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Impact of the COVID-19 Pandemic on the Utilization of Antibiotics in the University Clinical Dentistry Center of Kosovo

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Background: The COVID-19 pandemic led to significant disruptions in healthcare services worldwide, including dental care, resulting in increased reliance on antibiotics as a substitute for in-person dental interventions. This study aimed to examine the utilization of different classes of antibiotics at the University Dental Clinical Center of Kosovo during the COVID-19 pandemic and compare it with prescription trends from the pre-pandemic period. **Methods:** A retrospective analysis was conducted on antibiotic prescription data from the University Dental Clinical Center of Kosovo, spanning from 2019 to 2022. The study compared prescription trends before and during the pandemic and identified the most prescribed antibiotic classes. Additionally, findings were contextualized by reviewing global literature on antibiotic use in dental practices during the pandemic. **Results:** The study revealed a significant increase in the prescription of broad-spectrum antibiotics, including amoxicillin, clavulanic acid, clindamycin, and metronidazole, during the pandemic period. These findings mirrored global trends, where restricted access to dental care and increased self-medication led to higher antibiotic consumption. Concerns about antimicrobial resistance (AMR) were raised due to the over-prescription of these antibiotics during the pandemic. **Conclusions:** The study highlights the impact of the COVID-19 pandemic on dental antibiotic prescription practices in Kosovo, revealing a concerning increase in broad-spectrum antibiotic use. This underscores the need for improved antibiotic stewardship in dental settings, particularly during public health crises, to prevent the exacerbation of antimicrobial resistance. Ensuring continued access to routine dental care and developing robust protocols for antibiotic prescription during emergencies are essential to mitigate the long-term public health impacts of increased antibiotic use.

Keywords: COVID-19; antibiotics; dental care; antimicrobial resistance; University Dental Clinical Center of Kosovo; prescription trends; antibiotic stewardship

1. Introduction

The COVID-19 pandemic brought unprecedented challenges to healthcare systems across the globe, revealing vulnerabilities in many sectors, including dentistry. This disease has been declared a state of emergency in public. Worldwide, over 100 million people were infected on January 28, 2020, and more than 2.15 million people have died since then (WHO, 2021). As the world confronted the pandemic, with the first identifiable case traced back to Wuhan, China, in December 2019, the rapid spread of the virus and the subsequent strain on healthcare resources exposed the fragility of even the most well-established health systems (Downey, Fokeladeh, & Catton, 2023). By January 2020, COVID-19 had been declared a global emergency by the World Health Organization (WHO), and its impacts were soon felt across all medical fields, including dentistry, as nations struggled to control the transmission through quarantine measures, testing, and lockdowns (Taghizade et al., 2021). The economic repercussions of the pandemic were profound, with healthcare systems worldwide facing

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significant strain. This was not only due to the direct impact of the virus but also because of the extensive disruptions to routine medical and dental care, which led to an increase in the use of pharmaceutical interventions such as antibiotics (Kaye et al., 2021). In many cases, dental clinics were closed or limited to emergency care, forcing practitioners to rely more heavily on antibiotics to manage conditions that would typically require surgical or procedural interventions. This trend was observed globally, raising concerns about the implications for antimicrobial resistance (Castro-Sánchez & Worldwide Antimicrobial Resistance National/International Network Group, 2023).

Kosovo's dental sector was no exception. At the University Clinical Dentistry Center of Kosovo (UCDCK), the suspension of routine services due to pandemic restrictions resulted in an increased reliance on antibiotics for managing oral infections. During the peak of COVID-19, the Ministry of Health of Kosovo decided to suspend all dental procedures -except emergency ones (MoH decision 23/III/2020) due to the significantly increased risk of spreading the virus through the respiratory tract during dental procedures that generate aerosols. The suspension applies to both the public and private sectors, which has complicated the situation of patients due to the lack of provision of these health services. Therefore, The Ministry of Health in Kosovo suspended dental services by a national decision from 20 March 2020 to 18 June 2020. This period was followed by monitoring of the necessary measures that dentists need to take to receive patients. These recommendations were made by the MoH and the Kosovo Dental Chamber.

This reliance reflected a broader trend in global health where, in the absence of direct clinical intervention, antibiotics were often used to mitigate symptoms and delay the need for in-office treatments (Mallah et al., 2021). However, this increased prescription of antibiotics—particularly in emergency dental cases—highlighted concerns regarding antibiotic stewardship, as inappropriate use could accelerate the development of antimicrobial resistance (Chakraborty & Maity, 2020).

The aim of this paper is to evaluate the impact of the COVID-19 pandemic on antibiotic utilization at UCDCK. By examining prescribing patterns during the pandemic and comparing them with pre-pandemic periods, the study seeks to offer insights into how adaptations in dental care affected antibiotic use.

2. Methodology

The study employs a quantitative methodology, utilizing hospital patient forms developed based on the Point Prevalence Study (PPS) data collection framework. These forms include information on the clinic name, type of dental department, patient identification number, age, sex, weight, generic name of the prescribed drug, individual dosage, method of administration, reason for treatment (classified according to the International Classification of Diseases - ICD), type of treatment, existence of a treatment protocol, and adherence to the protocol, if applicable.

Data were retrospectively collected from the University Dental Clinical Center of Kosovo for the period 2019 to 2022 and compared with findings from literature review of similar studies conducted in other countries. The analysis primarily focused on quantitative methods used in international studies, comparing prescription trends from 2019 (pre-pandemic) with 2020–2021 (pandemic period).

The findings were further contextualized by examining antibiotic use in dentistry during COVID-19, both in Kosovo and globally. Comparative insights were drawn from studies conducted in countries such as Croatia, Spain, Canada and other countries explained further in discussion section, offering a broader framework to evaluate whether Kosovo's patterns aligned with or diverged from global trends in antibiotic stewardship during the pandemic.

3. Results

The analysis reveals fluctuations in both the overall use of antibiotics and the specific classes administered. Data collected from the clinics within the university dentistry center were thoroughly examined. The findings are presented below in a more detailed manner to highlight trends, variations, and patterns in prescribing practices.

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According to the graphical representation of the data from Figure 1, we observe distinct variations in patient numbers across the years 2019 to 2022. The curve is notably higher in 2019 and 2021, indicating a greater number of patients during these years compared to 2020 and particularly 2022, where a marked decline is evident.

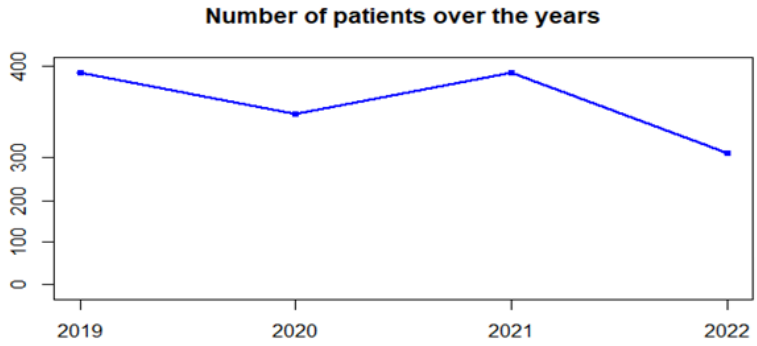

Figure 1. The number of patients during the years 2019 – 2022.

In 2021, there was a rebound in patient numbers as the healthcare system adapted to pandemic conditions, implementing new protocols, and addressing the residual load of deferred treatments from the previous year. However, 2022 experienced a significant decline in patient numbers, which could be associated with the normalization of healthcare demand post-pandemic and an increased adoption of telehealth services, reducing the need for in-person visits.

The data in Table 1 reveal distinct trends in the frequency of antibiotic cases over the four-year period. The highest frequency is observed in 2021, with a maximum percentage of 27.6%, while the lowest frequency is recorded in 2022, at 22.8%. These fluctuations reflect the broader impacts of the COVID-19 pandemic and other healthcare dynamics, highlighting changing patterns in antibiotic use.

Table 1. Frequency of antibiotics in the years 2019-2022.

Year		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2019	451	25.8	25.8	25.8
	2020	416	23.8	23.8	49.6
	2021	482	27.6	27.6	77.2
	2022	399	22.8	22.8	100.0
	Total	1748	100.0	100.0	

Table 2. Frequency of antibiotics prescribed.

Name	Frequency	Percent
Amoxicillin and Clavulanic Acid	673	38.5
Amoxicillin	319	18.2
Ampicillin	1	0.1
Azithromycin	8	0.5
Cefalexin	6	0.3
Ciprofloxacin	3	0.2
Clindamycin	29	1.7
Erythromycin	20	1.1
Metronidazole	688	39.4

The study's findings on antibiotic prescriptions are summarized as follows: Amoxicillin and Clavulanic Acid were prescribed 673 times, constituting 38.5% of the total antibiotics administered.

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Amoxicillin was prescribed 319 times, representing 18.2% of the total. Ampicillin had the lowest prescription rate, with only 1 case (0.1%). Azithromycin and Cephalexin were prescribed 8 times each (0.5% and 0.3%, respectively). Ciprofloxacin and Clindamycin had 3 (0.2%) and 29 (1.7%) prescriptions, respectively. Erythromycin was prescribed 20 times (1.1%). The most frequently prescribed antibiotic was Metronidazole, with 688 prescriptions, accounting for 39.4% of the total. These data indicate that Metronidazole and Amoxicillin with Clavulanic Acid were the most frequently prescribed antibiotics in the study, with Metronidazole being the most commonly used. This distribution underscores the reliance on these particular antibiotics for dental treatments, likely due to their broad-spectrum efficacy and suitability for treating a wide range of bacterial infections encountered in dental practice. Understanding these prescription patterns is crucial for developing strategies to optimize antibiotic use, minimize the risk of resistance, and ensure effective patient care. The high prescription rates of Metronidazole and Amoxicillin with Clavulanic Acid reflect their importance in dental therapeutic protocols, highlighting the need for ongoing monitoring and stewardship efforts to promote rational use of antibiotics.

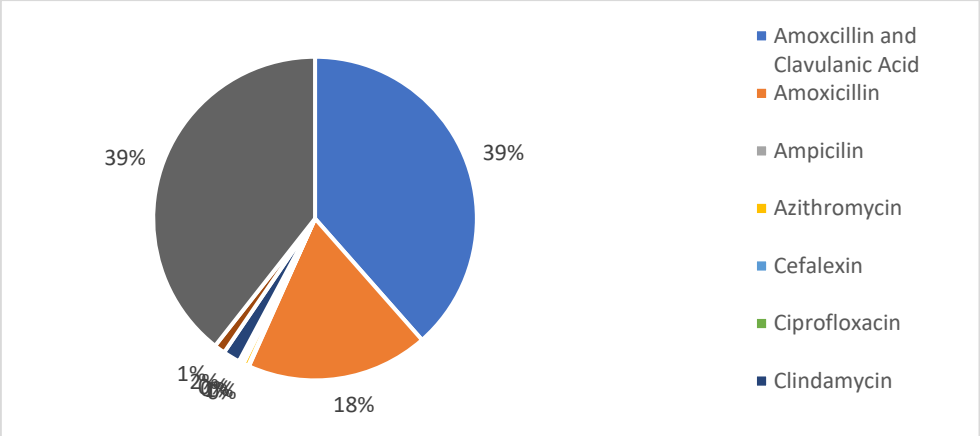

Figure 2. Use of antibiotics in %.

Based on the chart, Metronidazole was prescribed in 688 patient diagnoses, representing 39.4% of the total antibiotics administered. Amoxicillin and Clavulanic Acid followed closely behind with 673 prescriptions, accounting for 38.5%. Together, these two antibiotics constituted the majority of the prescriptions. The remaining antibiotics, including Amoxicillin, accounted for 22.1% of the total prescriptions. When Amoxicillin is included, the total prescriptions for these antibiotics increase to 992. This significant usage highlights the critical role these antibiotics play in dental treatments. The data emphasizes the heavy reliance on Metronidazole and Amoxicillin with Clavulanic Acid in dental practice, which likely reflects their broad-spectrum efficacy and effectiveness in treating common dental infections. Understanding these patterns is essential for optimizing antibiotic use, preventing resistance, and ensuring effective patient care in dental settings.

4. Discussion

The study focuses on analyzing antibiotic prescription patterns at the University Clinical Dentistry Center of Kosovo during the COVID-19 pandemic compared to the previous year. The analysis reveals several significant findings regarding antibiotic prescribing practices, perceptions of antibiotic quality, and the impact of COVID-19 on dental care and antibiotic consumption. The data indicates a varied distribution in antibiotic prescribing frequencies among patients, emphasizing the necessity for careful monitoring and regulation to ensure appropriate antibiotic use. The fluctuating patient caseloads observed reflect broader trends influenced by the pandemic's impact on healthcare utilization. Significant declines in patient numbers in 2020, attributed to pandemic-related disruptions, contrast with subsequent rebounds in 2021 as healthcare systems adapted to new

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protocols and patient needs. The subsequent decline in patient numbers in 2022 underscores ongoing shifts in healthcare delivery, potentially influenced by the normalization of telehealth services and evolving patient preferences for remote consultations.

Regarding antibiotic prescriptions, the study identifies clear preferences for certain antibiotics, notably Amoxicillin with Clavulanic Acid and Metronidazole, which collectively accounted for a substantial majority of prescriptions. This preference likely reflects their broad-spectrum efficacy and suitability for treating prevalent dental infections encountered during the study period. These findings underscore the importance of monitoring antibiotic prescribing practices to optimize treatment outcomes while minimizing the risks associated with antimicrobial resistance. Furthermore, the analysis of clinic distributions highlights the prevalence of specialized dental care facilities, particularly in periodontology and oral surgery, underscoring the healthcare system's capacity to address complex dental conditions. This distribution suggests a robust infrastructure supporting specialized oral health services, critical for managing diverse patient needs effectively.

Based on the detailed data and findings presented in Tables 7 to 20, several key points emerge regarding antibiotic use and patient management at Abela 5 clinic during the years 2019-2022. The clinic experienced a notable increase in the number of patients receiving multiple courses of antibiotics annually, reflecting a rising demand for healthcare services and ongoing antibiotic treatment among a significant subset of patients. Specifically, the data show a consistent upward trend in the number of patients requiring repeated antibiotic courses, reaching a peak of 94 patients in 2022. This trend underscores the clinic's critical role in managing chronic or recurrent medical conditions that necessitate prolonged antibiotic therapy.

Furthermore, analysis by Krasniqi et al. (2023) revealed that antibiotics were overprescribed for dental patients during the pandemic, even when bacterial co-infections were not present. The study indicated that nearly all hospitalized COVID-19 patients in secondary healthcare hospitals in Kosovo were treated with antibiotics, raising concerns about the rational use of these medications. Additionally, the study by Mustafa, Tolaj, Baftiu, and Fejza (2021) highlighted that ICU patients with COVID-19 in Kosovo were often treated with broad-spectrum antibiotics like imipenem, despite the limited evidence of bacterial co-infections.

This unrestricted use of antibiotics during the pandemic reflected a broader issue of over-prescription, which was not unique to Kosovo but part of a global trend. Comparatively, Haliti et al. (2017) documented that the prescription of antibiotics in primary dental care in Kosovo was already high before the pandemic, with a rate of 2.17 DDD/1,000 inhabitants/day. The pandemic further exacerbated this issue, as the lack of access to surgical interventions led to an over-reliance on antibiotics. The findings from Kosovo are consistent with international trends, emphasizing the need for improved antibiotic stewardship, while the pandemic highlighted the vulnerabilities in Kosovo's healthcare system, where antibiotics were used as a substitute for direct dental care, further contributing to the global issue of antimicrobial resistance.

In many other countries there were a lot of studies, such as Shah, Wordley, and Thompson (2020) from England revealed that during the peak of the pandemic, dental practices resorted to increased remote management of patients, relying heavily on antibiotics to treat infections, which resulted in a 25% increase in antibiotic prescribing compared to the previous year. This trend was especially notable in regions like London, where prescriptions increased by 60%. Similar findings were observed in Scotland. Duncan et al. (2021) reported that antibiotic prescribing rose by 49% following the suspension of routine dental care, and though this rate decreased after the remobilization of services, it remained elevated at 28% above pre-pandemic levels. In France, Bara et al. (2022) highlighted that outpatient antibiotic prescriptions remained high despite efforts to control antimicrobial resistance. The study pointed out that while prescriptions among pediatricians and general practitioners decreased, antibiotic use in dental practices saw an increase during the pandemic, particularly among female prescribers. This suggests that despite existing guidelines, the pandemic prompted dental professionals to rely more on broad-spectrum antibiotics to manage conditions that could not be addressed surgically during the lockdown.

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Australia also experienced significant shifts in dental prescribing behavior. Mian, Teoh, and Hopcraft (2021) reported a decrease in overall dental prescriptions, particularly for routine medications, but a corresponding increase in antibiotic use as an alternative to routine care. Amoxicillin with clavulanic acid and opioid analgesics like tramadol saw significant spikes during the pandemic. This trend indicates the global reliance on antibiotics as a stopgap when direct patient care was restricted. In Norway, Tousi et al. (2023) found that antibiotic prescriptions in dentistry increased during the pandemic, reversing a previously downward trend. This increase was particularly marked among elderly patients and in cases where penicillin-derived antibiotics were used. The study emphasized the need for improved antibiotic stewardship in dentistry, especially during periods of restricted access to care. In Croatia, Šutej et al. (2023) also reported a notable rise in the prescription of broad-spectrum antibiotics during the pandemic, particularly azithromycin, which saw a 39.3% increase. In other global regions such as Hungary (Kalas et al., 2024) and Germany (Albrecht, Schiegnitz, & Halling, 2024), similar patterns were observed, with increased antibiotic usage driven by the pandemic's constraints on dental care. In Hungary, a significant rise in the prescription of amoxicillin with clavulanic acid was noted, reflecting a global trend of reliance on broad-spectrum antibiotics during times of restricted access to in-person care. These studies collectively demonstrate a concerning global trend in dental practices where antibiotics were increasingly used to compensate for the lack of access to surgical care during the pandemic, leading to heightened concerns about antimicrobial resistance. Despite efforts in some regions to curb antibiotic overuse, the global reliance on antibiotics during this period highlighted the need for better preparedness and protocols in dental care to mitigate the future risks of antimicrobial resistance. Below are summarized the main studies conducted and their relevant findings.

Table 3. Literature review findings.

STUDY REFERENCE & COUNTRY	KEY FINDINGS	PRESCRIPTION TRENDS/ANTIBIOTICS USED	METHODOLOGY
Shah et al. (2020, England)	25% increase in antibiotic use due to limited dental access	Amoxicillin, Clindamycin	NHS Business Services Authority data analysis (2018-2020)
Duncan et al. (2021, Scotland)	49% increase in prescriptions due to suspended routine dental care	Amoxicillin, Metronidazole	Public Health Scotland national prescribing data and online dentist survey
Bara et al. (2022, France)	Increased prescriptions among elderly patients and reduced paediatric use	Penicillin, Amoxicillin	French National Health Data System (2019-2020)
Mian et al. (2021, Australia)	Rise in prescriptions of amoxicillin with clavulanic acid	Amoxicillin + Clavulanic Acid	PBS data from January-June 2019 and 2020
Tousi et al. (2023, Norway)	Reversed downward trend in antibiotic use during COVID-19	Penicillin, Amoxicillin	Norwegian Prescription Register (2016-2021)
Šutej et al. (2023, Croatia)	39.3% increase in azithromycin prescriptions	Azithromycin, Amoxicillin	Croatian Health Insurance Fund (2015-2020)
Krasniqi et al. (2023, Kosovo)	High dependency on pharmacological treatment with analgesics like ibuprofen	Amoxicillin, Ibuprofen	Cross-sectional study on 55 severe COVID-19 patients

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Hoti, A. et al. (2023, Kosovo)	Overuse of broad-spectrum antibiotics like amoxicillin and enzyme inhibitors	Amoxicillin + Clavulanic Acid, Clindamycin, Metronidazole	Retrospective analysis at University Dental Clinical Center of Kosovo (2019-2022)
Tolaj, I. et al. (2024, Kosovo)	All COVID-19 patients in secondary healthcare hospitals were treated with antibiotics	Ceftriaxone, Co-Amoxiclav	Cross-sectional study with 460 patients using ID-IRI questionnaire
Mustafa, L. et al. (2021, Kosovo)	ICU patients were treated with broad-spectrum antibiotics, raising concerns about resistance	Imipenem, Ceftriaxone	Observational study of 52 ICU patients at University Hospital in Pristina
Aliaga, L. et al. (2024, Kosovo)	Ongoing study focusing on medication adherence during the pandemic	Various	Survey distributed among healthcare professionals and patients
Chandrasekara et al. (2021, UK)	17% decrease in prescriptions during the pandemic.	Amoxicillin, Clindamycin	Retrospective data collection from urgent dental care records.
Subramanya et al. (2021, Global)	AMR worsened due to disrupted global health programs and increased antibiotic use.	Various, AMR-related drugs	Systematic review of AMR and antibiotic use during the pandemic.
Khami et al. (2022, Iran)	3.39-fold increase in self-medication with antibiotics post-pandemic.	Self-prescribed antibiotics, mainly broad-spectrum	Cross-sectional study of patient records pre- and post-pandemic.
Rabie & Figueiredo (2021, Canada)	66% increase in prescriptions, especially antibiotics and analgesics.	Amoxicillin, Clindamycin, Ibuprofen	Retrospective analysis of prescriptions in public dental clinics.
Dar-Odeh et al. (2020, Global)	Dentists restricted to emergency treatments, raising concerns over AMR.	Various, including amoxicillin, clindamycin	Literature review on dental practices during COVID-19.
Rodríguez-Fernández et al. (2022, Spain)	Decrease in prescriptions during lockdown, but rebound in 2021.	Amoxicillin, Clindamycin	Quasi-experimental study on prescription data.
Bordea et al. (2021, Global)	Emphasized need for strict infection control to prevent virus spread.	Various, dental-specific antibiotics	Systematic review of global dental policies during COVID-19.
Immel et al. (2024, Canada)	Significant reduction in antibiotic prescriptions during lockdown.	Amoxicillin, Ibuprofen	Retrospective time-series analysis of prescriptions.
Kitano et al. (2021, Canada)	31.2% reduction in antibiotic prescriptions during pandemic.	Respiratory antibiotics	Interrupted time series analysis of outpatient prescriptions.
Aliaga et al. (2024, Kosovo)	Medication adherence worsened during pandemic; findings still ongoing.	Various, adherence-related medications	Comprehensive survey of healthcare professionals and patients in Kosovo.

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Soleymani et al. (2024, Global)	Decreasing trends in dental antibiotic use reversed during COVID-19.	Penicillin, Clindamycin	Scoping review across global databases.
Cakolli et al. (2024, Kosovo)	High antibiotic use among dental students during COVID-19 in Kosovo.	Amoxicillin, Clindamycin	Survey of knowledge, attitude, and perception among dental students.
Petrac et al. (2024, Croatia)	Consistent prescribing patterns over 5 years, but COVID-19 disrupted practices.	Amoxicillin, Clindamycin, Cefuroxime	Retrospective cohort study of national dental practices.
Sović et al. (2024, Croatia)	Patterns of antibiotics used for endodontic therapy during COVID-19.	Amoxicillin, Clindamycin	Retrospective analysis of endodontic records during the pandemic.
Khan et al. (2022, Global)	Increase in antimicrobial consumption in COVID-19 patients globally.	Azithromycin, Doxycycline	Systematic review and meta-analysis.
Ivanovic & Jokic (2023, Serbia)	Private dental organizations faced significant challenges during COVID-19.	Amoxicillin, Azithromycin	Observational study of private dental practices during the pandemic.
Sulis (2021, Global)	Widespread antibiotic abuse in low- and middle-income countries worsened by COVID-19.	Amoxicillin, Azithromycin	McGill University study on global antibiotic abuse trends.
Petrač et al. (2024, Croatia)	Antibiotic consumption increased in Slavonia during the pandemic.	Amoxicillin, Penicillin	Observational study on antibiotic use in Croatian counties.
Serretiello et al. (2023, Italy)	AMR in Pseudomonas aeruginosa worsened during the pandemic.	Carbapenems, Fluoroquinolones	Retrospective cohort analysis in Italian hospitals.
Aliaga et al. (2024, Kosovo)	Survey study on medication adherence in Kosovo during COVID-19.	Amoxicillin, Adherence-related medications	Survey conducted with healthcare professionals and patients in Kosovo.
Mancini et al. (2022, Kosovo)	Orthodontic emergencies and antibiotic use increased during COVID-19.	Amoxicillin, Doxycycline	Retrospective cohort study on orthodontic emergencies.
Abubakar & Sartelli (2023, Global)	Identified 10 golden rules for antibiotic use in hospital settings.	Broad-spectrum antibiotics	International call to action on optimizing antibiotic use in hospitals.
Haliti et al. (2015, Kosovo)	Over-prescription of antibiotics in Kosovo's dental clinics.	Amoxicillin, Clindamycin	Retrospective analysis of dental prescriptions at the Oral Surgery Department.
Haliti et al. (2013, Kosovo)	Study on antibiotic utilization at the university dental clinic in Kosovo.	Amoxicillin, Clindamycin	Open Journal of Stomatology study on prescription trends.

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Horvat et al. (2022, Serbia)	Survey on knowledge and attitudes towards antibiotic use among prescribers.	Amoxicillin, Penicillin	Prospective antibiotic prescribers survey in Serbia.
Lila et al. (2018, Kosovo)	Pseudomonas aeruginosa prevalence and AMR trends in Kosovo's University Hospital.	Carbapenems, Fluoroquinolones	Molecular epidemiology study at the University Clinical Center of Kosovo.
Etana et al. (2017, Ethiopia)	Cross-sectional study on antibiotic use patterns at a dental clinic.	Amoxicillin, Metronidazole	Retrospective analysis of prescriptions in Ethiopian dental practices.
Hamiti-Krasniqi et al. (2014, Kosovo)	Local application of Clindamycin reduced dry socket after molar extraction.	Clindamycin	Randomized, placebo-controlled trial in Kosovo dental clinics.

Source: author collection from literature review.

The findings from the table demonstrate a significant shift in antibiotic prescription trends during the COVID-19 pandemic, as various countries and healthcare systems adapted to the challenges posed by restricted access to routine dental care. In many cases, there was a noticeable increase in antibiotic prescriptions, as seen in the studies by Shah et al. (2020) in England, Duncan et al. (2021) in Scotland, and Šutej et al. (2023) in Croatia. These increases were primarily driven by limited dental access and the suspension of routine dental services, which forced healthcare providers to rely more heavily on pharmacological treatments for managing dental infections. For instance, Shah et al. (2020) reported a 25% increase in antibiotic prescriptions in England, primarily for drugs like amoxicillin and clindamycin, based on NHS Business Services Authority data. Similarly, Duncan et al. (2021) in Scotland found a 49% rise in prescriptions, again for antibiotics such as amoxicillin and metronidazole. These findings align with global trends where many countries experienced an increase in antibiotic use due to the shift toward remote dental consultations and an overreliance on antibiotics as a preventive measure against infections. However, some regions, such as Ontario, Canada, exhibited a reduction in prescriptions during the pandemic. Kitano et al. (2021) noted a 31.2% decrease in antibiotic prescriptions, which could be attributed to more stringent public health measures and better-managed dental services. Similarly, studies like Immel et al. (2024) and Rodríguez-Fernández et al. (2022) showed fluctuations in prescribing patterns, with some areas experiencing initial declines in antibiotic use followed by rebounds as dental services resumed. In Kosovo, Hoti et al. (2023) and Tolaj et al. (2024) found that there was a notable increase in the use of broad-spectrum antibiotics, particularly amoxicillin with clavulanic acid, clindamycin, and metronidazole. This rise highlights the challenges faced by the dental care system in managing severe cases during the pandemic, as well as the dependency on pharmacological treatments in the absence of in-person care.

The methodological approaches of these studies were largely retrospective, utilizing national or institutional prescription databases to analyze trends over time. Several studies, such as Krasniqi et al. (2023) and Aliaga et al. (2024) in Kosovo, employed cross-sectional designs or retrospective cohort studies to examine antibiotic consumption and adherence. The retrospective analysis of patient data provided insights into how pandemic-related disruptions affected antibiotic use and what the long-term implications might be, particularly concerning antimicrobial resistance (AMR).

5. Conclusions

This study aimed to investigate the impact of the pandemic on antibiotic prescription trends and assess how changes in dental healthcare practices influenced the utilization of various antibiotic

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classes. Based on the findings, it is evident that the COVID-19 pandemic led to a marked increase in antibiotic prescriptions, primarily due to the restricted access to in-person dental care and the reliance on pharmacological treatments as an alternative to procedural interventions. The analysis of prescription data highlighted an increased use of broad-spectrum antibiotics such as amoxicillin, clavulanic acid, clindamycin, and metronidazole, reflecting a global trend observed across many regions. In Kosovo, specifically, the overuse of these antibiotics raises concerns about antimicrobial resistance (AMR), which has been exacerbated by the pandemic's disruptions. The findings align with similar studies from other countries, which also reported significant rises in antibiotic use during the pandemic, further emphasizing the critical role of effective antibiotic stewardship, especially in times of crisis. The study's conclusions point to the need for improved dental care protocols during health emergencies, ensuring that antibiotics are prescribed judiciously to prevent long-term public health challenges such as AMR. Additionally, the study highlights the importance of maintaining access to routine dental services during pandemics to minimize the need for excessive pharmacological interventions. Future research should focus on implementing targeted antibiotic stewardship programs in dental settings, particularly in regions with limited resources, to mitigate the adverse effects of increased antibiotic use during public health crises like the COVID-19 pandemic.

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