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Changes in Antibiotic Redemption Related to Hungarian Dental Care During COVID-19

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ABSTRACT

Introduction and aims: Antibiotic resistance is a global health problem that can affect individuals, health systems, and the economy. Our aim was to investigate how the redemption of antibiotics and the associated dental care changed during COVID-19 in Hungary.
Methods: The ICD codes for the infections for which antibiotics should be prescribed in dental care were identified based on the professional recommendation. The database was provided by the National Health Insurance Fund Manager of Hungary. Pearson's chi-squared test with Bonferroni correction was used to compare both the redemption of antibiotics and the associated dental care based on the recommendations in the year 2020 of the COVID-19 and the 2 preceding years.
Results: There were fewer antibiotic redemptions and associated dental care in 2020 than in 2018 and 2019. The ratio of professionally relevant and nonrelevant antibiotics redeemed did not change significantly between 2018 and 2019, but the proportion of antibiotics redeemed following recommendations increased significantly during the COVID-19 year of 2020 compared to the previous 2 years. The proportion of all dental care involving antibiotic redemptions increased significantly from 2018 to 2019, and then showed a further increase in 2020. The sex and age of the patient did not affect these findings, while the type of dental care did alter the trends in some cases.
Conclusions: Antibiotics in dentistry are required only for very low proportion of cases, due to the nature of dental care where most infections such as caries and periodontal disease could be managed without resorting to antibiotics. Antibiotic redemptions during COVID-19 pandemic period increased compared to the pre-pandemic period in Hungary. Therefore, Hungarian policy makers need to develop control systems to promote the correct use of antibiotics in dental care.
Clinical relevance: It is important to reduce unjustified use of antibiotics so as to curb the emergence of antibiotic resistance organisms.

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Introduction

The discovery of antibiotics was a milestone in the development of medicine.[1] Many diseases with high mortality and morbidity became treatable with the use of these drugs.[2] In dentistry, these diseases are grouped into odontogenic and non-odontogenic infections.[3] Odontogenic infections are caused by the inflammation of the teeth or the surrounding periodontal tissues around them, while other oral infections are called non-odontogenic.[4] All of these infections can develop cavernous sinus thrombosis,[5] brain abscess,[6] airway obstruction,[7] and mediastinitis[8] as possible life-threatening complications.[9] Antibiotics can be used by dentists for prophylactic and therapeutic reasons.[10] From all of the above, we can conclude the importance of these drugs. However, even with the proper use of antibiotics, multidrug-resistant bacteria appeared that still poses a new challenge for everyday medicine.[11] Nowadays, antimicrobial resistance is a global problem, mainly due to doctors prescribing antibiotics to patients without justification.[12,13] Approximately 10% of all antibiotic prescription are related to dental infections.[14] If the misuse and overuse of these drugs do not change in the near future, the preantibiotic era can re-emerge, which will be a considerable burden on health care systems all around the world.[15] Dentists play a crucial role in avoiding antimicrobial infections and also in the fight against multidrug-resistant bacteria. Several studies have shown that the contribution of dentists to the total antibiotic consumption is significant,[16-19] and an increasing trend in the rate of antibiotic prescription by dentists has been observed worldwide.[19-21] Other studies have found that dentists tend to prescribe antibiotics unnecessarily for inappropriate clinical indications and may not adhere to the recommended guidelines.[22,23] Over prescription of antibiotics exposes patients to the risk of adverse effects and increases dental care cost.[24] Therefore, the variation in prescription patterns and clinical indications underline the need for guidelines for dentists.

The Antimicrobial Prescribing in Dentistry: Good Practice Guidelines gives a clear, simple, and practical guidance for dentists on when to prescribe antimicrobials, what to prescribe, for how long, and at what dosage.[25] Based on these recommendations, several countries created their own national clinical guidelines for antibiotic prophylaxis to help the work of their dentists.[25,26] However, in Hungary, there is no national guideline for the prescription of antibiotics in dentistry; therefore, the Faculty of Dentistry of the Semmelweis University has produced a position paper on the use of antibiotics in oral surgery.[27] The resolution aims to present a comprehensive picture of the use of antibiotics in oral aspects and use of oral medicine, which is consistent with the most recent scientific research findings and recommendations in the literature.[27]

Currently, there is no study which investigates the pattern of antimicrobial use in dental care in Hungary covering the majority of the population. Furthermore, the effect of the coronavirus disease 2019 (COVID-19) on antibiotic use in dental care is also unknown.

Taking these into consideration, the goal of our study was to investigate how many of these drugs were redeemed in the first year of the COVID-19 pandemic and in the previous 2 years. The primary question this study aims to answer is does a pandemic change antibiotic redemption ratio and the ratio of dental care associated with the usage of antibiotics. Understanding the possible relations could be beneficial during the next global pandemic, as such an event might either facilitate or prevent proper antibiotic usage.

Methods

This longitudinal study was carried out between 2018 and 2021. The study focused on a comparative analysis of data for antibiotic redemption with relevant ICD 10 (International Statistical Classification of Diseases and Related Health Problems) codes and beyond relevant ICD codes related to publicly funded dental care in Hungary. The number of redemptions for antibiotics with relevant ICD codes and redemptions beyond relevant ICD codes prescribed by dentists were obtained from the National Health Insurance Fund Manager of Hungary covering the total adult population (aged 18 years and older). The data were provided at the dental care level in an aggregated form; therefore, the identification of individual patients was not possible. The authors requested the database taking into consideration the following factors: The relevant ICD codes for antibiotic use were determined by the Faculty of Dentistry of the Semmelweis University in Hungary.[27] Antibiotic prescription and redemption with the relevant ICD 10 codes are as follows: K0470 Abscess around root apex without cavity, K1020 inflammatory lesions of jawbones, K1030 alveolitis, K1220 cellulitis and abscess in mouth, M8690 osteomyelitis. Although it is not included in the guideline, the following 2 conditions also require antibiotic therapy: J0100 Acute maxillary sinusitis and S0250 Fracture of teeth.

Antibiotic drug redemption data for the Hungarian adult population were stratified by type of care provider (university dental care, university specialised dental care, specialised dental care for adults with disabilities, adult dental care, orthodontics, periodontology, oral surgery, out of hour service, adult, and children's dental care) year, age groups (18-29, 30-49, 50-69, 70-89, 90+), and sex. Regarding the type of care, X-rays and various types of dental care for children were excluded from the analysis.

The examined period was divided into 3 years (March 2018-February 2019; March 2019-February 2020; March 2020-February 2021). The first 2 examined years were before the COVID-19 pandemic, thus, they can be used as a baseline. The first confirmed case of COVID-19 infection in Hungary was reported on March 4, 2020[28]; therefore, each 12-month period in our study starts from March and lasts until February.

Pearson's chi-squared test was performed to investigate the differences in proportions between the years, with the level of significance being set at 0.05. Bonferroni correction was applied to account for multiple comparisons. All statistical analyses were done with STATA v13 (StataCorp LLC).

The study was approved by the Scientific Research and Ethics Committee of the Medical Research Council in Hungary (code: IV/129/2022/EKU; date: January 26, 2022).

Results

Between March 2018 and February 2021, 490,033 antibiotic drug redemptions and 4,652,108 adult dental visits occurred

Table 1 – Distribution and change in antibiotic drug redemption and dental care between March 2018 and February 2021 by sex and overall.

			03.2018-02.2019	03.2019-02.2020	03.2020-02.2021	2018/19 vs 2019/20 P-value	2018/19 vs 2020/21 P-value	2019/20 vs 2020/21 P-value
Male	Drug redemption with relevant ICD code	N	21,143	21,335	19,683	.132	<.001*	<.001*
		%	28.9%	28.5%	30.0%			
	Drug redemption beyond relevant ICD code	N	52,030	53,419	46,002			
		%	71.1%	71.5%	70.0%			
	Dental care with relevant ICD code	N	56,522	58,151	52,503	<.001*	<.001*	<.001*
		%	7.5%	7.9%	9.8%			
	Dental care beyond relevant ICD code	N	702,053	678,992	481,728			
		%	92.5%	92.1%	90.2%			
Female	Drug redemption with relevant ICD code	N	26,560	27,468	24,780	.085	<.001*	<.001*
		%	28.0%	28.4%	29.2%			
	Drug redemption beyond relevant ICD code	N	68,170	69,278	60,165			
		%	72.0%	71.6%	70.8%			
	Dental care with relevant ICD code	N	69,657	71,404	62,746	<.001*	<.001*	<.001*
		%	7.1%	7.5%	9.1%			
	Dental care beyond relevant ICD code	N	908,511	882,769	627,072			
		%	92.9%	92.5%	90.9%			
Overall	Drug redemption with relevant ICD code	N	47,703	48,803	44,463	.769	<.001*	<.001*
		%	28.4%	28.5%	29.5%			
	Drug redemption beyond relevant ICD code	N	120,200	122,697	106,167			
		%	71.6%	71.5%	70.5%			
	Dental care with relevant ICD code	N	126,179	129,555	115,249	<.001*	<.001*	<.001*
		%	7.3%	7.7%	9.4%			
	Dental care beyond relevant ICD code	N	1,610,564	1,561,761	1,108,800			
		%	92.7%	92.3%	90.6%			

* Significant after Bonferroni correction ($P < .0027$); $\chi 2$ test.

in Hungary. In all 3 years, the minority of antibiotic drug redemptions (28.4%-29.5%) were registered with a prescription having the expected ICD code (Table 1). There was no significant difference observed between 2018 and 2019 ($P = .769$); however, there was a significant increase in 2020 compared to the previous 2 years ($P < .001$ in both cases). Regarding dental care with the investigated ICD codes, a steady significant increase was detected year by year ($P < .001$ in all cases). After stratifying the overall data based on the sex of the patient, the overall pattern remained the same for both female and male patients. Similarly, when dividing the overall data based on age groups, with the exemption of patients 90 years and older, the same pattern was observed than with the overall data (Table 2). Therefore, neither the sex or the age of the patient influenced the rate of the antibiotic drug redemptions with the investigated ICD codes, nor the rate of the dental care with relevant ICD codes.

However, when investigating the antibiotic drug redemptions and the dental care based on the type of health care provider, a more complex pattern emerged (Table 3). While university dental care, university specialised dental care, adult dental care, and adult and child dental care followed the aforementioned pattern, the other types of care deviated from this. Regarding specialised dental care for adults with disabilities and considering orthodontic care the absolute number of the yearly antibiotic redemptions never reached 100; thus, the statistical analysis of these types of care should be interpreted with caution. When investigating the changes in antibiotic redemption for periodontology and oral surgery, no significant difference was observed between the years, even though the dental care episode which would have allowed the prescription of antibiotics increased significantly in almost in each year. Finally, for out of hours dental service, the ratio of antibiotic redemption has decreased regarding with a prescription containing the expected ICD between 2018 and 2019 ($P = .002$), which has increased the following year ($P = .021$); however, this change was not significant after Bonferroni correction.

Discussion

In our study, we investigated dental care antibiotic use in Hungary in order to identify the extent that antibiotic use complies with professional recommendations. Our results show that the number of dental visits and the corresponding use of antibiotics increased from 2018 to 2019 and decreased in 2020.

Overall, the majority of antibiotic prescriptions in Hungary were not redeemed with a prescription containing the relevant ICD codes as per the professional recommendation. There was no difference between 2018 and 2019 in terms of antibiotic prescriptions, but in 2020, there was a small but significant increase in the number of professionally justified antibiotic prescriptions. This is presumably due to the restrictions imposed[29,30] on the availability of health care services (including dental care) in 2020 as the COVID-19 pandemic appeared in Hungary. In addition, during the pandemic period, designated dental treatments were mainly provided at the highest level of progressivity of care, so it can be

Table 2 – Distribution and change in antibiotic drug redemption and dental care between March 2018 and February 2021 by age groups.

			03.2018-02.2019	03.2019-02.2020	03.2020-02.2021	2018/19 vs 2019/20 P-value	2018/19 vs 2020/21 P-value	2019/20 vs 2020/21 P-value
18-29	Drug redemption with relevant ICD code	N	10,090	10,273	9,128	.691	<.001*	<.001*
		%	28.4%	28.5%	29.5%			
	Drug redemption beyond relevant ICD code	N	25,465	25,726	21,828			
		%	71.6%	71.5%	70.5%			
	Dental care with relevant ICD code	N	27,355	28,298	26,035	<.001*	<.001*	<.001*
		%	6.8%	7.4%	9.8%			
	Dental care beyond relevant ICD code	N	374,425	354,943	239,859			
		%	93.2%	92.6%	90.2%			
30-49	Drug redemption with relevant ICD code	N	18,859	18,961	17,460	.892	.024	.033
		%	28.7%	28.7%	29.4%			
	Drug redemption beyond relevant ICD code	N	46,841	47,002	41,940			
		%	71.3%	71.3%	70.6%			
	Dental care with relevant ICD code	N	47,150	47,985	43,654	<.001*	<.001*	<.001*
		%	7.2%	7.6%	9.4%			
	Dental care beyond relevant ICD code	N	608,905	583,557	422,354			
		%	92.8%	92.4%	90.6%			
50-69	Drug redemption with relevant ICD code	N	13,942	14,268	13,014	.442	<.001*	<.001*
		%	28.2%	28.0%	29.5%			
	Drug redemption beyond relevant ICD code	N	35,476	36,771	31,152			
		%	71.8%	72.0%	70.5%			
	Dental care with relevant ICD code	N	36,923	37,379	32,628	.001*	<.001*	<.001*
		%	7.6%	7.8%	9.3%			
	Dental care beyond relevant ICD code	N	448,813	442,129	317,470			
		%	92.4%	92.2%	90.7%			
70-89	Drug redemption with relevant ICD code	N	4,759	5,241	4,804	.181	<.001*	.012*
		%	27.9%	28.7%	30.2%			
	Drug redemption beyond relevant ICD code	N	12,273	13,020	11,114			
		%	72.1%	71.3%	69.8%			
	Dental care with relevant ICD code	N	14,513	15,617	12,726	<.001*	<.001*	<.001*
		%	7.6%	8.1%	9.1%			
	Dental care beyond relevant ICD code	N	175,397	178,002	126,930			
		%	92.4%	91.9%	90.9%			
90+	Drug redemption with relevant ICD code	N	53	60	57	.750	.550	.346
		%	26.8%	25.2%	30.0%			
	Drug redemption beyond relevant ICD code	N	145	178	133			
		%	73.2%	74.8%	70.0%			
	Dental care with relevant ICD code	N	238	276	206	.235	.082	.511
		%	7.3%	8.1%	8.6%			
	Dental care beyond relevant ICD code	N	3,024	3,130	2,187			
		%	92.7%	91.9%	91.4%			

* Significant after Bonferroni correction ($P < .0017$); $\chi 2$ test.

assumed that the appropriateness of the prescription of antibiotics led to better outcomes as a result of higher professional standards. Nevertheless, during the COVID-19 period, the prescription of antibiotics with the relevant ICD code on the prescription did not amount to one third of the prescriptions. Our study found that sex and age did not influence the results. However, our previous hypothesis is supported by the fact that the health care institution's type influenced whether antibiotic prescriptions were in accordance with the professionally relevant recommendation. Antibiotic utilisation was already researched in other countries; however, the methodology was never quite the same. In Sweden, they used 2 questionnaires which were answered by dentists at a large public and private dentistry. One of the questionnaires was about the dentists' knowledge and attitude towards antibiotic treatment, while the other pertained to the emergency care provided there.[31] In Germany, they summarised literature, clinical guidelines, and interventions on antibiotic use in the outpatient dental care sector. They also reviewed national and international studies which have investigated the effectiveness of antibiotic stewardship strategies tailored to dentistry.[32] In Ghana, a retrospective clinical audit was conducted by extracting the medical records of patients seeking dental care in the Keta Municipal Hospital to evaluate the appropriateness of antibiotic use among ambulatory patients.[33] Thompson et al[34] used Delphi method on a total of 33 participants from 15 countries, including 8 low- and middle-income countries to try to ensure responsible antibiotic use. The conclusion in almost all related studies was that there is an urgent need for the education of dentists and patients regarding antibiotic knowledge, and prescription guidelines would be necessary to make everyday work easier.

Table 3 – Distribution and change in antibiotic drug redemption and dental care between March 2018 and February 2021 by type of care provider.

			03.2018-02.2019	03.2019-02.2020	03.2020-02.2021	2018/19 vs 2019/20 P-value	2018/19 vs 2020/21 P-value	2019/20 vs 2020/21 P-value
University dental care	Drug redemption with relevant ICD code	N	6	9	32	.753	.025	.031
		%	7.1%	8.3%	18.4%			
	Drug redemption beyond relevant ICD code	N	79	99	142			
		%	92.9%	91.7%	81.6%			
	Dental care with relevant ICD code	N	177	284	314	<.001*	<.001*	<.001*
		%	2.1%	3.2%	5.5%			
	Dental care beyond relevant ICD code	N	8,389	8,461	5,420			
		%	97.9%	96.8%	94.5%			
University specialised dental care	Drug redemption with relevant ICD code	N	1,013	1,094	968	.109	.024	<.001*
		%	40.6%	37.9%	45.0%			
	Drug redemption beyond relevant ICD code	N	1,480	1,793	1,184			
		%	59.4%	62.1%	55.0%			
	Dental care with relevant ICD code	N	12,714	10,898	15,873	<.001*	<.001*	<.001*
		%	11.7%	10.8%	19.1%			
	Dental care beyond relevant ICD code	N	95,835	89,714	67,116			
		%	88.3%	89.2%	80.9%			
Specialised dental care for adults with disabilities	Drug redemption with relevant ICD code	N	0	2	4	.035	.004	.445
		%	0%	8.7%	16.7%			
	Drug redemption beyond relevant ICD code	N	51	21	20			
		%	100%	91.3%	83.3%			
	Dental care with relevant ICD code	N	54	64	37	.170	.133	.747
		%	4.8%	6.1%	6.6%			
	Dental care beyond relevant ICD code	N	1,077	977	526			
		%	95.2%	93.9%	93.4%			
Adult dental care	Drug redemption with relevant ICD code	N	7,197	7,627	7,050	.076	<.001*	<.001*
		%	27.8%	28.6%	30.6%			
	Drug redemption beyond relevant ICD code	N	18,683	19,010	16,014			
		%	72.2%	71.4%	69.4%			
	Dental care with relevant ICD code	N	22,012	27,507	21,227	<.001*	<.001*	<.001*
		%	7.3%	9.3%	10.4%			
	Dental care beyond relevant ICD code	N	278,755	266,849	182,204			
		%	92.7%	90.7%	89.6%			
Orthodontic care	Drug redemption with relevant ICD code	N	9	26	7	.271	.241	.014
		%	32.1%	49.1%	17.9%			
	Drug redemption beyond relevant ICD code	N	19	27	32			
		%	67.9%	50.9%	82.1%			
	Dental care with relevant ICD code	N	1,786	960	2,242	<.001*	<.001*	<.001*
		%	9.7%	5.8%	14.4%			
	Dental care beyond relevant ICD code	N	16,547	15,571	13,316			
		%	90.3%	94.2%	85.6%			
Periodontology	Drug redemption with relevant ICD code	N	65	76	61	.713	.345	.537
		%	51.2%	48.1%	43.3%			
	Drug redemption beyond relevant ICD code	N	62	82	80			
		%	48.8%	51.9%	56.7%			
	Dental care with relevant ICD code	N	612	1,000	1,793	<.001*	<.001*	<.001*
		%	13.8%	19.7%	36.3%			
	Dental care beyond relevant ICD code	N	3,811	4,079	3,145			
		%	86.2%	80.3%	63.7%			
Oral surgery	Drug redemption with relevant ICD code	N	3,143	3,566	2,470	.168	.120	.757
		%	30.2%	29.2%	28.9%			
	Drug redemption beyond relevant ICD code	N	7,270	8,654	6,063			
		%	69.8%	70.8%	71.1%			
	Dental care with relevant ICD code	N	15,614	15,424	11,955	.012	<.001*	<.001*
		%	11.5%	11.2%	13.1%			
	Dental care beyond relevant ICD code	N	120,062	122,457	79,504			
		%	88.5%	88.8%	86.9%			

(*continued*)

Table 3. (*Continued*)

			03.2018-02.2019	03.2019-02.2020	03.2020-02.2021	2018/19 vs 2019/20 P-value	2018/19 vs 2020/21 P-value	2019/20 vs 2020/21 P-value
Out of hours service	Drug redemption with relevant ICD code	N	2,688	2,567	2,211	.002	.021	.546
		%	42.4%	39.0%	39.7%			
	Drug redemption beyond relevant ICD code	N	3,655	4,020	3,364			
		%	57.6%	61.0%	60.3%			
	Dental care with relevant ICD code	N	6,668	7,774	6,199	<.001*	<.001*	<.001*
		%	18.5%	22.2%	24.4%			
	Dental care beyond relevant ICD code	N	29,465	27,290	19,211			
		%	81.5%	77.8%	75.6%			
Adult and children dental care (mixed)	Drug redemption with relevant ICD code	N	33,582	33,836	31,660	.539	<.001*	<.001*
		%	27.4%	27.5%	28.5%			
	Drug redemption beyond relevant ICD code	N	88,901	88,991	79,268			
		%	72.6%	72.5%	71.5%			
	Dental care with relevant ICD code	N	66,542	65,644	55,609	.008	<.001*	<.001*
		%	5.9%	6.0%	7.0%			
	Dental care beyond relevant ICD code	N	1,056,623	1,026,363	738,358			
		%	94.1%	94.0%	93.0%			

* Significant after Bonferroni correction ($P < .001$); $\chi 2$ test.

Also global efforts to tackle antibiotic resistance could and should be improved significantly. Although certain types of dental care facilities have a more favourable use of professionally relevant antibiotics, but even so, we did not identify a single type of facility where at least half of the total antibiotic prescriptions was in accordance with the ICD code as listed in the professional recommendation.[27]

Limitations and strengths

In our research, we were only able to examine publicly funded antibiotic prescriptions and dental care, as the National Health Insurance Fund Manager of Hungary has no data on private care. The number of antibiotic prescriptions for certain types of care was very low, as was the number of people aged 90 and over, which may have affected the statistical analysis. We did not have data that could show whether the dentist's specifications affected the examined outcomes. In addition, our data were available only for antibiotic redemption as the owner of the data did not have information on prescription; thus, the data analysed did not include the cases where the dentist prescribed the antibiotic, but the patient decided not to redeem it at the pharmacy.

The strengths of our study were that we were able to compare 3 years of data nationally and that this was done with a large number of cases. Also, we were able to look at 2 full years as a baseline prior to the onset of the COVID-19 pandemic.

Conclusions

Despite a fair proportion of patients needing antibiotics, only a low proportion of antibiotic prescriptions are recommended by the dental profession due to the nature of dental care where most infections such as caries and periodontal disease could be managed without resorting to antibiotics. Although the situation has improved during the COVID-19 epidemic, the extent of the improvement is not satisfactory. Therefore, Hungarian health policy makers need to develop an incentive and monitoring system to promote the correct use of antibiotics in dental care.

Author contributions

Nándor Kalas: Conceptualisation, Data curation, Writing—original draft. Klára Boruzs: Conceptualisation, Writing—original draft, Methodology, Supervision. Klára Bíró: Conceptualisation, Methodology, Writing—original draft. Gábor Bányai: Writing—review and editing. Viktor Dombrádi: Conceptualisation, Methodology, Writing—review and editing. Attila Nagy and Nóra Kovács: Conceptualisation, Methodology, Data analysis, Writing—original draft. All authors contributed to the article and approved the submitted version.

Conflict of interest

None disclosed.

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