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The Effect of COVID-19 On Antibiotic Resistance

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Abstract

Over three years have passed since the beginning of the COVID-19 pandemic. During these times we have experienced significant changes in all areas of our life. In healthcare, more attention was focused on COVID-19 than other concerns. An unexpected consequence of the pandemic was a silent progression of an increased spread of multi-resistant pathogens. While antibiotic use during the pandemic varied across healthcare settings, antibiotics were prescribed for COVID-19 patients, even though antibiotics are known not to be effective against viruses.[1] In dentistry, antibiotics were prescribed to prevent potential dental infections, since many dental offices were not open. Antimicrobial resistance was one of our greatest public health concerns prior to the COVID-19 pandemic, and it remains so.

Keywords

COVID-19, antibiotics, resistance

The Effect of COVID-19 On Antibiotic Resistance

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Summary

Over three years have passed since the beginning of the COVID-19 pandemic. During these times we have experienced significant changes in all areas of our life. In healthcare, more attention was focused on COVID-19 than other concerns. An unexpected consequence of the pandemic was a silent progression of an increased spread of multi-resistant pathogens. While antibiotic use during the pandemic varied across healthcare settings, antibiotics were prescribed for COVID-19 patients, even though antibiotics are known not to be effective against viruses.[1] In dentistry, antibiotics were prescribed to prevent potential dental infections, since many dental offices were not open. Antimicrobial resistance was one of our greatest public health concerns prior to the COVID-19 pandemic, and it remains so.

Background

In the U.S., more than 2.8 million antimicrobial-resistant infections occur each year. More than 35,000 people die as a result, according to CDC's 2019 Antibiotic Resistance Threats Report.[2]

In 2019, the WHO has published a list with the ten largest global health threats. Among them are anti-microbial resistance as well as multi-resistant pathogens (MRP).[3] In the year 2019, MRP was responsible for 1.27 million deaths directly and indirectly for another 3.68 million.[4] This problem is not only seen in developing countries, but also in more economically developed countries like the U.S., Canada and the European Union. In developed countries, MRP caused about 11.3 death per 100,000 people. One fourth is caused by *Staphylococcus aureus* and *Escherichia coli*.[4]

MRP are bacterial microorganisms, where common antibiotics have developed a resistance and do not work anymore. Among the gram-positive bacteria, we see methicillin-resistant *S. aureus* (MRSA) and vancomycin-resistant *Enterococcus faecalis* and *faecum* (VRE).

Multi-resistant gram-negative bacteria are generally called 3- or 4-MRGN. They are resistant against three or four of the clinically relevant antibiotic groups: penicillin, cephalosporin, fluoroquinolone and/or carbapenem.

However, as the pandemic pushed healthcare facilities, health departments, and communities near their breaking points in 2020, we saw a significant increase in antimicrobial use, difficulty in following infection prevention and control guidance, and a resulting increase in healthcare-associated, antimicrobial-resistant infections in U.S. hospitals. In fact, resistant hospital-onset infections and deaths both increased at least 15% during the first year of the pandemic.[1]

Antibiotic Prescription and Resistance

While amoxicillin was also the most frequently prescribed antibiotic in the U.S. according to the CDC, azithromycin replaced clindamycin as the second choice for patients with a true penicillin allergy. This is most likely due to the additional risk for developing a severe *Clostridium difficile* infection necessitating changes in antibiotic recommendations in 2019.[5]

Characteristics	Number Of Antibiotic Prescriptions (Millions)	Antibiotic Prescriptions Per 1,000 Persons,Rate
Amoxicillin	42.9	129
Azithromycin	28.7	86
Amoxicillin clavulanic acid	22.6	68
Doxycycline	21.7	65
Cephalexin	20.5	62

Table 1 Top Oral Antibiotic Classes and Agents in the United States 2021[6]
Courtesy of CDC. Outpatient Antibiotic Prescriptions – United States, 2021. CDC 2021.

Amoxicillin resistance by *streptococcus* is in private practice isolation relatively rare, but it is much more frequent by hospital isolates.

As seen in a multiple site study in the U.S., the table below illustrates the pathogen resistance to the corresponding antibiotic. It was found that resistance for clindamycin is about 53% against Group B *streptococcus*. This makes therapy increasingly difficult.

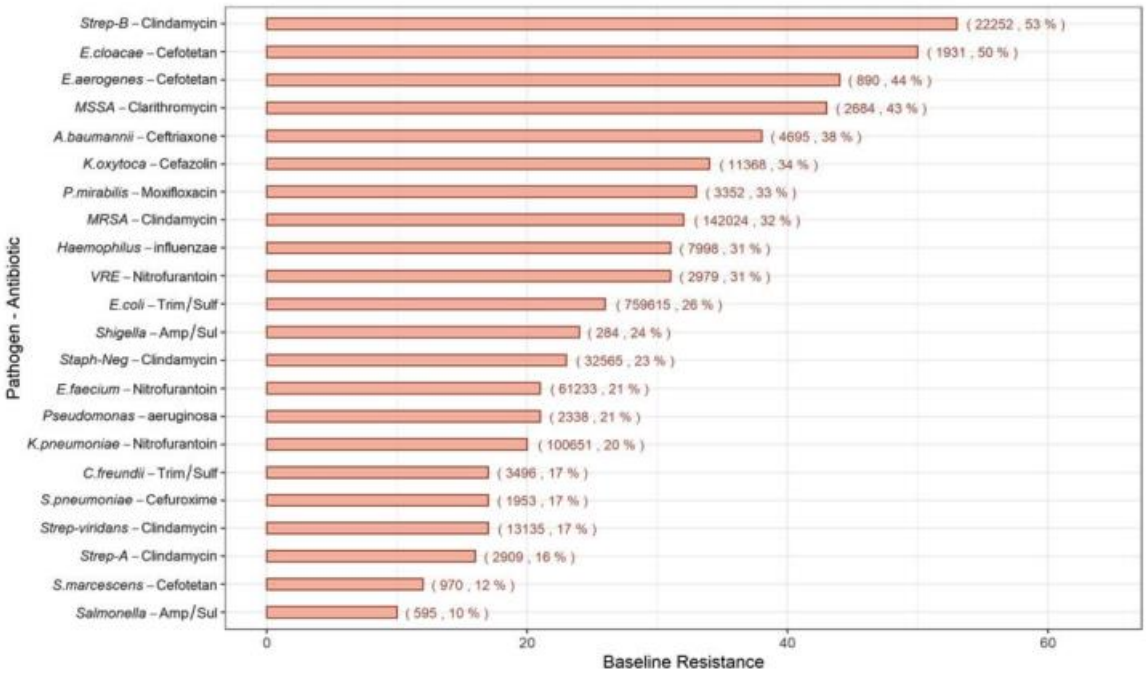

Figure 1 Baseline resistance of the study cohort (Total no. of resistant encounters, Resistance %)[7]

Courtesy of Sivasankar S, Goldman JL, Hoffman MA. Variation in antibiotic resistance patterns for children and adults treated at 166 non-affiliated US facilities using EHR data. JAC Antimicrob Resist 2023; 5(1):dlac128.

Furthermore, dental prescriptions are ranking third after primary care physicians and physician assistants/nurse practitioners as seen in the table below.

Specialty	Number Of Antibiotic Prescriptions (Millions)	Antibiotic Prescriptions Per Healthcare Professional, Rate
Primary Care Physicians	61.2	258
Physician Assistants & Nurse Practitioners	69.8	403
Surgical Specialties	16.3	183
Dentistry	25.5	208
Emergency Medicine	10.7	332
Dermatology	5.7	505
Obstetrics/Gynecology	4.6	122
Other	17.1	82
All Healthcare Professionals	211.1	231

Table 2: Oral Antibiotic Prescribing by Specialty in United States, 2021[6]

Courtesy of CDC. Outpatient Antibiotic Prescriptions – United States, 2021. CDC 2021.

A classic example is the prescription of antibiotics for viral respiratory diseases. For many years it has been shown that prescribed antibiotics correlate with the flu infection, even though it is not indicated.[8] This is also evident in dentistry where antibiotics are prescribed as initial treatment or primary therapy for an infection when it is rarely indicated. Most odontogenic infections should be primarily treated with mechanical/surgery interventions. Only if the infection tends to spread or if the patient is immunocompromised should antibiotics be considered.[9]

Several publications show evidence of prescribed antibiotics without a diagnosis.[10, 11, 12, 13, 14] The inappropriate use of antibiotics is problematic for several reasons: first, side effects such as allergic reactions, gastrointestinal discomfort and *Clostridium difficile* infections are unnecessary.[15, 16] Second, the pressure of selection is increased on the bacteria which grows MRP even more.[17]

During the pandemic the use of antibiotics progressively increased.[18] Antibiotic prescribing in dentistry, whether for prophylactic or therapeutic purposes, accounts for approximately 10% of antibiotic prescriptions worldwide. These prescriptions are not always considered appropriate, leading to excessive or incorrect antibiotic use in dental practice.[19, 20] This emphasizes the importance of the awareness of antibiotic resistance and appropriate prescribing. We continue to need stewardship programs to reduce the overall use of antibiotics. Prescribing responsibly, based on a proper diagnosis and for specifically indicated situations will result in higher success rates.[11, 21, 22]

Conclusions

The pandemic has undone much of the nation's progress on antimicrobial resistance, especially in hospitals. We must continue to invest in prevention-focused public health actions to combat antimicrobial resistance, so it will remain as an effective therapy in our future.

References

[1] CDC. COVID-19: U.S. Impact on Antimicrobial Resistance Special Report 2022. CDC 2022.

[2] CDC. Antibiotic Resistance Threats in the United States 2019. CDC 2019.

[3] WHO. Global action plan on antimicrobial resistance. WHO 2015.

[4] Murray CJL, Ikuta KS, Sharara F, Swetschinski L, Robles Aguilar G, Gray A, et al. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. Lancet 2022; 399(10325):629-655.

[5 was 23] AAE. AAE Guidance on the Use of Systemic Antibiotics in Endodontics. AAE 2017.

[6] CDC. Outpatient Antibiotic Prescriptions – United States, 2021. CDC 2021.

[7] Sivasankar S, Goldman JL, Hoffman MA. Variation in antibiotic resistance patterns for children and adults treated at 166 non-affiliated US facilities using EHR data. JAC Antimicrob Resist 2023; 5(1):dlac128.

[8] Yaacoub S, Lanoy E, Hider-Mlynarz K, Saleh N, Maison P. Trend of antibiotic consumption and its association with influenza-like illnesses in France between 2004 and 2018. Eur J Public Health 2021; 31(6):1137-1143.

[9] Al-Nawas B, Karbach J. S3-Leitlinie (Langversion) Odontogene Infektionen. German Society for Dentistry, Oral and Maxillofacial Medicine 2017.

[10] Cope AL, Francis NA, Wood F, Chestnutt IG. Antibiotic prescribing in UK general dental practice: a cross-sectional study. Community Dent Oral Epidemiol 2016; 44(2):145-153.

[11] Patrick A, Kandiah T. Resistance to change: how much longer will our antibiotics work? Fac Dent J 2018; 9(3):103-111.

[12] Teoh L, Marino RJ, Stewart K, McCullough MJ. A survey of prescribing practices by general dentists in Australia. BMC Oral Health 2019; 19: 193.

[13] Suda KJ, Calip GS, Zhou J, Rowan S, Gross AE, Hershow RC, et al. Assessment of the Appropriateness of Antibiotic Prescriptions for Infection Prophylaxis Before Dental Procedures, 2011 to 2015. JAMA Netw 2019; 2(5):e193909.

[14] Hubbard CC, Evans CT, Calip GS, Zhou J, Rowan SA, Suda KJ. Appropriateness of Antibiotic Prophylaxis Before Dental Procedures, 2016-2018. Am J Prev Med 2022; 62(6):943-948.

[15] Shehab N, Patel PR, Srinivasan A, Budnitz DS. Emergency department visits for antibiotic-associated adverse events. Clin Infect Dis 2008; 47(6):735-743.

[16] Hansen MP, Scott AM, McCullough A, Thorning S, Aronson JK, Beller EM, et al. Adverse events in people taking macrolide antibiotics versus placebo for any indication. Cochrane Database Syst Rev 2019; 1:CD011825.

[17] Costelloe C, Metcalfe C, Lovering A, Mant D, Hay AD. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. BMJ 2010; 340:C2096.

[18] Shah S, Wordley V, Thompson W. How did COVID-19 impact on dental antibiotic prescribing across England? Br Dent J 2020; 229(9):601-604.

[19] Oberoi S.S., Dhingra C., Sharma G., Sardana D. Antibiotics in Dental Practice: How Justified Are We. Int Dent J 2015; 65:4-10.

[20] Thompson W., Williams D., Pulcini C., Sanderson S., Calfon P., Verma M. Tackling Antibiotic Resistance: Why Dentistry Matters. Int Dent J 2021; 71:450-453.

[21] Milani RV, Wilt JK, Entwisle J, Hand J, Cazabon P, Bohan JG. Reducing inappropriate outpatient antibiotic prescribing: normative comparison using unblinded provider reports. BMJ Open Quality 2019; 8(1):e000351.

[22] Teoh L, Stewart K, Marino RJ, McCullough MJ. Improvement of dental prescribing practices using education and a prescribing tool: A pilot intervention study. Br J Clin Pharmacol 2021; 87(1):152-162.