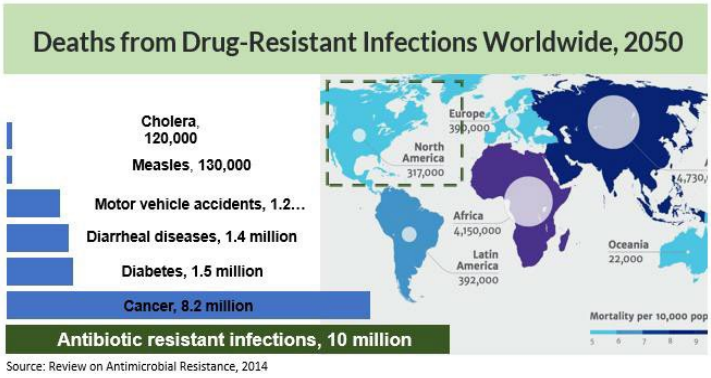
And the shorter the course the better: in another study, when shorter high-dosed amoxicillin courses were used compared to standard longer coursed amoxicillin regimens, nasopharyngeal penicillin-resistant *S.pneumoniae* carriage decreased from 32 percent (long-coursed) to 24 percent (short-coursed).[13]

Most people harboring resistant pathogens are asymptomatic, in which no signs or symptoms of infection are exhibited at all. However, when an infection does develop treatment is more complex, more expensive, and often associated with greater morbidity and mortality.

For more information go to the CDC Antibiotic Resistance Site.



THE SCOPE OF THE PROBLEM



Source: Review on Antimicrobial Resistance, 2014

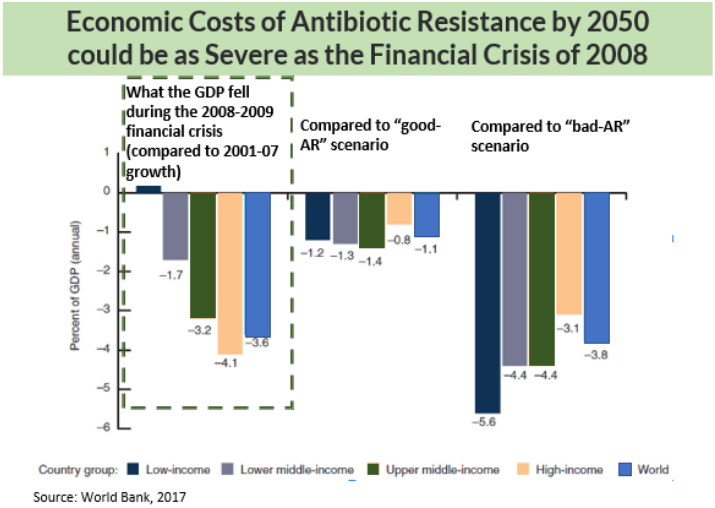
The World Health Organization deems AR as one of the **three most significant threats** to human health in the coming decade.[10] Over 700,000 people die worldwide every year from multidrug-resistant organisms (MDROs), and by 2050 AR is projected to contribute to 10 million deaths annually – surpassing diabetes, heart disease, and even cancer as the leading cause of death.

These resistant infections come at a projected cumulative global cost of $100 trillion – potentially amounting to a 2008 global financial crisis *every year*.[10,14]

CDC's *Antibiotic Resistance Threats in the United States 2019* report indicates 2.8 million people are infected with resistant bacterial and fungal infections every year in the U.S., contributing to 35,900 deaths annually.[15] Nearly a third of these deaths are from *Clostridioides difficile* (*C. diff*). Antibiotics are identified as the single most significant risk factor for *C. diff* infections.[16-17]

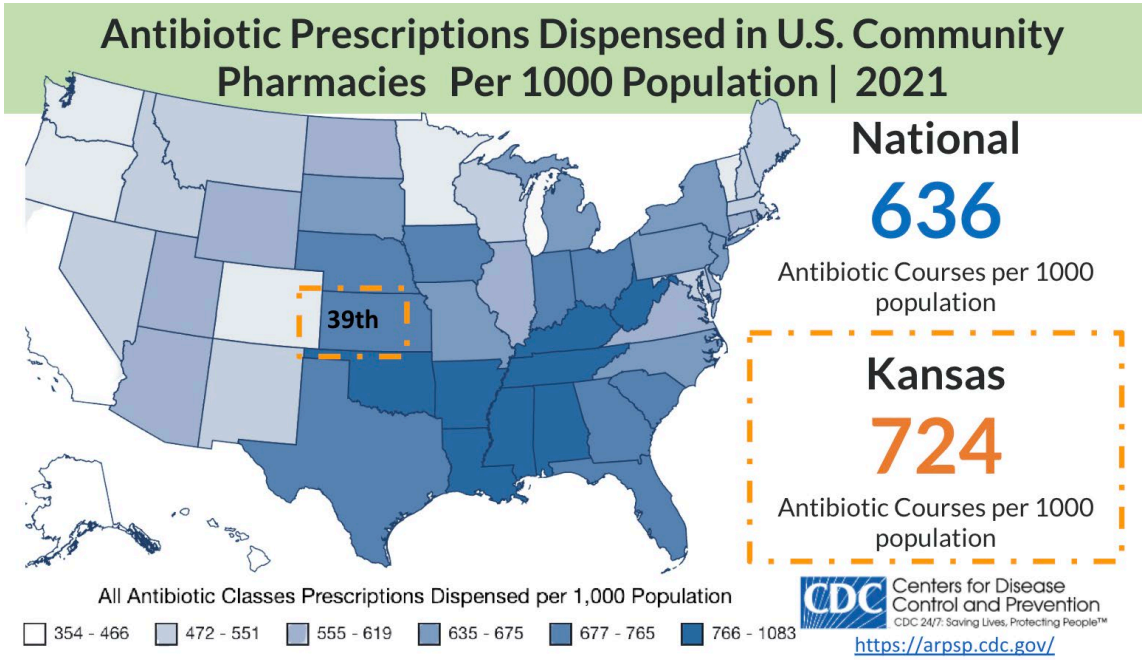
While dentists may have limited opportunity to observe the potential negative side effects from antibiotic use, significant adverse events do occur. A study of Minnesotans having developed *C. diff* infections, found that fifteen percent of those patients had taken antibiotics for a dental procedure (most commonly clindamycin).[18]

DRIVERS OF ANTIMICROBIAL RESISTANCE



Source: World Bank, 2017

Over-prescribing is an issue globally, nationally, and locally. Kansas is consistently ranked as one of the worst prescribing states (9th in 2018, 10th in 2020, and improved to 11th in 2021), highlighting the need for all of us to improve antibiotic use in order to improve the health of our patients and of our state.[24]



CORE ELEMENTS OF A DENTAL CLINIC ANTIBIOTIC STEWARDSHIP PROGRAM

A set of four core elements is recommended by CDC when developing and implementing effective antibiotic stewardship program (ASP) in outpatient settings: commitment, actions to improve AU, tracking and monitoring of antibiotics, and education.[9] This toolkit follows CDC's *The Core Elements of Outpatient Antibiotic Stewardship Programs*, adapting the core elements to Kansas dental clinic specific needs, as well as providing helpful links and tools to better aid clinics in the development and implementation of effective ASPs.

1. Commitment

For an ASP to become successful and established, stewardship efforts *must* be supported and endorsed by clinic leaders (i.e., owners, administrators, clinic managers, dentists, and dental hygienist leaders). Every person involved in patient care can, and should, act as an antibiotic steward.[9]

Commitment can be exhibited by resource allocation to the ASP by way of financial support, personnel, or time.

The 4 Core Elements of Outpatient Antibiotic Stewardship Programs

Source: CDC https://www.cdc.gov/antibiotic-use/core-elements/outpatient.html

Incorporation of stewardship practices into job criteria shows employees that clinic leadership is committed to improve AU and ensures a dentist continues to champion stewardship activities. Posting written statements of support to improving clinic antibiotic prescribing not only demonstrates a commitment to patients but also nudges providers to improve their prescribing habits.[9,22]

Priority examples of leadership commitment include:

- Designate a dentist as the ASP leader or ASP "champion"
- Develop and issue formal statements of commitment to stewardship
- Display a customizable commitment poster
- Include the statement of ASP commitment in annual reports

Other examples of leadership commitment may include:

- Set ASP expectations (e.g., include in contracts or job description upon hire regarding responsibilities, outcomes)
- Director participates in ASP practices and policies
- Allocate stewardship educational time and resources to dentists, staff, and patients
- Include AS in provider education and annual competencies
- Educate all staff on how to manage patient expectations regarding inappropriate antibiotic requests
- Create a culture around appropriate antibiotic utilization by disseminating frequent messages, newsletters, educational opportunities, and celebrating the achievements of ASP activities and goals

Download the presentation here

Download, Customize, Sign and Post Your Clinic's Commitment

A randomized controlled trial in outpatient settings found that when providers signed a poster committing to improving antibiotic use, there was a twenty percent reduction in Inappropriate antibiotics within just two months.[25]

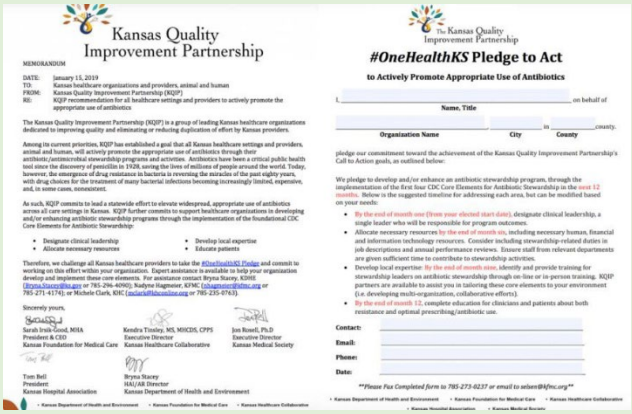
Download poster here

Clinic Antibiotic Stewardship Pledges, Mission Statements, and Commitments

Pledges can be posted onto social media sites, websites, posted publicly in waiting rooms, computer screens, pre-appointment texts (e.g., patients with frequent dental pain visits).

Example clinic pledge:
"Dentists at the Smile a Mile Dental Clinic pledge to be a steward of antibiotics by optimizing antibiotic prescribing for all patients, all dental conditions, all procedures, all the time"

Kansas Quality Improvement Partnership Pledge


Kansas Quality Improvement Partnership

MEMORANDUM

DATE: January 15, 2019
TO: Kansas healthcare organizations and providers, animal and human
FROM: Kansas Quality Improvement Partnership (KQIP)
RE: KQIP recommendation for all healthcare settings and providers to actively promote the appropriate use of antibiotics

The Kansas Quality Improvement Partnership (KQIP) is a group of leading Kansas healthcare organizations dedicated to improving quality and eliminating or reducing duplication of effort by Kansas providers.

Among its current priorities, KQIP has established a goal that all Kansas healthcare settings and providers, animal and human, will actively promote the appropriate use of antibiotics through their antibiotic/antimicrobial stewardship programs and activities. Antibiotics have been a critical public health tool since the discovery of penicillin in 1928, saving the lives of millions of people around the world. Today, however, the emergence of drug resistance in bacteria is reversing the miracles of the past eighty years, with drug choices for the treatment of many bacterial infections becoming increasingly limited, expensive, and, in some cases, nonexistent.

As such, KQIP commits to lead a statewide effort to elevate widespread, appropriate use of antibiotics across all care settings in Kansas. KQIP further commits to support healthcare organizations in developing and/or enhancing antibiotic stewardship programs through the implementation of the foundational CDC Core Elements for Antibiotic Stewardship:

- Designate clinical leadership
- Develop local expertise
- Allocate necessary resources
- Educate patients

Therefore, we challenge all Kansas healthcare providers to take the #OneHealthKS Pledge and commit to working on this effort within your organization. Expert assistance is available to help your organization develop and implement these core elements. For assistance contact Bryna Stacey, KDHE (Bryna.Stacey@ks.gov or 785-296-4090); Nadyne Hagmeier, KFMC (nhagmeier@kfmc.org or 785-271-4174), or Michele Clark, KHC (mclark@khconline.org or 785-235-8763).

Sincerely yours,

Sarah Irvin Good, MHA
President & CEO
Kansas Foundation for Medical Care

Kendra Tinsley, MS, MHCDS, CPPS
Executive Director
Kansas Healthcare Collaborative

Jon Rosell, Ph.D
Executive Director
Kansas Medical Society

Tom Bell
President
Kansas Hospital Association

Bryna Stacey
HAI/AR Director
Kansas Department of Health and Environment

The Kansas Quality Improvement Partnership

#OneHealthKS Pledge to Act

to Actively Promote Appropriate Use of Antibiotics

I, _____ on behalf of
Name, Title
_____ in _____ county.
Organization Name City County

pledge our commitment toward the achievement of the Kansas Quality Improvement Partnership's Call to Action goals, as outlined below:

We pledge to develop and/or enhance an antibiotic stewardship program, through the implementation of the first four CDC Core Elements for Antibiotic Stewardship in the next 12 months. Below is the suggested timeline for addressing each area, but can be modified based on your needs:

- By the end of month one (from your elected start date), designate clinical leadership, a single leader who will be responsible for program outcomes.
- Allocate necessary resources by the end of month six, including necessary human, financial and information technology resources. Consider including stewardship-related duties in job descriptions and annual performance reviews. Ensure staff from relevant departments are given sufficient time to contribute to stewardship activities.
- Develop local expertise: By the end of month nine, identify and provide training for stewardship leaders on antibiotic stewardship through on-line or in-person training. KQIP partners are available to assist you in tailoring these core elements to your environment (i.e. developing multi-organization, collaborative efforts).
- By the end of month 12, complete education for clinicians and patients about both resistance and optimal prescribing/antibiotic use.

Contact: _____
Email: _____
Phone: _____
Date: _____

Please Fax Completed form to 785-273-0237 or email to sebers@kfmc.org

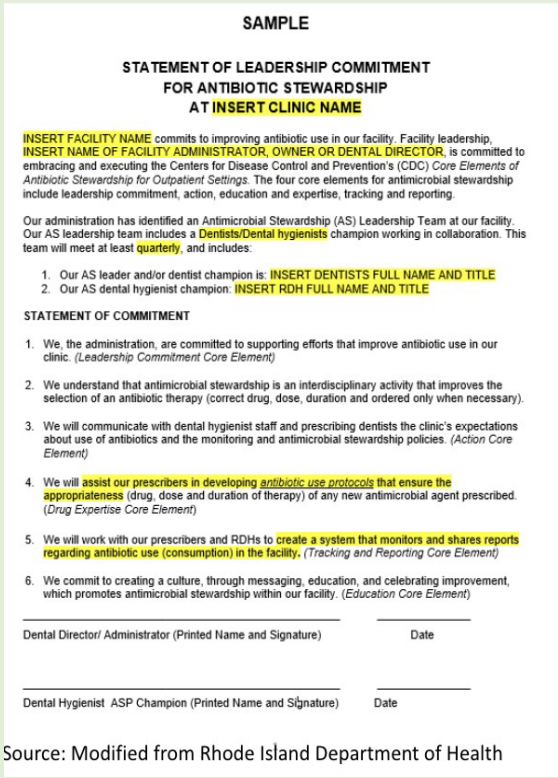
Kansas Department of Health and Environment • Kansas Foundation for Medical Care • Kansas Healthcare Collaborative
Kansas Hospital Association • Kansas Medical Society

[Kansas Quality Improvement Partnership Pledge]

Mission and vision statements can be incorporated into clinic antibiotic stewardship policies, annual reports to stakeholders, added to websites, letterheads, or when giving interviews. Although clinics know why they are trying to improve AU, it's easy to lose sight of this when dealing with the day-to-day organizational hassles. Your vision and mission statements remind staff why stewardship is important.

Example clinic mission statement:
"The Smile a Mile Dental Clinic strives to achieve the best possible antibiotic use by ensuring the optimal selection, dose, and duration of antibiotics for treatment or prevention while minimizing the impact of possible side effects and antibiotic resistance"

Formal Statement of Commitment


SAMPLE

STATEMENT OF LEADERSHIP COMMITMENT FOR ANTIBIOTIC STEWARDSHIP AT INSERT CLINIC NAME

INSERT FACILITY NAME commits to improving antibiotic use in our facility. Facility leadership, INSERT NAME OF FACILITY ADMINISTRATOR, OWNER OR DENTAL DIRECTOR, is committed to embracing and executing the Centers for Disease Control and Prevention's (CDC) *Core Elements of Antibiotic Stewardship for Outpatient Settings*. The four core elements for antimicrobial stewardship include leadership commitment, action, education and expertise, tracking and reporting.

Our administration has identified an Antimicrobial Stewardship (AS) Leadership Team at our facility. Our AS leadership team includes a Dentists/Dental hygienists champion working in collaboration. This team will meet at least quarterly, and includes:

1. Our AS leader and/or dentist champion is: INSERT DENTISTS FULL NAME AND TITLE
2. Our AS dental hygienist champion: INSERT RDH FULL NAME AND TITLE

STATEMENT OF COMMITMENT

1. We, the administration, are committed to supporting efforts that improve antibiotic use in our clinic. *(Leadership Commitment Core Element)*
2. We understand that antimicrobial stewardship is an interdisciplinary activity that improves the selection of an antibiotic therapy (correct drug, dose, duration and ordered only when necessary).
3. We will communicate with dental hygienist staff and prescribing dentists the clinic's expectations about use of antibiotics and the monitoring and antimicrobial stewardship policies. *(Action Core Element)*
4. We will assist our prescribers in developing *antibiotic use protocols* that ensure the appropriateness (drug, dose and duration of therapy) of any new antimicrobial agent prescribed. (*Drug Expertise Core Element*)
5. We will work with our prescribers and RDHs to create a system that monitors and shares reports regarding antibiotic use (consumption) in the facility. *(Tracking and Reporting Core Element)*
6. We commit to creating a culture, through messaging, education, and celebrating improvement, which promotes antimicrobial stewardship within our facility. (*Education Core Element*)

_____ _____
Dental Director/ Administrator (Printed Name and Signature) Date

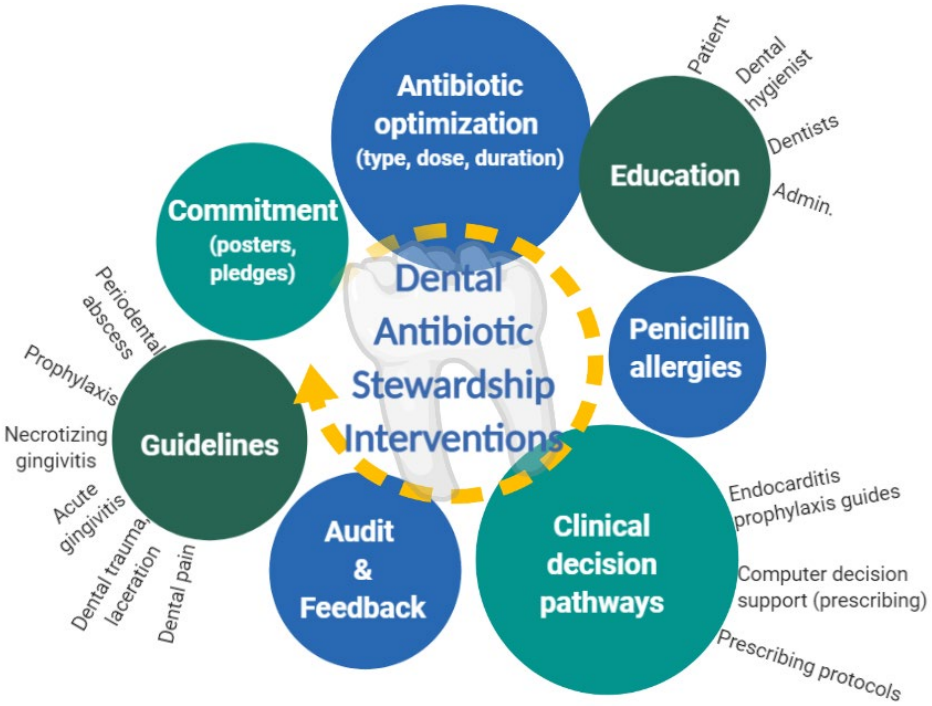
_____ _____
Dental Hygienist ASP Champion (Printed Name and Signature) Date

Source: Modified from Rhode Island Department of Health

Download policy here

2. Action for Policy and Practice

There is no “one size fits all” stewardship strategy or policy to improve antibiotic prescribing. Stewardship programs should tailor activities to their clinic, providers, and patient’s needs.



Optimizing antibiotic prophylaxis prescribing and conditions in which antibiotics generally are not indicated are two of the highest yield targets most clinics could start with. Communication skills training is another intervention most dentists and hygienists can benefit from. Enhancing patient-clinician communication and helping to learn how to address patient concerns, attitudes, and beliefs lead to better care in general, not just regarding antibiotic use.

Develop clinic guidelines and treatment recommendations

As there are no national guidelines for specific dental infections, prescribers determine independently when antibiotics are indicated. Subsequently, wide variations exist in antibiotic prescribing by condition, antibiotic, dosing, and duration.

Example of a Clinic Antibiotic Prescribing Protocol	
Pre-prescription Considerations Prescribe only if:	Post-prescription Considerations Prescribe/adjust:
☐ Bacterial infection presents with signs / symptoms of spread (fever, malaise, swelling) ☐ Review allergies and medical history (drug-drug interactions, *C. diff*, immunosuppressed or pregnancy status) ☐ Document diagnosis, treatment steps, and antibiotic rationale ☐ Use most narrow-spectrum antibiotic for the shortest possible duration (2-3 days after clinical signs/symptoms subside)	☐ For empirical regimens, revise antibiotic regimens on basis of patient progress, if not improving consider culture ☐ Consider conversing with referring specialists about their own antibiotic prescribing practices and protocols ☐ Educate patients ☐ Take antibiotic exactly as prescribed ☐ Take antibiotics only prescribed for them ☐ Do not save antibiotics for future illness
Avoid prescribing if:	
☐ Localized oral infection ☐ Localized gingival infection ☐ Viral or fungal infection ☐ Trauma ulcer or aphthae ☐ Patient demands or expectations ☐ Clinician time pressures or pressures from other health care professionals	
Adapted from Fluent M. et al., JADA 2016;147(8):683-86; Endodontics Colleagues for Excellence, Use and Abuse of Antibiotics.	

Decision-Support Tools

Up to ninety-two percent of dental prophylaxis antibiotics were the wrong antibiotic, dose, or duration.[26] We have created a prophylaxis decision script pad to assist in determining who should receive prophylaxis, and which antibiotic is preferred.

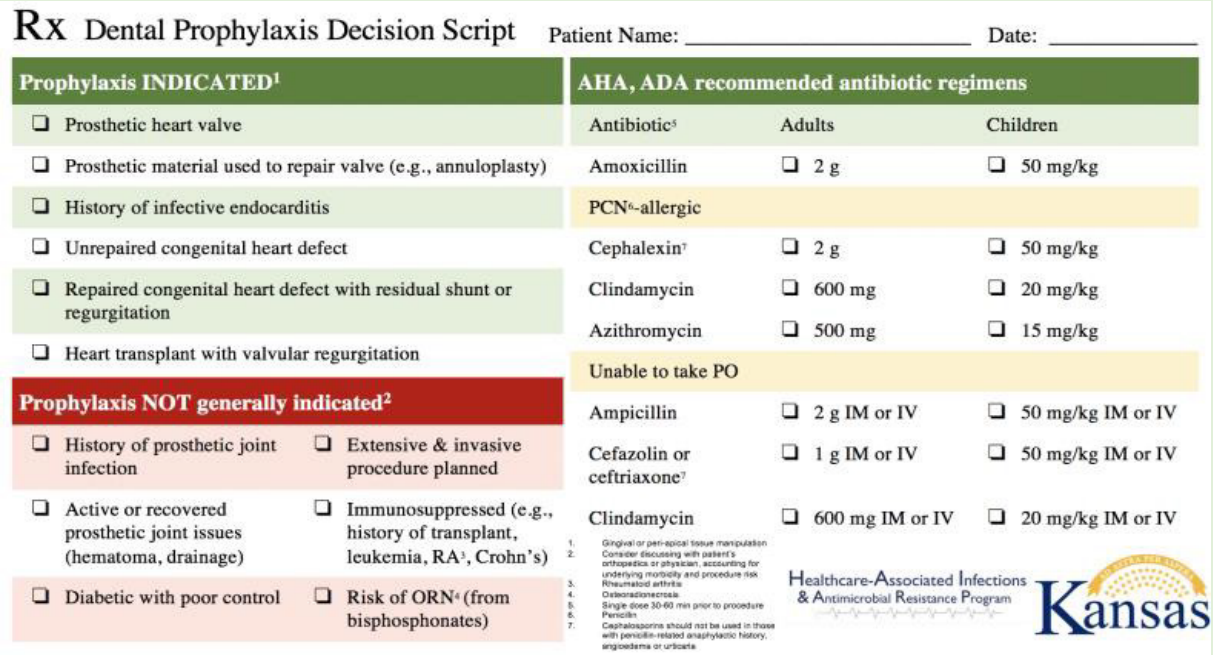
Similar script pads for viral upper respiratory infections (URIs) were deemed very helpful by clinicians in convincing patients why antibiotics were not indicated and seventy-six percent of patients reported written and verbal instructions, such as these scripts for URI management, were preferred.[28]

Treatment Guidelines

Until ADA endorses specific treatment guidelines, dentists must continue to rely on judgement calls.[25] Consider developing clinic treatment guidance for the most common conditions encountered necessitating (or possibly necessitating) antibiotics. We have summarized the American Academy of Pediatric Dentistry (AAPD) recommendations, ADA guidelines for urgent management of oral pain and swelling into example guidelines which could be disseminated and implemented in your clinic.

Clinical Decision Support Tools

Download & Print Prophylaxis Script Pads



Rx Dental Prophylaxis Decision Script Patient Name: _____ Date: _____

Prophylaxis INDICATED[1]

- ❑ Prosthetic heart valve
- ❑ Prosthetic material used to repair valve (e.g., annuloplasty)
- ❑ History of infective endocarditis
- ❑ Unrepaired congenital heart defect
- ❑ Repaired congenital heart defect with residual shunt or regurgitation
- ❑ Heart transplant with valvular regurgitation

Prophylaxis NOT generally indicated[2]

- ❑ History of prosthetic joint infection
- ❑ Extensive & invasive procedure planned
- ❑ Active or recovered prosthetic joint issues (hematoma, drainage)
- ❑ Immunosuppressed (e.g., history of transplant, leukemia, RA[3], Crohn's)
- ❑ Diabetic with poor control
- ❑ Risk of ORN[4] (from bisphosphonates)

AHA, ADA recommended antibiotic regimens

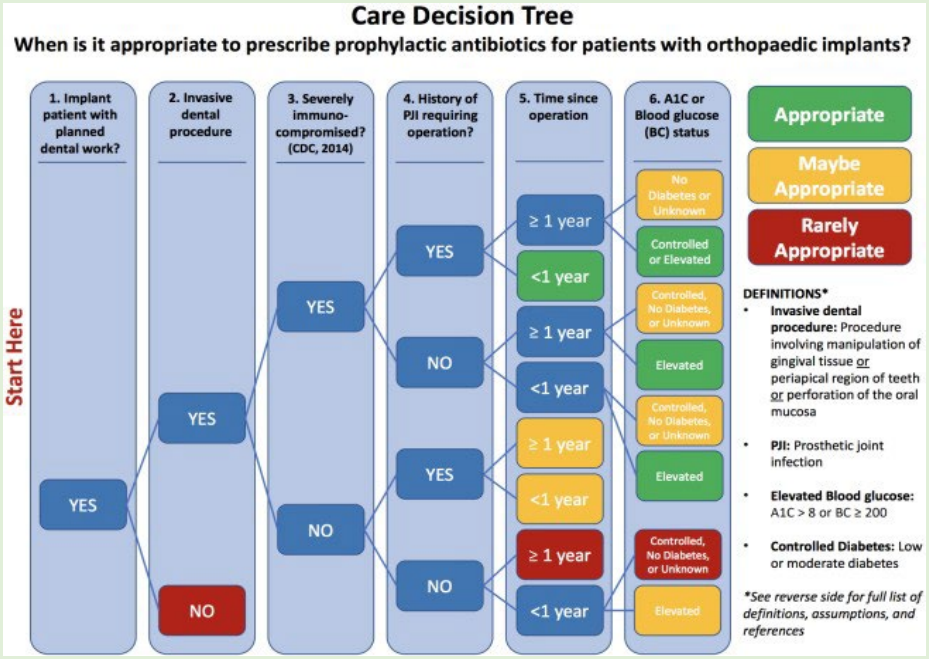
Antibiotic[5]	Adults	Children
Amoxicillin	❑ 2 g	❑ 50 mg/kg
PCN[6]-allergic		
Cephalexin[7]	❑ 2 g	❑ 50 mg/kg
Clindamycin	❑ 600 mg	❑ 20 mg/kg
Azithromycin	❑ 500 mg	❑ 15 mg/kg
Unable to take PO		
Ampicillin	❑ 2 g IM or IV	❑ 50 mg/kg IM or IV
Cefazolin or ceftriaxone[7]	❑ 1 g IM or IV	❑ 50 mg/kg IM or IV
Clindamycin	❑ 600 mg IM or IV	❑ 20 mg/kg IM or IV

1. Gingival or peri-apical tissue manipulation
2. Consider discussing with patient's orthopedics or physician, accounting for underlying morbidity and procedure risk
3. Rheumatoid arthritis
4. Osteoradionecrosis
5. Single dose 30-60 min prior to procedure
6. Penicillin
7. Cephalosporins should not be used in those with penicillin-related anaphylactic history, angioedema or urticaria

Healthcare-Associated Infections & Antimicrobial Resistance Program — Kansas

Script pads can be printed on 4"x6" notepads and used to educate patients on why antibiotics may be unnecessary for them.

Download decision tool here



ADA and American Academy of Orthopedic Surgeons (AAOS) jointly developed guide to assist in determining if patients with prosthesis are candidates for prophylaxis. Access the guide here.

Table 1

Antibiotic Guidelines

Diagnosis		Pediatric	Adult
Trauma & Lacerations	**Laceration** (full-thickness mucosal or through-and-through injury)	No antibiotics found to offer conclusive benefit, may consider similar regimen as adults, if deemed severe, high risk morbidity, or immunosuppressed	☑ PCN VK 500 QID mg x 5 days ☑ Amoxicillin 500 mg TID x 5 days
		PCN-allergic	
			☑ Clindamycin 300-450 mg TID x 5 days ☑ Cephalexin 250-500 mg TID -QID[2-4] +/- + metronidazole 500 TID[5] x 5 days
		☑ Consider saltwater rinse or 0.12% chlorohexidine gluconate[9] topically (cotton swab or swish/spit) BID x 7 days ☑ Lingual edema can be controlled with cold (e.g., ice chips, popsicles) ☑ If deep laceration ensure tetanus vaccination up to date (i.e., within past 5 years)	
	Laceration (foreign body, debris or gravel, dirty wounds, open fracture)	☑ PCN VK 25-50 mg/kg/d (divided doses q6h) x 5 days ☑ Amoxicillin 25-50 mg/kg/d (divided doses q8h)[1]	☑ PCN VK 500 QID mg x 5 days ☑ Amoxicillin 500 mg TID x 5 days
		PCN-allergic	
		☑ Cephalexin 25-50 mg/kg/day (divide doses TID-QID)[2,4] + metronidazole 50 mg/kg[5] (divide TID) x 5 days ☑ Clindamycin 20 mg/kg/day (divide doses TID) x 5 days[6]	☑ Cephalexin 250-500 mg TID-QID [2-4] + metronidazole 500 TID[5] x 5 days ☑ Clindamycin 300-450 mg TID x 5 days
		☑ Ensure tetanus vaccination up to date (i.e., within past 5 years) ☑ Consider saltwater rinse or 0.12% chlorohexidine gluconate[9] topically (cotton swab or swish/spit) BID x 7 days ☑ Lingual edema can be controlled with cold (e.g., ice chips, popsicles)	
	Dental trauma (avulsed permanent incisors with open or closed apex)	Depending on exam, consider: ☑ Kids >12: Doxycycline 4.4 mg/kg/d (divided BID) x 7 days ☑ Kids <12: PCN VK 25-50 mg/kg/d (divided doses q6h) x 7 days	No antibiotics found to offer conclusive benefit, may consider similar regimen as peds if deemed severe, high risk trauma or immunosuppressed
		☑ Rinse with 0.12% chlorohexidine gluconate[9] BID x 7 days ☑ Brush teeth with soft toothbrush after meals	

Find complete guidelines in Appendix, Tables 1-4 or download here

Table 2

Antibiotic Guidelines

Diagnosis		Pediatric	Adult
Pulpal and Periapical Conditions	**Pulpitis** (+/- periodontitis, irreversible pulpitis, apical abscess, ***without*** systemic symptoms or localized swelling)	No antibiotics	No antibiotics
	Pulpitis (pulp necrosis and symptomatic apical periodontitis)	No antibiotics	No antibiotics
		☑ If awaiting definitive treatment, may consider delayed antibiotic prescription (as below for pulpitis + systemic symptoms/swelling), instructing to fill script 24-48h after visit if symptoms worsen ☑ If immunocompromised may consider treatment below for pulpitis + systemic symptoms/swelling)	
	Pulpitis (***with*** systemic symptoms or localized swelling)	☑ PCN VK 25-50 mg/kg/d (div. doses q6h) x 5 days ☑ Amoxicillin 25-50 mg/kg/d (div. doses q8h)[1]	☑ PCN VK 500 QID mg x 3-5 days ☑ Amoxicillin 500 mg TID x 3-5 days
		PCN-allergic	
		☑ Clindamycin 20 mg/kg/day (div. doses TID) x 3-5 days[6] ☑ Cephalexin 25-50 mg/kg/day (div. doses TID-QID)[2,4] + metronidazole 50 mg/kg[5] (div. TID) x 3-5 days	☑ Clindamycin 300-450 mg TID x 3-5 days ☑ Cephalexin 250-500 mg TID -QID[2-4] +/- metronidazole 500 TID[5] x 3-5 days
		Instruct patients to discontinue antibiotics 24h after symptoms resolve, irrespective of reevaluation after 3 days	
	Pulpitis (with systemic symptoms, swelling, worsening)	If failing to improve after 3 days of above antibiotics, re-examine, re-emphasize definitive dental treatment, if drainage or aspirate send for culture, and adjust antibiotics:	
		☑ Amoxicillin/clavulanate 25 mg (amox)/kg/day[8] (div. BID) x 5-7 days	☑ Amoxicillin/clavulanate 500/125 – 875/125[7] BID x 5-7 days

Table 3

Antibiotic Guidelines

Diagnosis		Pediatric	Adult
Gingival Conditions	**Acute gingivitis** (non-complicated)	None	None
		☑ Rinse with 0.12% chlorohexidine gluconate[9] BID x 1 month ☑ Lingual edema may be improved with cold (e.g., ice chips, popsicles)	
	Acute gingivitis (rapidly progressive, immunosuppressed, severe pain)	☑ PCN VK 25-50 mg/kg/d (div. doses QID) + metronidazole 50 mg/kg[5] (div. BID-TID) x 3-5 days ☑ Amoxicillin 25-50 mg/kg/d (div. TID)[1] + metronidazole 50 mg/kg[5] (div. BID-TID) x 3-5 days ☑ Amoxicillin/clavulanate 25 mg (amox)/kg/day[8] (div. BID) x 3-5 days	☑ PCN VK 500 QID mg +/- metronidazole 500 TID[5] x 3-5 days ☑ Amoxicillin 500 mg TID +/- metronidazole 500 TID[5] x 3-5 days ☑ Amoxicillin/clavulanate 500/125 – 875/125[7] BID x 3-5 days
		PCN-allergic	
		☑ Clindamycin 20 mg/kg/day (div. doses TID) x 3-5 days[6] ☑ Kids >12: Doxycycline 4.4 mg/kg/d (divided BID) + metronidazole 50 mg/kg[5] (div. BID-TID) x 3-5 days	☑ Clindamycin 300-450 mg TID x 3-5 day ☑ Cephalexin 250-500 mg TID -QID[2-4] +/- metronidazole 500 TID[5] x 3-5 days
		☑ Rinse with 0.12% chlorohexidine gluconate[9] BID x 1 month ☑ Lingual edema may be improved with cold (e.g., ice chips, popsicles)	
	Acute necrotizing ulcerative gingivitis (i.e., fusospirochetosis, trench mouth, Vincent's angina)	No antibiotics	No antibiotics
		☑ Rinse hourly with warm normal saline or salt rinses ☑ Rinse with 0.12% chlorohexidine BID[9] (especially post debridement) ☑ Brush teeth with soft toothbrush	
		If severe, debridement delayed, or immunocompromised, consider antibiotics:	
		☑ PCN VK 25-50 mg/kg/d (div. doses QID) + metronidazole 50 mg/kg[5] (div. BID-TID) x 7 days ☑ Amoxicillin 25-50 mg/kg/d (div. TID)[1] + metronidazole 50 mg/kg[5] (div. BID-TID) x 7 days ☑ Amoxicillin/clavulanate 25 mg (amox)/kg/day[8] (div. BID) x 7 days	☑ PCN VK 500 QID mg +/- metronidazole 500 TID[5] x 7 days ☑ Amoxicillin 500 mg TID +/- metronidazole 500 TID[5] x 7 days ☑ Amoxicillin/clavulanate 500/125 – 875/125[7] BID x 7 days
		PCN-allergic	
		☑ Clindamycin 20 mg/kg/day (div. doses TID) x 7 days[6] ☑ Kids >12: Doxycycline 4.4 mg/kg/d (divided BID) + metronidazole 50 mg/kg[5] (div. BID-TID) x 7 days	☑ Clindamycin 300-450 mg TID x 3-5 day ☑ Cephalexin 250-500 mg TID -QID[2-4] +/- metronidazole 500 TID[5] x 7 days

1. Amoxicillin max dose 500 mg/dose
2. Cephalexin use only if not a PCN-associated anaphylaxis, urticaria, angioedema
3. Cephalexin adjusted in renal dysfunction (CrCl 30-59 max daily dose 1000 mg/d, CrCl 15-29 500 mg max/d, CrCl 5-14 250 mg/d and if on dialysis no renal adjustments
4. Cephalexin max dose 2,000 mg/day
5. Cephalexin activity not well described for **some** oral pathogens, low threshold to add metronidazole if gross infection, anaerobes, or delayed response to antibiotics
6. Clindamycin max 1800 mg per day in kids and adolescents
7. Amox/clavulanate renally adjusted if CrCl 10-30 to 250-500 BID, CrCl <10 or on dialysis 250-500 mg/day (administer antibiotic after dialysis)
8. Amox/clavulanate not to exceed 1,500 mg/day (if >40 kg not to exceed 2,000 mg daily)
9. Chlorohexidine oral rinses may help control dental plaque bacteria, but have no proven effect on caries, and prolonged application stains enamel and tongue, and prolonged use may promote emergency of resistance

Sources:
ADA. Clinical practice guidelines on antibiotic use for urgent management of pulpal and periapical dental pain and intraoral swelling. 2019.
AAPD. Use of antibiotic therapy for pediatric dental patients. Reference Manual of Pediatric Dentistry, 2019-2020.
AAP Red Book. 2018
UpToDate: overview and treatment of gingivitis, periodontitis, in adults. Oct 2019.

Table 4

Antibiotic Guidelines

Diagnosis		Adult
Implants	Prophylaxis[1-2]	Role of Antibiotics Unclear, unlikely of benefit
		❒ Chlorhexidine oral rinses post-op
		If history of recurrent infections, recent active dental infection, stage 2-4 periodontitis, immunocompromised, diabetic, or with risk of medication-related osteonecrosis of the jaw - may consider:
		❒ PCN VK 1-2 g (dose 1 hour prior to surgery) ❒ Amoxicillin 1 - 2 g (dose 1 hour prior to surgery)
		PCN-allergic
		❒ Clindamycin 900 mg (dose 1 hour prior to surgery)
	Peri-implantitis (in combination of detoxification of implant surface, regeneration of lost support)[3-4]	Role of antibiotics unclear
		❒ Chlorhexidine oral rinses x 5-7 days
		❒ PCN VK 500 mg QID + metronidazole 500 mg TID x 5-7 days ❒ Amoxicillin 500 mg QID + metronidazole 500 mg TID x 5-7 days ❒ Amoxicillin/clavulanate 500/125 – 875/125' BID x 5-7 days
		PCN-allergic
		❒ Clindamycin 300-450 mg TID x 5-7 days ❒ Cephalexin 250-500 mg TID -QID[2-4] + metronidazole 500 TID x 5-7 days

Sources:
1. Khouly I., et al. Clinical Oral Investigations; 2019;23:1525-53. This meta-analysis found no difference among 22 studies of **healthy** patients receiving prophylactic antibiotics (for total, early or late infections, nor for wound dehiscence or adverse events)
2. Kim A., et al. British Dental journal; 2020;228:943-951.
3. Renvert S. J Clin Periodontal. 2008;35(8 Suppl): 305-15.
4. Leonhardt A. J Periodontal 2003;74:1415-22.

Provider-based interventions

Education is essential to stewardship and is itself one of the core elements of all programs. Educational programs can provide a foundation of knowledge that will work to enhance and increase acceptance of stewardship initiatives; however, education alone is only marginally effective in changing prescribing practices and has not demonstrated sustained impacts.[45]

Case Study: University of Illinois School of Dentistry

The University of Illinois School of Dentistry in 2017 implemented a stewardship initiative targeting unnecessary antibiotic prescribing. By first examining the primary antibiotic prescriptions by the provider they were able to determine urgent care acute dentoalveolar conditions was an area of significant quality improvement potential. Guidelines and a clinical decision support tool for acute pain were developed and disseminated via email and posted in dental clinics. A 1 hour continuing education presentation was posted to the faculty development website and CDC tip sheets were placed throughout the school and clinic. In only 8 months antibiotic prescribing in urgent care clinics decreased by 73 percent, and clinicians reported more awareness of their prescribing habits.[41]

Penicillin Allergy

Assessing for penicillin allergy frequently opens opportunity for penicillin treatment, working to improve both stewardship and treatment outcomes. Avoidance of beta-lactam treatment in those with a "penicillin allergy" has significant impact on clinical outcomes. Those with penicillin allergies treated with non-beta-lactams have shown [33-34]

1. Higher treatment failure rates
2. Greater risk for *C. diff*
3. Greater risk for colonization with methicillin-resistant Staphylococcus aureus (MRSA) and vancomycin-resistant Enterococci (VRE)

For more information on how to ask patients about their penicillin allergy, visit CDC's penicillin factsheet.

Penicillin Allergy Assessments

Penicillin-allergy is reported by up to 10% of patients, yet <1% have true allergy.[36] With high clindamycin resistance in oral strep (18-30%),and increasing anaerobic resistance (31-38% *Prevotella* sp., *Porphyromonas* sp.), penicillin remains the preferred treatment.[37-39]

GI upset, nausea, diarrhea	• Not an allergy • Re-trial penicillin
Itching or rash	• Non-IgE mediated, cross-reaction unlikely • Use alternative penicillin, or any cephalosporin
Hives or Anaphylaxis	• Ig-E mediated, cross-reaction possible

Note: if *Bacteroides* sp. is a concern amoxicillin-clavulanate or metronidazole should be added to the penicillin-regimen (more information page 15 for microbiologic trends).

Antibiogram

An antibiogram is a report showing how susceptible strains of bacteria (or fungi) to a variety of antibiotics. This graph helps ensure antibiotic-directed treatment depending on what pathogen you are most suspicious of.

Download: Dental Antibiogram
Preferred Antibiotics - Susceptibility for Common Oral Pathogens (laminate for pocket cards or poster reminders)

Cumulative antimicrobial susceptibility report for commonly isolated oral or dental bacteria

	Percent Susceptible Isolates From Kansas Healthcare Facilities and National Samples (Anaerobes)	Antibiotic Class	Beta-lactams								Fluoro quinolones			Folate inhib.	Lincos amide	Macrolides		Tetra cycline	An-aerobic
			Penicillins			Cephalosporins													
		Number of Isolates	penicillin (PCN VK)	amoxicillin (Amoxil)	amoxicillin/clavulante (Augmentin)	Cephalexin (Keflex)	ceftriaxone (IM/IV)	cefadroxil (Duracef)	cefpodoxime (Vantin)	cefdinir (Omnicef)	ciprofloxacin	levofloxacin (Levaquin)	moxifloxacin (Avelox)	trimethoprim/sulfamethaxazole (Bactrim)	clindamycin (Cleocin)	azithromycin (Zithromax, Z-pak)	erythromycin	doxycycline	metronidazole (Flagyl)
Gram Positive	***Strep agalactiae (GBS)***	598	100	100	100		99					100			46		28	15	
	Strep anginosus group *(anginosus, constellatus, intermedius)*	122	85				96					97			90		74	38	
	Strep pyogenes (GAS)	27	100				100					96			89		74		
	Strep viridans group *(mitis, oralis, mutans, bovis, sanginis)*	207	67				96					95			72		76	78	
Anaerobes	***anaerobic gram positive cocci*** *(peptococcus, peptostreptococcus, finegoldia, anaerococcus)*	300-1853	100		100*								72		97				100
	Actinomyces spp.																		
	Bacteroides fragilis	129-1505			84*								61		26				100
	Bacteroides thetaiotaomicron	29-92	100		82*								54		28				100
	Prevotella spp.	29-92	100		97*								66		69				99
	Fusobacterium spp.	20-75			100*								68		77				95

1 Strep isolates from Kansas statewide antibiogram (2018-19 isolates, which are not specifically of oral sources)
2 Anaerobes from CLSI, cumulative antimicrobial susceptibility data, 4th ed. CLSI 100M document M39-A4.
* Extrapolated from amp/sulbactam susceptibility

= intrinsically resistant or poor coverage
= intermediate or unreliable coverage
= excellent to good coverage

Download antibiogram here

Social Determinants of Prescribing, Patient – Clinician Interventions

While patient demands are an oft-cited driver of antibiotic prescribing, clinicians seem to over-estimate a patient's desire for antibiotics.[43,46] Amongst antibiotics prescribed for conditions without evidence of infection, dentists cited the greatest factor was patient requests for antibiotics (OR 3.69), and patient unwillingness to accept definitive surgical treatment (OR 4.89).[42] Clinicians were 5.3 times more likely to prescribe antibiotics when they perceived the patient expected antibiotics – yet clinician's perceptions did not align with the patient's expectations.

Studies indicate providers misinterpret patients' questions and cues about treatment as a desire for antibiotics.[5] Of just under 300 patients presenting to the emergency department (ED) with an URI, while only twenty-seven percent of patients expected antibiotics, sixty-eight percent were prescribed antibiotics.[43] Yet satisfaction was rated higher amongst those *not* prescribed antibiotics compared to those leaving the ED with an antibiotic script (89% vs 89%).[43] These findings were confirmed by a recent survey in Kansas outpatient settings at local university clinics.[47] Re-aligning dentist's perceptions starts with educating them that the desire for antibiotics is overestimated.

Communication Skills Training

Clinicians want to satisfy patients' needs, but perceive patients place less value in their assessment than a script (i.e., exam and counseling does not satisfy a patient's desire for an antibiotic). Outpatient clinicians cite repercussions if/when they don't prescribe – including clinical, financial, emotional or relational impacts.[5] These concerns seem to be a much greater factor than diagnostic uncertainty or even fear of missing an infection.

Encouraging communication skills training to dentists and hygienists may significantly impact the quality of patient-provider interactions and reduce unnecessary medications (not just antibiotics but perhaps opioids and other unnecessary requests).

Delayed Prescribing

Delayed prescribing (i.e., "watchful waiting") is the process of filling a prescription but asking the patient to wait a few days prior to filling the script. This method allows the clinician to prescribe antibiotics when pressured and provides the patient with a plan should their symptoms worsen. Delayed prescribing reduces unnecessary antibiotics while still achieving high patient satisfaction, without affecting clinical outcomes of certain infections (upper respiratory, otitis media, urinary tract infections).[44,48] The same opportunity can be utilized by dentists for acute oral pain or while awaiting definitive treatment, with instructions on pain management in the interim to hopefully alleviate the desire to fill the antibiotics.

Create a Clinic Campaign

Engaging staff is an important component to improving antibiotic use. Shifting the facility's culture and conveying this to patients is the key to lasting change. Patients should be encouraged to commit to improving antibiotic use as well. Pledging (page 16) can mean more than raising awareness. In 2014 Public Health England developed an engagement and behavior change campaign intending to tackle AR. Promotional methods included short (2 minutes) YouTube videos, social media messages, resources (leaflets, posters, toolkits), and interactive quizzes with campaigners pledging to be "antibiotic guardians."[39] Within two years nearly a quarter of a million visitors had visited the campaign website from over 200 countries, of which nineteen percent were outside England. Pledged public members were almost six times as likely after a pledge to be an "antibiotic guardian" to report acting in line with their pledge of prudent antibiotic use – a rate significantly higher than even that of health care workers! Additionally, awareness of AR after pledging was significantly higher than the average public, even a year and a half later.

We encourage clinics to post commitments within view of their front desk, exam rooms, clinic website, social media sites, communication letters, and even text messages. We encourage all facilities to disseminate information regarding their local communities. KDHE and their partners at the Kansas Healthcare Collaborative have developed several suggested posting blurbs with over a dozen graphics to edit to your clinic, download the toolkit here, or CDC's social media and graphics resources here.

Communication Skills Training Techniques to Improve Patient & Parent Communication

Short 30-60 minute videos expose clinicians to communication techniques to patients regarding when antibiotics are not needed. A randomized clinical trial of 259 primary care clinics found that internet-based communication skills training resulted in a fifteen percent reduction in inappropriate antibiotic prescribing (adjusted rate ratio [aRR] 0.53, 95% CI 0.36-0.74 , p<0.0001 of routine internet training and aRR 0.68 95% CI 0.5-0.89 for enhanced training).[44]

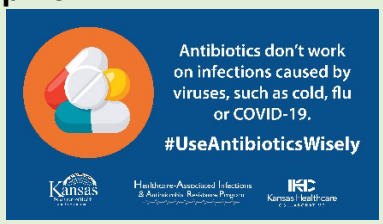
Create a Campaign

Spread the word to #UseAntibioticsWisely!
UseAntibioticsWisely.org #OneHealth #SmartUseBestCare

Example Messages

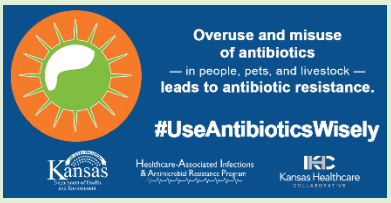
Graphic

Antibiotics don't work for all infections.
They only work on bacteria, NOT on illness caused by viruses, such as COVID-19 or flu. Be antibiotics aware and do your part to #UseAntibioticsWisely.



Colored mucous isn't always a sign of an infection, and the same is true for symptoms like cough, sore throat, earaches or fever. While some people with these symptoms will need antibiotics, most will get better without antibiotics.

If we continue to overuse and misuse antibiotics, the problem of #AntibioticResistance could lead to a return to a time when there is little or no cure for bacterial infections.



Taking antibiotics when they are not needed can actually hurt your health: It exposes you to adverse drug reactions and it increases your risk of getting an infection later that resists antibiotic treatment.

Misuse of antibiotics is the main cause of ER visits for adverse drug reactions in children<18. Side-effects include allergic reactions, potentially deadly diarrhea, and interference with effectiveness of other drugs.

More post ideas and graphics online, download the KDHE/KHC toolkits here (2019-2020) and here (2020-21), or CDC's social media toolkit here.

3. Tracking and Reporting

Measurement is a key component of all ASPs. Many will be familiar with the phrase "what gets measured gets managed."[41]

Actions for tracking

- Track number of antibiotics administered to patients per day (i.e., days of therapy [DOT]), adapt this antibiotic tracking tool to calculate antibiotic prescriptions, which then can be used to compare practices by providers
- Monitor adherence to facility-specific treatment policies and guidelines (e.g., adherence rates for documenting antibiotic indications, prophylaxis, and other clinic-set guidelines)
- Monitor provider adherence to treatment guideline recommendations
- Record accurate antibiotic allergy and adverse reaction histories
- Monitor frequency in which patient's penicillin allergies are assessed, penicillin prescribed, and assess for missed opportunities
- Assess how often patients are prescribed unnecessary duplicate therapy (e.g., double anaerobic coverage such as metronidazole concurrently with amoxicillin-clavulanate)
- Log reported patient's antibiotic outcome measures (e.g., *C. diff*, rash, ED or urgent care visits)

Actions for Reporting

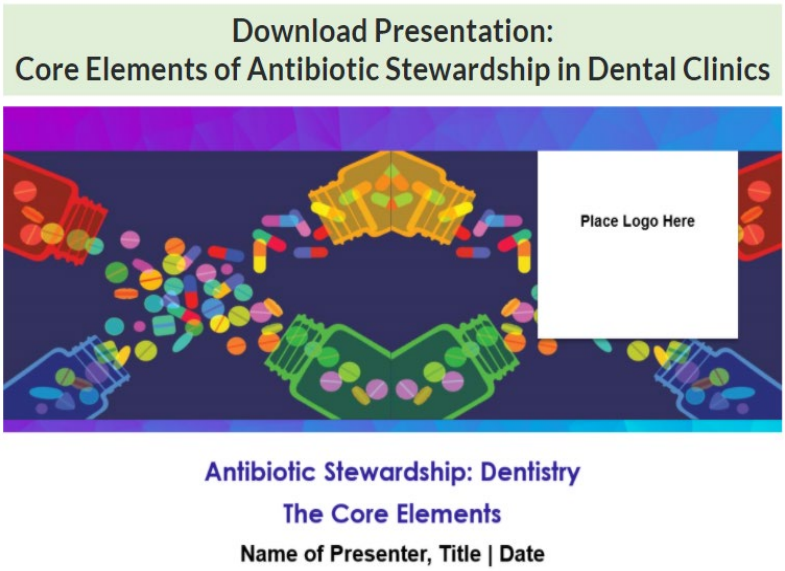
- Share data (adverse events, *C. diff*, penicillin false allergies) as well as outcomes with all clinicians, leadership, and other stakeholders
- Produce regular reports on antibiotics that are being tracked (e.g., audit 1-month worth of prophylaxis adherence, penicillin allergy assessments and subsequent penicillin, and/or number of delayed prescriptions recommended)
- Share antimicrobial stewardship data at staff meetings
- Ensure that ASP reports and successes (and failures) are available to leadership, dentists, hygienists, and patients
- Share updates and improvements with leadership, dentists, and all other stakeholders
- Distribute provider- level information on antibiotic use and provide suggestions for improvement when possible
- Focus reports to providers with actionable information in a way that is non-threatening to prevent data overload as well as appearing threatening or punitive

4. Expertise and Education

While education alone is insufficient to change the prescribing culture, it is vital to a successful stewardship program. Antimicrobial prescribing practices are a multifactorial process driven by more than just the clinician's knowledge. Dentist's attitudes and beliefs greatly affect prescribing habits. Universally amongst health care workers, AR has been perceived to be a global and national problem rather than a local one.[32] When considering whether to prescribe antibiotics, resistance was ranked last as a barrier to prescribing practices. Educational initiatives should focus on not just antibiotic prescribing and AR, but also infections which necessitate antibiotics versus those which do not (e.g., localized acute apical peritonitis, most cases dental avulsions etc.).

Knowledge of the hygienist and frontline staff can also affect attitudes and beliefs, not just among their peers but also among patients and families, so being aware of what constitutes a true infection over colonization is vital. Prescribing an antibiotic over the phone (without seeing the patient) or following simple, non-invasive procedures such as radiographs, sets the tone for inappropriate antibiotic prescribing practice.
Education on current best practices, prescribing guidelines, and policies/procedures of your ASP must be provided to all staff to be effective.

Download presentation here



Examples of actions stewardship programs can take toward improving antibiotic expertise:

- Assign a dentist as the dental stewardship champion to develop and set standards of antibiotic prescribing practices
- Allocate time and resources for dentist and hygienists AS/AR education
- Require stewardship and AR training to new hires

Continuing Education & Informational Resources

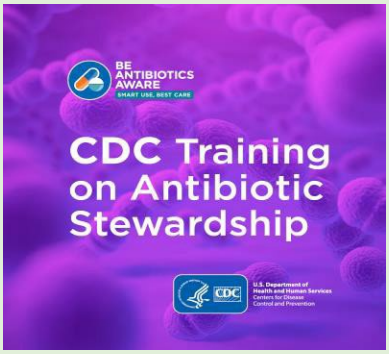
There are many options for providing education on AR, antibiotic use and stewardship: in person didactics can be done in formal or informal settings, messaging through posters, flyers and newsletters or electronic communication to staff groups, annual education as part of provider competency, and daily by feedback review.

A variety of web-based educational resources are available that can help facilities develop educational content. Education has been found to be most effective when paired with corresponding interventions and measurement of outcomes.

ADA Oral Health Topics: Antibiotic Stewardship, ADA antibiotic stewardship guidelines, ADA urgent care management of pulpitis clinical practice guidelines (summarized in guidelines on page 13), 2017 ADA update on prophylaxis in those with prosthetic joints (summarized in decision support script pad page 12).

International Association of Dental Specialists Foundation Webinar: The Drugs Won't Work: Treating the Emergency Dental Patient. Appropriate Antibiotic Prescribing for Dentists (1.5 hours CE). The Essentials of Endodontic Emergencies: Diagnosis, Safe Access and Infection Management (2 hours CE).

For general education on stewardship in the outpatient settings: CDC Training on Antibiotic Stewardship module (10 hours free CE), CDC's "Be Antibiotics Aware" partner toolkit contains key messages for clinicians, patient information including video, audio, graphics and press materials, as well as how AR affects food safety. CDC 2020 Report on Antibiotic Use in the United States.



Treatment = Source Control

It has been estimated up to sixty percent of human infections resolve by host defenses alone following source control without antibiotics (AAE report 2012). The majority of endodontic infections do not require systemic antibiotics when the infection was effectively managed (e.g., complete debridement of pulp space, proper obturation and sealing of pulp space from oral environment). AAE has developed a reference for AU and abuse.

NO antibiotics (generally) indicated	Example
Asymptomatic apical periodontitis Often pulpal origin, generated from immune system and intra-radicular infections, the apical foramen inflammatory cells generally prevent spread to periapical tissues and endodontic treatment alone is sufficient	
Chronic apical abscesses When intra-radicular infection overwhelms host immune cells, bacteria breach periapical tissues forming active infection → apical abscess. Gradual onset, sometimes sinus tract or parulis forms, generally endodontic treatment alone sufficient	
Acute apical abscess, localized Acute abscesses rapidly progress with new onset pain, welling, sometimes exudate, diffuse facial cellulitis. If abscess localized and intra-oral (right) pulp space incision and debridement, calcium hydroxide placement is sufficient.	
Antibiotics (generally) indicated	
Acute apical abscess with systemic complaints or diffuse facial swelling When facial cellulitis has developed or systemic symptoms (fevers, rigors, malaise), antibiotics are indicated after incision and debridement.	

Source: Endodontics Colleagues for Excellence Use and Abuse of Antibiotics. 2012.

Patient Educational Resources

Lastly, do not forget the importance also of patient education and involvement. Clinicians over-estimate patient's desire for antibiotics. Local surveys of Kansas providers and patients reveal the rate in which providers believe patients are seeking antibiotics is about twice as high as what patients are seeking.[47]

Pre-procedure Education	
Video: Prophylaxis for those with heart conditions (ADA)	
Poster: What is endocarditis – English and Spanish (AHA) **Wallet-card:** printable wallet card for patients to remind dentists they are endocarditis-prophylaxis candidate (AHA)	
Informational sheet: Why those with prosthetic joint infections do not need prophylaxis (ADA MouthHealthy.org)	
Waiting & Exam Rooms	
Poster: Do your part to reduce antibiotic resistance (KDHE, KHC)	
Poster: antibiotic safety do's and don'ts at the dentist (CDC)	
Posters: improving antibiotic use and be antibiotic aware, do I really need antibiotics (smaller poster 8 x5, infographics), what are antibiotic-resistant bacteria (smaller poster 8 x5) (CDC)	

Appendix

Table 1

<table>
<tr><th colspan="4">Antibiotic Guidelines</th></tr>
<tr><th colspan="2">Diagnosis</th><th>Pediatric</th><th>Adult</th></tr>
<tr><td rowspan="6">Trauma & Lacerations</td><td rowspan="3">Laceration (full-thickness mucosal or through-and-through injury)</td><td>No antibiotics found to offer conclusive benefit, may consider similar regimen as adults, if deemed severe, high risk morbidity, or immunosuppressed</td><td>☐ PCN VK 500 QID mg x 5 days
☐ Amoxicillin 500 mg TID x 5 days</td></tr>
<tr><td colspan="2">PCN-allergic</td></tr>
<tr><td></td><td>☐ Clindamycin 300-450 mg TID x 5 days
☐ Cephalexin 250-500 mg TID -QID[2-4] +/- + metronidazole 500 TID[5] x 5 days</td></tr>
<tr><td colspan="2"></td><td colspan="2">☐ Consider saltwater rinse or 0.12% chlorohexidine gluconate[9] topically (cotton swab or swish/spit) BID x 7 days
☐ Lingual edema can be controlled with cold (e.g., ice chips, popsicles)
☐ If deep laceration ensure tetanus vaccination up to date (i.e., within past 5 years)</td></tr>
<tr><td rowspan="3">Laceration (foreign body, debris or gravel, dirty wounds, open fracture)</td><td>☐ PCN VK 25-50 mg/kg/d (divided doses q6h) x 5 days
☐ Amoxicillin 25-50 mg/kg/d (divided doses q8h)[1]</td><td>☐ PCN VK 500 QID mg x 5 days
☐ Amoxicillin 500 mg TID x 5 days</td></tr>
<tr><td colspan="2">PCN-allergic</td></tr>
<tr><td>☐ Cephalexin 25-50 mg/kg/day (divide doses TID-QID)[2,4] + metronidazole 50 mg/kg[5] (divide TID) x 5 days
☐ Clindamycin 20 mg/kg/day (divide doses TID) x 5 days[6]</td><td>☐ Cephalexin 250-500 mg TID-QID [2-4] + metronidazole 500 TID[5] x 5 days
☐ Clindamycin 300-450 mg TID x 5 days</td></tr>
<tr><td colspan="2"></td><td colspan="2">☐ Ensure tetanus vaccination up to date (i.e., within past 5 years)
☐ Consider saltwater rinse or 0.12% chlorohexidine gluconate[9] topically (cotton swab or swish/spit) BID x 7 days
☐ Lingual edema can be controlled with cold (e.g., ice chips, popsicles)</td></tr>
<tr><td colspan="2">Dental trauma (avulsed permanent incisors with open or closed apex)</td><td>Depending on exam, consider:
☐ Kids >12: Doxycycline 4.4 mg/kg/d (divided BID) x 7 days
☐ Kids <12: PCN VK 25-50 mg/kg/d (divided doses q6h) x 7 days</td><td>No antibiotics found to offer conclusive benefit, may consider similar regimen as peds if deemed severe, high risk trauma or immunosuppressed</td></tr>
</table>

		☐ Rinse with 0.12% chlorohexidine gluconate[9] BID x 7 days ☐ Brush teeth with soft toothbrush after meals

1. Amoxicillin max dose 500 mg/dose
2. Cephalexin use only if not a PCN-associated anaphylaxis, urticaria, angioedema
3. Cephalexin adjusted in renal dysfunction (CrCl 30-59 max daily dose 1000 mg/d, CrCl 15-29 500 mg max/d, CrCl 5-14 250 mg/d and if on dialysis no renal adjustments
4. Cephalexin max dose 2,000 mg/day
5. Cephalexin activity not well described for **some** oral pathogens, low threshold to add metronidazole if gross infection, anaerobes, or delayed response to antibiotics
6. Clindamycin max 1800 mg per day in kids and adolescents
7. Amox/clavulanate renally adjusted if CrCl 10-30 to 250-500 BID, CrCl <10 or on dialysis 250-500 mg/day (administer antibiotic after dialysis)
8. Amox/clavulanate not to exceed 1,500 mg/day (if >40 kg not to exceed 2,000 mg daily)
9. Chlorohexidine oral rinses may help control dental plaque bacteria, but have no proven effect on caries, and prolonged application stains enamel and tongue, and prolonged use may promote emergency of resistance

Sources:
ADA. Clinical practice guidelines on antibiotic use for urgent management of pulpal and periapical dental pain and intraoral swelling. 2019.
AAPD. Use of antibiotic therapy for pediatric dental patients. Reference Manual of Pediatric Dentistry, 2019-2020.
AAP Red Book. 2018
UpToDate: overview and treatment of gingivitis, periodontitis, in adults. Oct 2019.

Table 2

Antibiotic Guidelines			
Diagnosis		**Pediatric**	**Adult**
Pulpal and Periapical Conditions	**Pulpitis** (+/- periodontitis, irreversible pulpitis, apical abscess, ***without*** systemic symptoms or localized swelling)	No antibiotics	No antibiotics
	Pulpitis (pulp necrosis and symptomatic apical periodontitis)	No antibiotics	No antibiotics
		☐ If awaiting definitive treatment, may consider delayed antibiotic prescription (as below for pulpitis + systemic symptoms/swelling), instructing to fill script 24-48h after visit if symptoms worsen ☐ If immunocompromised may consider treatment below for pulpitis + systemic symptoms/swelling)	
	Pulpitis (***with*** systemic symptoms or localized swelling)	☐ PCN VK 25-50 mg/kg/d (div. doses q6h) x 5 days ☐ Amoxicillin 25-50 mg/kg/d (div. doses q8h)[1]	☐ PCN VK 500 QID mg x 3-5 days ☐ Amoxicillin 500 mg TID x 3-5 days
		PCN-allergic	

		☐ Clindamycin 20 mg/kg/day (div. doses TID) x 3-5 days[6] ☐ Cephalexin 25-50 mg/kg/day (div. doses TID-QID)[2,4] + metronidazole 50 mg/kg[5] (div. TID) x 3-5 days	☐ Clindamycin 300-450 mg TID x 3-5 days ☐ Cephalexin 250-500 mg TID -QID[2-4] +/- metronidazole 500 TID[5] x 3-5 days
		Instruct patients to discontinue antibiotics 24h after symptoms resolve, irrespective of reevaluation after 3 days	
	Pulpitis (with systemic symptoms, swelling, worsening)	If failing to improve after 3 days of above antibiotics, re-examine, re-emphasize definitive dental treatment, if drainage or aspirate send for culture, and adjust antibiotics:	
		☐ Amoxicillin/clavulanate 25 mg (amox)/kg/day[8] (div. BID) x 5-7 days	☐ Amoxicillin/clavulanate 500/125 – 875/125[7] BID x 5-7 days

10. Amoxicillin max dose 500 mg/dose
11. Cephalexin use only if not a PCN-associated anaphylaxis, urticaria, angioedema
12. Cephalexin adjusted in renal dysfunction (CrCl 30-59 max daily dose 1000 mg/d, CrCl 15-29 500 mg max/d, CrCl 5-14 250 mg/d and if on dialysis no renal adjustments
13. Cephalexin max dose 2,000 mg/day
14. Cephalexin activity not well described for **some** oral pathogens, low threshold to add metronidazole if gross infection, anaerobes, or delayed response to antibiotics
15. Clindamycin max 1800 mg per day in kids and adolescents
16. Amox/clavulanate renally adjusted if CrCl 10-30 to 250-500 BID, CrCl <10 or on dialysis 250-500 mg/day (administer antibiotic after dialysis)
17. Amox/clavulanate not to exceed 1,500 mg/day (if >40 kg not to exceed 2,000 mg daily)

Chlorohexidine oral rinses may help control dental plaque bacteria, but have no proven effect on caries, and prolonged application stains enamel and tongue, and prolonged use may promote emergency of resistance

Sources:
ADA. Clinical practice guidelines on antibiotic use for urgent management of pulpal and periapical dental pain and intraoral swelling. 2019.
AAPD. Use of antibiotic therapy for pediatric dental patients. Reference Manual of Pediatric Dentistry, 2019-2020.
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Table 3

Antibiotic Guidelines			
Diagnosis		**Pediatric**	**Adult**
Gingival Conditions	**Acute gingivitis** (non-complicated)	None	None
		☐ Rinse with 0.12% chlorohexidine gluconate[9] BID x 1 month ☐ Lingual edema may be improved with cold (e.g., ice chips, popsicles)	
	Acute gingivitis (rapidly progressive,	☐ PCN VK 25-50 mg/kg/d (div. doses QID) + metronidazole 50 mg/kg[5] (div. BID-TID) x 3-5	☐ PCN VK 500 QID mg +/- metronidazole 500 TID[5] x 3-5 days ☐ Amoxicillin 500 mg TID +/-

	immunosuppressed, severe pain)	days ☐ Amoxicillin 25-50 mg/kg/d (div. TID)[1] + metronidazole 50 mg/kg[5] (div. BID-TID) x 3-5 days ☐ Amoxicillin/clavulanate 25 mg (amox)/kg/day[8] (div. BID) x 3-5 days	metronidazole 500 TID[5] x 3-5 days ☐ Amoxicillin/clavulanate 500/125 – 875/125[7] BID x 3-5 days
		PCN-allergic	
		☐ Clindamycin 20 mg/kg/day (div. doses TID) x 3-5 days[6] ☐ Kids >12: Doxycycline 4.4 mg/kg/d (divided BID) + metronidazole 50 mg/kg[5] (div. BID-TID) x 3-5 days	☐ Clindamycin 300-450 mg TID x 3-5 day ☐ Cephalexin 250-500 mg TID -QID[2-4] +/- metronidazole 500 TID[5] x 3-5 days
		☐ Rinse with 0.12% chlorohexidine gluconate[9] BID x 1 month ☐ Lingual edema may be improved with cold (e.g., ice chips, popsicles)	
	Necrotizing periodontitis stage 4 (previously acute necrotizing ulcerative gingivitis i.e., fusospirochetosis, trench mouth, Vincent's angina)	No antibiotics	No antibiotics
		☐ Rinse hourly with warm normal saline or salt rinses ☐ Rinse with 0.12% chlorohexidine BID[9] (especially post debridement) ☐ Brush teeth with soft toothbrush	
		If severe, debridement delayed, or immunocompromised, consider antibiotics:	
		☐ PCN VK 25-50 mg/kg/d (div. doses QID) + metronidazole 50 mg/kg[5] (div. BID-TID) x 7 days ☐ Amoxicillin 25-50 mg/kg/d (div. TID)[1] + metronidazole 50 mg/kg[5] (div. BID-TID) x 7 days ☐ Amoxicillin/clavulanate 25 mg (amox)/kg/day[8] (div. BID) x 7 days	☐ PCN VK 500 QID mg +/- metronidazole 500 TID[5] x 7 days ☐ Amoxicillin 500 mg TID +/- metronidazole 500 TID[5] x 7 days ☐ Amoxicillin/clavulanate 500/125 – 875/125[7] BID x 7 days
		PCN-allergic	
		☐ Clindamycin 20 mg/kg/day (div. doses TID) x 7 days[6] ☐ Kids >12: Doxycycline 4.4 mg/kg/d (divided BID) + metronidazole 50 mg/kg[5] (div. BID-TID) x 7 days	☐ Clindamycin 300-450 mg TID x 3-5 day ☐ Cephalexin 250-500 mg TID -QID[2-4] +/- metronidazole 500 TID[5] x 7 days

18. Amoxicillin max dose 500 mg/dose
19. Cephalexin use only if not a PCN-associated anaphylaxis, urticaria, angioedema
20. Cephalexin adjusted in renal dysfunction (CrCl 30-59 max daily dose 1000 mg/d, CrCl 15-29 500 mg max/d, CrCl 5-14 250 mg/d and if on dialysis no renal adjustments
21. Cephalexin max dose 2,000 mg/day
22. Cephalexin activity not well described for **some** oral pathogens, low threshold to add metronidazole if gross infection, anaerobes, or delayed response to antibiotics
23. Clindamycin max 1800 mg per day in kids and adolescents
24. Amox/clavulanate renally adjusted if CrCl 10-30 to 250-500 BID, CrCl <10 or on dialysis 250-500 mg/day (administer antibiotic after dialysis)
25. Amox/clavulanate not to exceed 1,500 mg/day (if >40 kg not to exceed 2,000 mg daily)

Chlorohexidine oral rinses may help control dental plaque bacteria, but have no proven effect on caries, and prolonged application stains enamel and tongue, and prolonged use may promote emergency of resistance

Sources:
ADA. Clinical practice guidelines on antibiotic use for urgent management of pulpal and periapical dental pain and intraoral swelling. 2019.
AAPD. Use of antibiotic therapy for pediatric dental patients. Reference Manual of Pediatric Dentistry, 2019-2020.
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Table 4

Antibiotic Guidelines		
Diagnosis		Adult
Implants	Prophylaxis[1-2]	Role of Antibiotics Unclear, unlikely of benefit ☐ Chlorhexidine oral rinses post-op
		If history of recurrent infections, recent active dental infection, stage 2-4 periodontitis, immunocompromised, diabetic, or with risk of medication-related osteonecrosis of the jaw - may consider:
		☐ PCN VK 1-2 g (dose 1 hour prior to surgery) ☐ Amoxicillin 1 - 2 g (dose 1 hour prior to surgery)
		PCN-allergic
		☐ Clindamycin 900 mg (dose 1 hour prior to surgery)
	Peri-implantitis (in combination of detoxification of implant surface, regeneration of lost support)[3-4]	Role of antibiotics unclear ☐ Chlorhexidine oral rinses x 5-7 days
		☐ PCN VK 500 mg QID + metronidazole 500 mg TID x 5-7 days ☐ Amoxicillin 500 mg QID + metronidazole 500 mg TID x 5-7 days ☐ Amoxicillin/clavulanate 500/125 – 875/125[7] BID x 5-7 days
		PCN-allergic
		☐ Clindamycin 300-450 mg TID x 5-7 days ☐ Cephalexin 250-500 mg TID -QID[2-4] + metronidazole 500 TID x 5-7 days

Sources:
1. Khouly I., et al. Clinical Oral Investigations; 2019;23:1525-53: meta-analysis found no difference among 22 studies of **healthy** patients receiving prophylactic antibiotics (for total, early or late infections, nor for wound dehiscence or adverse events)
2. Kim A., et al. British Dental journal; 2020;228:943-951.
3. Renvert S. J Clin Periodontal. 2008;35(8 Suppl): 305-15.
4. Leonhardt A. J Periodontal 2003;74:1415-22.

References

1. Public Health England. English Surveillance Program for Antimicrobial Utilization and Resistance ESPAUR): report 2018-2019. London, England: Public Health England; 2019. Accessed 11/7/19: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/843129/English_Surveillance_Programme_for_Antimicrobial_Utilisation_and_Resistance_201 9.pdf
2. Suda K., Hicks L., Roberts R., Hunkler R., Matusiak L., Schumock G. Antibiotic expenditures by medication, class, and healthcare setting in the United States, 2010-2015. Clinical Infectious Diseases 2018; 66(2):185-190.
3. Durkin M., Hsueh K., Sallah Y., Feng Q., et al. An evaluation of dental antibiotic prescribing practices in the United States. J Am Dent Assoc. 2017;148(12):878-86.
4. Lockhart P., Tampi M., Abt E., Urquhart O., et al. Evidence-based clinical practice guidelines on antibiotic use for the urgent management of pulpal and periapical-related dental pain and intraoral swelling. J Am Dent Assoc. 2019;150(11):p906.12.
5. Kohut M., Keller S., Linder J., Tamma P., Cosgrove S et al. The inconvincible patient: how clinicians perceive demands for antibiotics in the outpatient setting. Family Practice. 2020;37(2):276-82.
6. Hicks L., Bartoces M., Roberts R., Suda K., et al. US outpatient antibiotic prescribing variation according to geography, patient population, and provider specialty in 2011. Clin Infect Dis. 2015;60(9): 1308-16.
7. Fleming-Dutra K., Hersh A., Shapiro D., et al. Prevalence of inappropriate antibiotic prescriptions among US ambulatory care visits, 2010-2011. J Am Med Assoc. 2016;315(17):1864-73.
8. Marra F., George D., Chong M., Sutherland S., Patrick D. Antibiotic prescribing by dentists has increased: why? J Am Dent Assoc. 2016;147(5):320-7.
9. Sanchez G, Fleming-Dutra K, Roberts R., Hicks L. Core elements of outpatient antibiotic stewardship. MMWR Recomm Rep 2016;65(No. RR-6):1-12.
10. O'Neill, J. Review on antimicrobial resistance: tackling a crisis for the health and wealth of nations. London: Review on Antimicrobial Resistance. 2014. Retrieved December 3, 2019 from: https://amr-review.org/sites/default/files/AMR%20Review%20Paper%20-%20Tackling%20a%20crisis%20for%20the%20health%20and%20wealth%20of%20nations_1.pdf.
11. Fleming A. Penicillin's finder assays it's future. New York Times. 1945: pp 21.
12. Malhotra-Kumar S., Lammens C., Coenen S., Van Herck K., Goossens H. Effect of azithromycin and clarithromycin therapy on pharyngeal carriage of macrolide-resistant streptococci in healthy volunteers: a randomized, double-blind, placebo controlled study. Lancet. 2007;369(9560): 482 - 90.
13. Schrag S., Pena C., Fernandez J., et al. Effect of short-course, high-dose amoxicillin therapy on resistant pneumococcal carriage: a randomized trial. JAMA. 2001;286(1):49-56.
14. Centers for Disease Control and Prevention. Outpatient antibiotic prescriptions – United States, 2017. Updated August 2019. Retrieved from: https://gis.cdc.gov/grasp/PSA/AUMapView.html.
15. Jonas O., Irwin A., Berthe F., Cesar J., Le Gall F. Marquez P. Drug-resistant infections: a threat to our economic future (Vol. 2): final report. HNP/Agriculture Global Antibiotic Resistance Initiative. Washington, D.C.: World Bank Group. Retrieved Dec 3, 2019 from: http://www.worldbank.org/en/topic/health/publication/drug-resistant-infections-a-threat-to- our-economic-future.
16. Centers for Disease Control and Prevention. Antibiotic Resistance Threats in the US, 2019. Retrieved December 1, 2019 from: https://www.cdc.gov/nhsn/acute-care- hospital/aur/index.html.
17. Thomas C., Stevenson M., Riley T. Antibiotics and hospital-acquired Clostridium difficile-associated diarrhea: a systematic review. J Antimicrob Chemother. 2003;51(6):1339-50.
18. Stevens V., Dumyati G., Fine L., Fisher S., van Wigingaarden E. Cumulative antibiotic exposures over time and the risk of Clostridium difficile infection. Clin Infect Dis. 2011;53(1):42-8.
19. Bye M., Whitten T., Holzbauer S. Antibiotic prescribing for dental procedures in community-associated Clostridium difficile cases, Minnesota, 2009-2015. Open Forum Infect Dis. 2017;4(Suppl 1): S1.
20. Zaoutis T., Goyal M., Chu J., Coffin L., Nachamkin I., McGowan K., Bilker W., Lautenbach E. Risk factors for and outcomes of bloodstream infection caused by extended-spectrum beta-lactamase-

producing Escherichia coli and Klebsiella species in children. Pediatrics 2005; 115:942–949.
21. Patel G., Huprikar S., Factor S., Jenkins S., Calfee D. Outcomes of carbapenem- resistant Klebsiella pneumoniae infection and the impact of antimicrobial and adjunctive therapies. Infect Control Hosp Epidemiol 2008; 29:1099 -1106.
22. Schwaber M., Klarfield-Lidgji S., Navon-Venezia S., Schwartz D., Leavitt A, Carmeli Y. Predictors of carbapenem-resistant Klebsiella pneumoniae acquisition among hospitalized adults and effect of acquisition on mortality. Antimicrob Agents Chemother. 2008; 52(3):1028-33.
23. Teoh L, Thompson W., Suda K. Antimicrobial stewardship in dental practice. J Am Dent Assoc. 2020;151(8): pp 589-95.
24. Centers for Disease Control and Prevention. Outpatient Antibiotic Prescriptions – 2020. Retireved June 17, 2022 from: https://arpsp.cdc.gov/profile/antibiotic-use/all-classes
25. Meeker D., Knight T., Friedberg M., et al. Nudging guideline-concordant antibiotic prescribing: a randomized controlled clinic trial. J Am Med Assoc Internal Medicine. 2014; 174(3): 425-31.
26. Fluent M., Jacbosen P., Hicks L. Considerations for responsible antibiotic use in dentistry. J Am Dent Assoc. 2016;147(8):683-86.
27. Endodontics Colleagues for Excellence, Use and Abuse of Antibiotics. 2012. Retrieved October 10, 2020 from: http://www.aae.org/specialty/wp- content/uploads/sites/2/2017/07/ecfewinter12final.pdf.
28. Suda K., Henshel H., Patel U., Fitzpatrick M., Evans C. Use of antibiotic prophylaxis for tooth extractions, dental implants, and periodontal surgical procedures. Open Forum Infect Dis. 2017;5(1):ofx250.
29. Lee C., Jafari M., Brownridge R., Phillips C., Vanstone J. The viral prescription pad – a mixed methods study to determine the need for and utility of an educational tool for antimicrobial stewardship in primary health care. BMC Fam Pract. 2020;21:42.
30. American Academy of Pediatric Dentistry. Use of Antibiotic therapy for pediatric dental patients. Reference Manual of Pediatric Dentistry. 2019-2020. pp 412-15. Accessed October 12, 2020 from: https://www.aapd.org/research/oral-health- policies--recommendations/use-of-antibiotic-therapy-for-pediatric-dental- patients/#main.
31. Khanna S., Pardi D., Aronson S., Kammer P., Orenstein R., St Sauver J., Harmesen W. Zinsmeister A. The epidemiology of community-acquired Clostridium difficile infection: a population-based study. Am J Gastroenterol. 2012;107(1):89-95.
32. Shehab N., Lovegrove M, Geller A., Rose K., Weidle N., Budnitz D. US emergency department visits for outpatient adverse drug events, 2013 -2014. JAMA. 2016; 316(20):2115-2125.
33. Barlam T., Cosgrove S., Abbo L., MacDougall C., Schuetz A., Septimus E., et al. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clin Infect. Dis. 2016; 15(62)(10): e51-77.
34. Macy E., Khan D, Castells M, Lang D. Penicillin allergy testing: a key component of antibiotic stewardship. Clin Infect Dis. 2017;64(4):531-32.
35. Macy E. & Contreras R. Healthcare use and serious infection prevalence associated with penicillin “allergy” in hospitalized patients: a cohort study. J Allergy Clin Immunol. 2014;133(3):790-96.
36. Jeffres M, Narayanan P, Shuster J., Schramm G. Consequences of avoiding β-lactams
37. in patients with β-lactam allergies. J Allergy Clin Immunol. 2016;137(4):1148-53.
38. Marchand-Austin A., Rawte P., Toye B.., et al. Antimicrobial susceptibility of clinical isolates of anaerobic bacteria in Ontario, 2010-2011. Anaerobe. 2014;28:120-125.
39. Poeschl P., Ludwig S., Russmueller G., Seemann R., Hirschl A., et al. Antimicrobial susceptibility and resistance of the odontogenic microbiologic spectrum and its clinical impact on severe deep space head and neck infections. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010;110(2):151-156.
40. Wybo I., Van den Bossche D., Soetens O., Vekens E., et al. Fourth Belgian multicentre survey of antibiotic susceptibility of anaerobic bacteria. J Antimicrob Chemother. 2014;69(1):155-61.
41. Newitt S, Oloyede O., Puleston R., Hopkins S., Ashiru-Oredope D. Demographic, knowledge and impact analysis of 57,627 antibiotic guardians who have pledged to contribute to tackling antibiotic resistance. Antibiotics 2019; 8(1), 21.
42. Drucker, Peter F. The Practice of Management. New York: Harper & Row. 1954. Print.
43. Gross A., Hanna D., Rowan S., Bleasdale S., Suda K. Successful implementation of an antibiotic stewardship program in an academic dental practice. Open Forum Infectious Disease. 2019;6(3):ofz067.

44. Cope A., Francis N., Wood F., Chestnutt I. Antibiotic prescribing in UK general dental practice: a cross-sectional study. Community Dent Oral Epidemiol. 2016;44(2):145 -53.
45. Ong S., Nakase J., Moran J., Karras D., et al. Antibiotic use for emergency department patients with upper respiratory infections: prescribing practices, patient expectations, and patient satisfaction. Annals of Emergency Medicine. 2007; 50(3): pp 213 -20.
46. Little P., Stuart B., Francis N., Douglas E., Tonkin-Crine S., et al. Effects of internet-based training on antibiotic prescribing rates for acute respiratory-tract infections: a national, cluster, randomized, factorial, controlled trial. Lancet. 2013;382(9899):1175-82.
47. Satterfield J., Miesner A., Percival K. The role of education in antimicrobial stewardship. J Hosp Infection. 2020;105(2):130-141.
48. Szymczak J., Feemster K., Zaoutis T., Gerber J. Pediatrician perceptions of an outpatient antibiotic stewardship intervention. Inf Control and Hosp Epidemiol. 2014;35(suppl 3):s69-78.
49. Wark K. Patient desire for antibiotics and provider perceptions of patient's desires in an
50. outpatient clinic. Unpublished
51. Chao J., Kunkov S., Reyes L., Lichten S., et al. Comparison of two approaches to observation therapy for acute otitis media in the emergency department. Pediatrics. 2008;121(5):1352-56.