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Knowledge and practices of antibiotic prescription in Arkhangelsk, Russia. A cross-sectional survey among dentists and dental students

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Abstract

Aim:

Considering the possible risk of continuing the negative trend of the development of resistant bacteria, and the association of high resistance to high use of antibiotics, therefore it is important to map the general knowledge among all healthcare professionals, including dentists, about antibiotic use practices. The aim of the study was, therefore, to reveal the knowledge among dentists, specialists and dental students regarding usage and prescription of antibiotics in Arkhangelsk, Russia.

Material and methods:

A questionnaire was distributed to dentists and last year dental student in the Arkhangelsk region in the span of one month in April of 2017. It was comprised of a total of 50 scoreable questions regarding knowledge and prescription of antibiotics in dentistry. Demographical questions were also collected. The scoreable questions were given values of one for correct answers and zero for incorrect. Mean scores were calculated as percentages and categorized as good (>80%), intermediate (60–80%), or poor (<60%).

Results:

169 Participants fully filled out the questionnaire and were eligible to be analysed. The response rate was estimated to be around 22 percent. More than half of the participants were female (65.1%), and about half were in the age group 20 to 24 years of age (53.8%). The usage of Amoxicillin with Clavulanic acid was reported most frequently among the participants with over half checking it off (55.6%). Overall average knowledge was intermediate at 71.1%, with clinical signs having the poorest knowledge at 64.8% and the highest being non-clinical factors at 78.0%. Specialists working in the private sector had significantly better knowledge. Gender and work experience were not shown as statistically significant.

Conclusion:

The knowledge was shown to be intermediate, and generally consistent among groups and factors. Some outlier questions were answered mostly wrong or mostly correct, but the general consensus of the intermediate knowledge indicates that there is a need for more concentrated education and guidelines promoting restriction and correct usage of antibiotics.

Keywords:

Antibiotics; Antibiotic resistance; Prescription; Knowledge; Dentist. Russia; Arkhangelsk.

1. Introduction

Background:

Antibiotic resistance is one of the biggest threats to global health, food security, and development today (1). The usage of antimicrobial agents, ever since their discovery, has aided every branch of medicine both in effective infection treatment and prophylactic use. However, the usage and misuse of antimicrobial agents, such as antibiotics, has sped up and led to an increased development of antimicrobial resistant strains of bacteria, viruses and fungi (1, 2). A consequence of this is a decreased effectiveness of first-line antibiotics, resulting in more expensive treatments, longer illness duration in addition to more frequent hospitalization (2). The World Health Organization, European division (WHO-Europe), statement on antibiotic resistance read as follows: “Antibiotic resistance is putting the achievements of modern medicine at risk. Organ transplantations, chemotherapy and surgeries such as caesarean sections become much more dangerous without effective antibiotics for the prevention and treatment of infections” (3).

The misuse and overuse of antibiotics in medical professions, including dentistry, are probably contributing to the negative development of bacterial resistance to certain kinds of antibiotics (4-6). The use of antimicrobials by dentists is considerably lower than those of medical practitioners (7, 8), however, the number of reports of overuse of antibiotics by dentists are increasing and thus probably contributing to the development of resistant bacteria (5, 6, 9, 10). Inappropriate prescribing and use have been identified as major factors in the emergence of antibiotic resistance (5, 7, 11).

In dental practice, periodontal, and dental related diseases are mainly treated without the need of antibiotics, but rather by operative and mechanical intervention. In these situations where antibiotics are needed, empirical therapy with β -lactams antibiotics are the prominent drugs of choice to treat dental infections.

According to several studies, prescriptions attributed to dentists accounted for around 7 to 11 % of all commonly prescribed antibiotics for patients. The antibiotics prescribed by dentists include antibiotics such as β -lactams, tetracycline, macrolides and metronidazole (5, 12). One study even shows that 40% of all prescribed metronidazole in the community are prescribed by dentists alone (4).

Being the largest and one of the most populous countries in the world, spanning both Europa and Asia, Russia is without a doubt a major consumer of antimicrobial agents and antibiotics. When taking into consideration that Russia covers over one eighths of the worlds land area, but only house less than two percent of the world population. It is clear that this massive, yet partly sparsely populated nation will in some degree, have difficulties in maintaining control over its consumption and usage of antibiotics on a national scale.

The consumption of antibiotics per capita in Russia is fairly low, but a rapport from the Center for Disease Dynamics, Economics and Policy report that Russia had an increased consumption of antibiotics of 19 percent in the timespan from 2000 to 2010 (13).

For dental care, there are no written national antibiotic prescription guidelines for dentists working in Russia. The aim of the study was, therefore, to reveal the knowledge among dentists, specialists and dental students regarding the use and prescription of antibiotics in Arkhangelsk, Russia.

2. Material and Methods

A structured, cross-sectional, questionnaire composed of 50 questions was used to study knowledge and practices of antibiotic prescription among dentists in Arkhangelsk, Russia. The survey questionnaire was conducted in April 2017 and was completely anonymous. The questionnaire was based on a similar survey done previously in UK, Yemen and in Saudi Arabia (14-16)

Excluding demographical and professional data the questionnaire consisted of 50 scorable questions estimating knowledge of antibiotic prescription in clinical dentistry in five domains related to clinical practice and proper judgment: clinical signs (six items); clinical conditions (thirteen items); non-clinical factors (five items); dental procedures in absence of relevant medical history (seven items) and extraction/periodontal treatment in presence of relevant medical conditions (nineteen items). Questions regarding choice of antibiotics for empirical treatment of dental infections when antibiotics are truly needed and previous attendance of antibiotic workshops and lectures were also included in the questionnaire.

The original questionnaire was translated from English into Russian and then from Russian to English for quality control. However, the distributed questionnaire was presented in both English and Russian to study participants. The questionnaire was made available to general dental practitioners (GDPs), dental specialists and 5th year dental students in Arkhangelsk both by post and as an online survey. The distribution of questionnaire was facilitated by the Northern State Medical University and the Health authority in the Arkhangelsk region in North Russia.

Assessment of the questions describing knowledge of antibiotic prescription in the five domains was all given a possible score on one. Total, per-domain, and per-item mean scores were calculated, transformed to percentages, and categorized as good knowledge (>80%), intermediate knowledge (60-80%) and poor knowledge (<60%).

3. Results

Out of approximately 670 dentists serve in the Arkhangelsk region and a total of 100 last year dental students, a total of 178 participants submitted answers to the questionnaire, either online or by paper. However only 169 participants fully completed the obligatory questions on the questionnaire thus resulting in 169 valid entries. This results in a participation- and response rate of approximate 22%. The online questionnaire was made in such a way that it had to be fully answered to be submitted, but the ones filled out on paper was filled out however the participants saw fit. As such nine entries had to be discarded.

Table 1 displays the demographical characteristics of the 169 participants who completed the questionnaire. Most the participants were females (65%), Last year students (39%), between the age of 20 and 24 years (54%), worked in the governmental sector (55%), and had less than 5 years of experience (69%). Almost half (47%) of the participants reported to have attended a lecture or workshop regarding prescription of antibiotics as a part of continuous education program within the last two years.

Table 1. Characteristics of the respondents (N=169)

CHARACTERISTICS	NUMBER	%
GENDER		
MALE	59	34.9
FEMALE	110	65.1
AGE GROUP		
20-24 YEARS	91	53.8
25-29 YEARS	31	18.3
30-39 YEARS	23	13.6
40-49 YEARS	14	8.3
≥ 50 YEARS	10	5.9
SPECIALTIES[†]		
STUDENTS	66	39.1
GENERAL DENTAL PRACTITIONERS (GDP)	43	25.4
SPECIALISTS	60	35.4
WORK SECTOR		
GOVERNMENT	93	55
PRIVATE	46	27.2
ACADEMIC	30	17.8
YEARS OF EXPERIENCE (N=485)		

UP TO 5 YEARS	117	69.2
5-9 YEARS	12	7.1
10-14 YEARS	15	8.9
15-20 YEARS	7	4.1
> 20 YEARS	18	10.7
ATTENDING A LECTURE OR A WORKSHOP ON ANTIBIOTICS PRESCRIPTION AS PART OF CONTINUOUS EDUCATION PROGRAM IN LESS THAN 2 YEARS AGO	80	47.3
BETWEEN 2-5 YEARS AGO	32	18.9
MORE THAN 5 YEARS AGO	12	7.1
NEVER	45	26.6

Table 2. Antibiotics reported as choice by the respondents (N=169) stratified by different grouping factors. Multiple answers were allowed

Factor	Antibiotics prescribed				
	Penicillin/ Amoxicillin No. (% of factor)	Metronidazole (% of factor)	Amoxicillin with Clavulanic acid No. (% of factor)	First gen Cephalosporins (% of factor)	Other antibiotics (% of factor)
Gender					
Males	22 (37.3)	30 (50.8)	36 (61.0)	15 (25.4)	37 (62.7)
Females	48 (43.6)	39 (35.5)	58 (52.7)	42 (38.2)	15 (13.6)
p-value	.513*	.071*	.333*	.124*	-
Work Sector					
Government	39 (41.9)	37 (39.8)	49 (52.7)	33 (35.5)	35 (37.6)
Private	19 (41.3)	19 (41.3)	29 (63.0)	14 (30.4)	6 (13.0)
Academic	12 (40.0)	13 (43.3)	16 (53.3)	10 (33.3)	11 (36.7)
p-value	.982	.940	.493	.838	-
Specialty					
Students	31 (47.0)	26 (39.4)	31 (47.0)	26 (39.4)	32 (48.5)
GDP	19 (44.2)	16 (37.2)	21 (48.8)	20 (46.5)	9 (20.9)
Specialists	20 (33.33)	27 (45.0)	42 (70.0)	11 (18.3)	11 (18.3)
p-value	.274	.697	.020	.005	-
Years of experience					
Up to 5 years	51 (43.6)	46 (39.3)	59 (50.4)	41 (35.0)	44 (37.6)

5-9 years	5 (41.7)	5 (41.7)	9 (75.0)	5 (41.7)	1 (8.3)
10-14 years	7 (46.7)	5 (33.3)	8 (53.3)	5 (33.3)	2 (13.3)
15-20 years	2 (28.6)	1 (14.3)	4 (57.1)	2 (28.6)	2 (28.6)
> 20 years	5 (27.8)	12 (66.7)	14 (77.8)	4 (22.2)	3 (16.7)
p-value	.689	.113	.151	.813	-
Attending a lecture or a workshop on antibiotics prescription as part of continuous education program					
In less than 2 years ago	35 (43.8)	35 (43.8)	36 (45.0)	28 (35.0)	31 (38.6)
Between 2-5 years ago	5 (15.6)	13 (40.6)	21 (65.6)	10 (31.3)	7 (21.9)
More than 5 years ago	7 (58.3)	5 (41.7)	11 (91.7)	6 (50.0)	2 (16.7)
Never	23 (51.1)	16 (35.6)	26 (57.8)	13 (28.9)	12 (26.7)
p-value	.007	.848	.010	.564	-
All	70 (41.4)	69 (40.8)	94 (55.6)	57 (33.7)	10 (5.9)

All analyses Pearsons chi-square test

*Analyses were by Fisher Exact test.

GPD: General dental practitioners.

Table 2 shows which antibiotics the participants would choose as their first line drug. Among the antibiotics reported, amoxicillin with clavulanic acid was reported most frequently with over half of the participants (55.6%) citing it among the types of antibiotics frequently prescribed in their practice. It was possible to check more than one type of antibiotic, thus penicillin/amoxicillin alone (41.4%) and metronidazole (40.8%) also stood out as popular choices as number two and three respectively. Gender, work nor experience seems to affect the choices significantly. Nonetheless specialists reported a significantly higher tendency to prescribe amoxicillin with clavulanic acid (70%) than GDPs ($p \leq 0.020$). Specialist also prescribed significantly less ($p \leq 0.005$) of first generation cephalosporins compared to GDPs and dental students. Attendance to lectures or workshops regarding prescription also describes a significant difference; with the group “between two and five years” reporting much less usage of penicillin and amoxicillin alone (15.6%, $p \leq 0.007$), also the group of “more than five years” prescribing much more amoxicillin with clavulanic acid (91.7%, $p \leq 0.010$).

Table 3. Correct answers and their rates to each of the questions in the five assessment domains.

ITEMS/DOMAINS	CORRECT ANSWER	%	ITEMS/DOMAINS	CORRECT ANSWER	%
CLINICAL SIGNS[†]			DENTAL PROCEDURES IN ABSENCE OF RELEVANT MEDICAL HISTORY[‡]		
1. Elevated temperature and evidence of systemic spread	Yes	68.5	1. Routine extraction	No	97.6
2. Localized fluctuant swelling	No	51.5	2. Surgical extraction	No	27.8
3. Gross or diffuse swelling	Yes	93.5	3. Apicectomy	No	30.2
4. Unrestricted mouth opening	No	97	4. Root canal therapy (perioperative)	No	89.3
5. Difficulty in swallowing	Yes	43.2	5. Root canal therapy (postoperative)	No	75.1
6. Closure of the eye owing to swelling	Yes	71	6. Scaling and polishing	No	99.4
CLINICAL CONDITIONS[†]			7. Restorative treatment	No	97.6
1. Acute pulpitis	No	94.7	EXTRACTION/PERIODONTAL TREATMENT IN THE PRESENCE OF RELEVANT MEDICAL CONDITIONS[‡]		
2. Acute periapical infection before drainage	No	39.6	1. Diabetes Mellitus	No	62.7
3. Acute periapical infection after drainage	No	32	2. Hemodialysis patients	No	60.4
4. Chronic apical infection	No	84	3. Hodgkin's disease	No	66.9
5. Pericoronitis	No	51.5	4. AIDS	Yes	62.1
6. Cellulitis	Yes	98.8	5. Patients on immunosuppressives	Yes	62.1
7. Periodontal abscess	No	28.4	6. Autoimmune disease patients	No	50.9
8. Acute ulcerative gingivitis	Yes	59.8	7. Renal transplant patients	Yes	45.6
9. Chronic marginal gingivitis	No	94.7	8. Head and neck irradiated patients	No	55.6
10. Chronic periodontitis	No	93.5	9. Patients with prosthetic joints	No	67.5
11. Dry socket	No	88.8	10. History of infective endocarditis	Yes	79.9
12. Trismus	Yes	12.4	11. Prosthetic cardiac valves	Yes	63.9
13. Preimplantation of teeth	Yes	64.5	12. Rheumatic heart disease	No	55.6
NON-CLINICAL FACTORS[†]			13. Aortic stenosis	No	85.2
1. Patient expectation of a prescription	No	93.5	14. Ventricular septal defect	No	85.8

2. Pressure of time and workload	No	95.9	15. Coronary bypass surgery	No	75.1
3. Patient's social history	No	82.8	16. Rheumatic fever without valvular dysfunction	No	47.3
4. Uncertainty of diagnosis	No	67.9	17. Coronary heart disease	No	87.6
5. Where treatment has to be delayed	No	49.1	18. Pacemaker	No	88.2
			19. Physiologic, functional, or innocent murmur	No	93.5

†: Therapeutic prescription; ‡: Prophylactic prescription

Table 3 presents the data obtained on whether antibiotics should be prescribed or not during some dental procedures, either as a prophylactic measure or as a treatment option.

Out of a total of 50 questions, the study participants scored good knowledge in 20 items (40%) scored “intermediate” in 14 items (28%) and scored poor in 16 items (32%). The poor knowledge was observed to be, in descending order; Trismus (12.4%), surgical extraction (27.8%), periodontal abscess (28.4%), Apicectomy (30.2%) and difficulty swallowing (43.2%).

On the other side, multiple questions shared an almost unanimous degree of agreement among study participants, with correct scores above 95% being; scaling and polishing (99,4%), routine extraction (97,6%), restorative treatment (97.6%), unrestricted mouth opening (97,0%) and pressure of time and workload (95.9%).

Tables 4 to 8 represents the mean knowledge scores within the five assessed domains stratified by the different grouping factors. The overall score is at the intermediate level (71.1%), with the best domain being “non-clinical factors” averaging at high intermediate (78,0%), and the worst being “clinical conditions” averaging at low intermediate (64,8%).

Table 4. Mean±SD knowledge scores (%) in each of the five assessed domains stratified by gender

Grouping factor	Clinical signs [†] N=169	Clinical conditions [†] N=169	Non-clinical factors [†] N=169	Treatment procedure with no relevant medical history [‡] N=169	Relevant medical history [‡] N=169	Total N=169
Gender						
Male	73.16±20.99	65.19±11.9	76.61±19.71	74.09±17.08	69.85±15.7	71.72±8.08
Female	60.55±18.6	64.62±12.34	78.72±20.95	73.77±15.42	67.46±16.28	70.77±8.54
<i>p</i> -value [£]	0.205	0.720	0.389	0.596	0.488	0.580
Overall score	70.81±19.48	64.82±12.15	77.98±20.49	73.88±15.97	68.2±16.06	71.11±8.37
Level	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate

All tests were conducted using Kruskal Wallis test unless otherwise indicated. £: Mann Whitney U test; †: Therapeutic prescription; ‡: Prophylactic prescription.
Means with one similar lowercase latter superscript are similar.

There was no significant correlation between gender and any of the five domains, nor in total knowledge. Total score for both genders were at an intermediate level and corresponds to the overall score.

Table 5. Mean±SD knowledge scores (%) in each of the five assessed domains stratified by work sector

Grouping factor	Clinical signs [†] N=169	Clinical conditions [†] N=169	Non-clinical factors [†] N=169	Treatment procedure with no relevant medical history [‡] N=169	Relevant medical history [‡] N=169	Total N=169
Work sector						
Government	70.61±19.1 ^{a,b}	63.69±12.7	77.2±21.79	72.04±16.57	67.63±17.21	70.23±9.16 ^{a,b}
Private	76.81±17.38 ^a	67.06±10.84	79.56±18.33	77.64±15.25	69.79±14.86	74.12±6.64 ^a
Academic	62.22±20.96 ^b	64.87±12.24	78±19.9	73.81±14.57	67.54±14.37	69.29±7.13 ^b
<i>p</i> -value	0.008	0.669	0.941	0.113	0.781	0.027
Overall score	70.81±19.48	64.82±12.15	77.98±20.49	73.88±15.97	68.2±16.06	71.11±8.37
Level	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate

All tests were conducted using Kruskal Wallis test unless otherwise indicated. £: Mann Whitney U test; †: Therapeutic prescription; ‡: Prophylactic prescription.
Means with one similar lowercase latter superscript are similar.

In table 5 the answers of the different work sectors differ significantly in clinical signs and in the total score. It is shown that the academic sector got a significant lower score than the private sector in both the “clinical signs” domain and in total ($p \leq 0.008$ and $p \leq 0.027$ respectively).

No significant difference between private and governmental or between or governmental and academic, even though the academic scored the lowest in total.

Table 6. Mean±SD knowledge scores (%) in each of the five assessed domains stratified by specialty

Grouping factor	Clinical signs [†] N=169	Clinical conditions [†] N=169	Non-clinical factors [†] N=169	Treatment procedure with no relevant medical history [‡] N=169	Relevant medical history [‡] N=169	Total N=169
Specialty						
Students	61.11±18.8 ^a	63.4±13.02	78.48±20.84 ^{a,b}	71.21±14.28	67.78±16.99	68.4±7.94 ^a
GDP	77.51±15.8 ^b	63.86±10.42	71.63±20.58 ^b	75.08±15.62	68.54±18.57	71.33±9.82 ^{a,b}
Specialists	76.67±18.46 ^b	67.05±12.19	82.03±19.19 ^a	75.95±17.74	68.42±13.07	73.98±6.68 ^b
p-value	<0.000	0.298	0.035	0.068	0.688	0.001
Overall score	70.81±19.48	64.82±12.15	77.98±20.49	73.88±15.97	68.2±16.06	71.11±8.37
Level	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate

All tests were conducted using Kruskal Wallis test unless otherwise indicated. £: Mann Whitney U test; †: Therapeutic prescription; ‡: Prophylactic prescription; GDP: General dental practitioner. Means with one similar lowercase latter superscript are similar.

Stratified by speciality, the clinical signs domain presented in table 6, show a clear difference in knowledge between students at the last year and the other specialities. The students answered the questions significantly less correct than either general practitioners or specialists at “clinical signs” ($p \leq 0.000$). Also in the domain “non-clinical factors” there are significant differences. Here the specialists answered significantly more correct than the general practitioners ($p \leq 0.068$). The total scores summarize the knowledge as statistically significant higher in specialists than the students, putting the GDPs’ score in the middle.

Table 7. Mean±SD knowledge scores (%) in each of the five assessed domains stratified by years of experience

Grouping factor	Clinical signs [†] N=169	Clinical conditions [†] N=169	Non-clinical factors [†] N=169	Treatment procedure with no relevant medical history [‡] N=169	Relevant medical history [‡] N=169	Total N=169
Years of experience						
Up to 5 years	66.67±19.2 ^a	64.83±12.47	79.32±20.33	73.14±14.43	68.29±16.42	70.45±8.35
5-9 years	83.33±15.89 ^b	71.15±10.94	70±18.09	75±15.08	65.35±17.3	72.97±6.16
10-14 years	81.11±12.39 ^b	62.56±6.41	74.29±22.77	76.19±13.94	72.28±14.82	73.15±5.11
15-20 years	76.19±23.29 ^{a,b}	68.13±8.22	71.43±15.74	75.51±15.9	70.68±13.2	72.39±4.89
> 20 years	78.7±18.79 ^b	61.11±14.56	80 ±22.75	75.4±26.3	65.2±15.54	72.08±12.27
p-value	0.001	0.097	0.262	0.785	0.682	0.762
Overall score	70.81±19.48	64.82±12.15	77.98±20.49	73.88±15.97	68.2±16.06	71.11±8.37
Level	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate

All tests were conducted using Kruskal Wallis test unless otherwise indicated. £: Mann Whitney U test; †: Therapeutic prescription; ‡: Prophylactic prescription.
Means with one similar lowercase letter superscript are similar.

Whether years of experience offers a significant difference in the five domains are shown in table 7. Only therapeutic prescriptions of antibiotics to clinical signs are shown to be significantly different between the groups. Participants with up to five years of experience answered significantly less correct than all the other groups, except the group of between 15 and 20 years, which was not found significant ($p \leq 0.001$).

Table 8. Mean±SD knowledge scores (%) in each of the five assessed domains stratified by attendance to a lecture or a workshop on antibiotics prescription as part of continuous education program

Grouping factor	Clinical signs [†] N=169	Clinical conditions [†] N=169	Non-clinical factors [†] N=169	Treatment procedure with no relevant medical history [‡] N=169	Relevant medical history [‡] N=169	Total N=169
Attending a lecture or a workshop on antibiotics prescription as part of continuous education program						
In less than 2 years ago	69.17±19.32 ^a	63.94±13.1	78.25±21.86	74.46±16.81	68.95±16.08	70.95±9.19
Between 2-5 years ago	72.4±19.68 ^{a,b}	68.99±10.61	75.48±19.81	75.45±13.69	67.3±15.69	71.8±7.02
More than 5 years ago	87.5±12.56 ^b	63.46±13.57	80±17.06	65.48±23.16	65.35±19.75	72.36±9.07
Never	68.15±19.4 ^a	63.76±10.71	78.67±19.73	73.97±13.38	68.3±15.69	70.57±7.68
p-value	0.011	0.334	0.824	0.772	0.809	0.778
Overall score	70.81±19.48	64.82±12.15	77.98±20.49	73.88±15.97	68.2±16.06	71.11±8.37
Level	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate

All tests were conducted using Kruskal Wallis test unless otherwise indicated. £: Mann Whitney U test; †: Therapeutic prescription; ‡: Prophylactic prescription.
Means with one similar lowercase letter superscript are similar.

The only significant difference in whether and when the participants had attended lectures or workshops regarding antibiotics were once more only present in the domain of clinical signs. The least correct scores were in the groups less than two years ago and never. Participants reporting that the last time they attended were over five years ago scored significantly higher in the aforementioned domain ($p \leq 0.011$), with a score of over 87 percent (good).

The overall scores in all the domains were reported at an intermediate level (60-80%). The total scores were only found influenced significantly by the work sector and specialty of the participants. Showing that the worst knowledge was among students and in the academic sector. Per domain some influence was also significant regarding years of experience and attendance the lectures and workshops.

4. Discussion

Generalization of the results and data gathered in this study should be done with caution mainly because of the sample size and possible bias towards the participants who participated in this study. The Arkhangelsk region is large in area and covers multiple cities and towns in the north part of Russia. Since the questionnaire was distributed by the NSMU through their professional network, it is expected to be a certain bias towards who were included in the study. To presume the dentists included in the survey are in some way affiliated with the university is a safe assumption to make. Because of the distribution by the university there is also a large group of students and newly educated dentists included, which skews the normal distribution of our population somewhat.

The questionnaire was completely anonymous and therefore no email login was required. However, the possibility of someone taking the questionnaire multiple times cannot be rolled out.

The way that the participants were asked to list their preferred antibiotics did not include any form of ranking, thereby excluding the opportunity of knowing the first choice of antibiotic used in their day-to-day clinical practice. This is one limitation of the study, which could have been planned more carefully. In this particular issue, the study participants could choose multiple drugs of choices in their practice and thus we get a broader insight of what antibiotics are generally used in Arkhangelsk.

Amoxicillin or penicillin V are the most commonly prescribed antibiotic by dentists worldwide (7, 9, 14, 17-20). However, in our current study, amoxicillin with clavulanic acid is the antibiotic most commonly mentioned by study participants (55.6%). Penicillin and/or amoxicillin alone is only reported by under half of the participants (41.4%). This seems to follow the trend reported in similar surveys in other parts of the world like the Kingdom of Saudi Arabia (16), Turkey (21) and Czech Republic (10).

The fact, that specialists prescribe significantly more amoxicillin with clavulanic acid ($p \leq 0.020$) than GPs. On the other hand, specialists reported less use of first generation cephalosporins ($p \leq 0.005$) compared to the other two groups.

An overall score of 71.1% indicates that proper knowledge is lacking in almost 30% of investigated domains. If such improper knowledge receives no proper interventions, it could

contribute to the overprescription of antibiotics and contribute to increase antibiotic resistance in the society. Antibiotic resistance poses a risk for patients on an individual level and the general population and is considered by WHO as one of the great risk to human health nowadays.

Study participants scored only 64.8% in “Clinical conditions domain”, which could suggest that there are a lot of antibiotics gets prescribed unnecessary in cases where antibiotic prescription is irrelevant. Periodontal abscess, for instance, would get treated with antibiotics by an overall 72 % of the participants. This should not be first line treatment as local measures like incision and drainage is recommended. Trismus is usually caused by spread of infections and should be, therefore, treated with antibiotics, but this is only correctly reported by 12% of the participants. Choosing the option not to treat the patient which need antibiotics does not solve the infection, but rather puts the patient in unnecessary danger.

Using the demographic characteristics of the study participants to reveal any significant differences in all domains of the questionnaire result usually in no significant differences. Working in the academic sector and being a student showed generally lower scores than any other grouping factors. Being a student showed significantly lower total mean scores than the other two groups. This might indicate non-optimal focus on antimicrobial stewardship in the educational portfolio. The students included in the current study were on their last three months of graduation and our result underscore the need for more focus in proper antimicrobial prescription in the study curriculum. It is also worth mentioning that when study participants asked to indicate their place of work, students could have mistakenly ticked the academic box, which resulted in significantly lower general score of the academic sector than that of the private sector.

5. Conclusion

None of the demographic factors or the any investigated domain in our questionnaire scored higher than intermediate knowledge and only a few of the individual questions reached a consensus at the level of good knowledge. Our results suggest that there is an urgent need of more focused education in the area of prescriptions and usage of antibiotics in the dental practice in Russia. It would be beneficial if dentists are provided with clear guidelines to implement on a national level. Proper antibiotic prescription practices should be integrated more in the educational curriculum. In addition, post-graduation courses or audits in antibiotic prescription for dental professionals could help to reduce improper antibiotic prescription.

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7. Appendix I

Antibiotic prescribing survey among dentists in Arkhangelsk

* Required

Personal information

1. **1. Whats is your gender? / Ваш пол? ***

Mark only one oval.

- Female / Женский
- Male / Мужской

2. **2. What is your age? / Возраст? ***

Mark only one oval.

- 20 - 24
- 25 - 29
- 30 - 39
- 40 - 49
- 50 - above (старше)

3. **3. Profession classification / Ваша профессия: ***

Mark only one oval.

- General practitioner / Врач / Врач-стоматолог
- Specialist/ Врач-специалист / Врач-стоматолог-специалист
- Medical student / Студент медицинского факультета

4. **4. Work sector / Рабочий сектор: ***

Mark only one oval.

- Government sector / Государственный сектор
- Private sector / Приватный сектор
- Academic clinic / Университетская клиника

5. **5. No. of years of experience / Ваш опыт работы: ***

Mark only one oval.

- Up to 5 years / до 5 лет
- 5-9 years / 5-9 лет
- 10-14 years / 10-14 лет
- 15-20 years / 15-20 лет
- More than 20 years / более 20 лет

6. **6. When did you last attend a lecture/workshop on antibiotic prescription as part of a continuous education program / Когда вы проходили обучение по назначению антибиотиков в рамках учебной программы в последний раз? ***

Mark only one oval.

- Less than 2 years ago / меньше 2 лет назад
- Between 2-5 years ago / 2-5 лет назад
- More than 5 years ago / более 5 лет назад
- Never / Никогда

7. **1. What are the antibiotics of choice for treating dental infection (you can choose more than one)? / Какой из перечисленных антибиотиков является антибиотиком выбора для лечения одонтогенной инфекции (можно выбрать несколько вариантов)?: ***

Check all that apply.

- Penicillin or amoxicillin / Пенициллин или амоксициллин
- Metronidazole / Метронидазол
- Erythromycin / Эритромицин
- Clindamycin / Клиндамицин
- Amoxicillin with clavulanic acid (Augmentin) / Амоксициллин с клавулановой кислотой (Аугументин)
- First generation generation cephalosporins / Цефалоспорины первого поколения
- Other (please specify) / Другой _____
- Other: _____

8. **2. For which of the following clinical signs antibiotic prescription is required / В каких клинических ситуациях в стоматологии лечение антибиотиками является необходимостью? ***

Mark only one oval per row.

	Yes / Да	No / Нет
Elevated temperature and evidence of systemic spread / Подъем температуры с общими симптомами воспаления	<input type="radio"/>	<input type="radio"/>
Localized fluctuant swelling / Локализованная флюктуация	<input type="radio"/>	<input type="radio"/>
Gross or diffuse swelling / Разлитая флюктуация	<input type="radio"/>	<input type="radio"/>
Unrestricted mouth opening / Свободное открывание рта	<input type="radio"/>	<input type="radio"/>
Difficulty in swallowing / Затрудненное глотание	<input type="radio"/>	<input type="radio"/>
Closure of the eye owing to swelling / Закрытие глаза вследствие отека	<input type="radio"/>	<input type="radio"/>

9. **3. For which of the following clinical conditions antibiotic prescription is required? / В каких клинических ситуациях в стоматологии лечение антибиотиками является необходимостью: ***

Mark only one oval per row.

	Yes / Да	No / Нет
Acute pulpitis / Острый пульпит	<input type="radio"/>	<input type="radio"/>
Acute periapical infection before drainage / Острый периапикальный процесс без дренажа	<input type="radio"/>	<input type="radio"/>
Acute periapical infection after drainage / Острая периапикальная инфекция с дренажом	<input type="radio"/>	<input type="radio"/>
Chronic apical infection / Хроническая периапикальная инфекция	<input type="radio"/>	<input type="radio"/>
Pericoronitis / Перикоронит	<input type="radio"/>	<input type="radio"/>
Cellulitis / Флегмоны челюстно-лицевой области	<input type="radio"/>	<input type="radio"/>
Periodontal abscess / Пародонтальный абсцесс	<input type="radio"/>	<input type="radio"/>
Acute ulcerative gingivitis / Острый язвенный гингивит	<input type="radio"/>	<input type="radio"/>
Chronic marginal gingivitis / Хронический маргинальный гингивит	<input type="radio"/>	<input type="radio"/>
Chronic periodontitis / Хронический пародонтит	<input type="radio"/>	<input type="radio"/>
Dry socket / "Сухая" лунка после экстракции зуба	<input type="radio"/>	<input type="radio"/>
Trismus / Тризм	<input type="radio"/>	<input type="radio"/>
Reimplantation of teeth / Реимплантация зуба	<input type="radio"/>	<input type="radio"/>

10. **4. For which of the following non-clinical factors antibiotic prescription is required / Какие из перечисленных не клинических факторов требуют назначение антибиотиков?***

Mark only one oval per row.

	Yes / Да	No / Нет
Patient expectation of a prescription / Пациент имеет определенные ожидания назначения антибиотиков врачом	<input type="radio"/>	<input type="radio"/>
Pressure of time and workload / Большая нагрузка на врача/ недостаточно времени	<input type="radio"/>	<input type="radio"/>
Patient's social history / Определенное социальное положение пациента	<input type="radio"/>	<input type="radio"/>
Uncertainty of diagnosis / Сомнение в диагнозе	<input type="radio"/>	<input type="radio"/>
Where treatment has to be delayed / В ситуации, когда лечение откладывается	<input type="radio"/>	<input type="radio"/>

11. **1. If there is NO RELEVANT medical history, which of the following dental treatment requires antibiotic prescription / В отсутствии сопутствующих соматических заболеваний, какие из перечисленных стоматологических вмешательств требуют назначения антибиотиков? ***

Mark only one oval per row.

	Yes / Да	No / Нет
Routine extraction / Обычное удаление зуба	<input type="radio"/>	<input type="radio"/>
Surgical extraction / Осложненное удаление зуба	<input type="radio"/>	<input type="radio"/>
Apicectomy / Резекция верхушки корня	<input type="radio"/>	<input type="radio"/>
Root canal therapy (preoperative) / Эндодонтическое лечение (пре-операционное)	<input type="radio"/>	<input type="radio"/>
Root canal therapy (postoperative) / Эндодонтическое лечение (пост-операционное)	<input type="radio"/>	<input type="radio"/>
Scaling and polishing / Скейлинг и полировка	<input type="radio"/>	<input type="radio"/>
Restorative treatment / Восстановление коронковой части зуба	<input type="radio"/>	<input type="radio"/>

12. **2. For which of the following medical conditions antibiotic prophylaxis prescription is required BEFORE extractions or periodontal treatment / Какие из перечисленных сопутствующих заболеваний требуют назначения антибиотиков перед операцией удаления зуба/операцией на пародонте? ***

Mark only one oval per row.

	Yes	No
Diabetes mellitus / Сахарный диабет	<input type="radio"/>	<input type="radio"/>
Hemodialysis patients / Пациенты на гемодиализе	<input type="radio"/>	<input type="radio"/>
Hodgkin's disease / Болезнь Ходжкина	<input type="radio"/>	<input type="radio"/>
Aids / ВИЧ/СПИД	<input type="radio"/>	<input type="radio"/>
Patients on immunosuppressives / Пациенты на иммуносупрессивной терапии	<input type="radio"/>	<input type="radio"/>
Autoimmune disease patients / Аутоиммунные заболевания	<input type="radio"/>	<input type="radio"/>
Renal transplant patients / Пациенты с почечным трансплантатом	<input type="radio"/>	<input type="radio"/>
Head and neck irradiated patients / Пациенты, получающие лучевую терапию	<input type="radio"/>	<input type="radio"/>
Patients with prosthetic joints / Пациенты с трансплантатом суставов	<input type="radio"/>	<input type="radio"/>
History of infective endocarditis / Инфекционный эндокардит в анамнезе	<input type="radio"/>	<input type="radio"/>
Cardiac valve prosthesis / Протез сердечного клапана	<input type="radio"/>	<input type="radio"/>
Rheumatic heart disease / Ревматические болезни сердца неуточненные	<input type="radio"/>	<input type="radio"/>
Aortic stenosis / Стеноз аорты	<input type="radio"/>	<input type="radio"/>
Ventricular septal defect / Дефект межжелудочковой перегородки	<input type="radio"/>	<input type="radio"/>
Coronary bypass surgery / Аортокоронарное шунтирование	<input type="radio"/>	<input type="radio"/>
Rheumatic fever (no valvular dysfunction) Острая ревматическая лихорадка (ревматизм) без дисфункции перегородки	<input type="radio"/>	<input type="radio"/>
Coronary heart disease / Сердечно-сосудистые заболевания	<input type="radio"/>	<input type="radio"/>
Pacemaker / Водитель ритма	<input type="radio"/>	<input type="radio"/>
Physiological/functional/innocent murmurs / «Доброкачественные» и не причиняющие беспокойства сердечные шумы	<input type="radio"/>	<input type="radio"/>

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