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ANTIMICROBIAL DRUG USAGE AMOUNTS ASSESSMENT IN THE VETERINARY TREATMENT OF COMPANION ANIMALS

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Abstract. *Modern information systems allow for the recording and tracking of many parameters of veterinary practice almost in real-time. This powerful tool, when properly configured, serves as a valuable source of information, including the structure and amount of antimicrobial drug use. This information is particularly valuable in implementing the principles of One Health.*

An analysis and assessment of the volumes of antimicrobial drug use in small animal veterinary practice was conducted based on the example of a specific veterinary clinic over the past five years. The information was obtained from the database of a licensed private veterinary clinic located in the Bucha district of Kyiv Oblast. The study examined the quantity and frequency of use of antimicrobial drugs from the following groups: aminoglycosides, beta-lactams, lincosamides, macrolides, nitroimidazole derivatives, sulfonamides, tetracyclines, phenicols, fluoroquinolones, polymyxins, third-generation cephalosporins, and fourth-generation cephalosporins.

It was found that over five years, 27.88% of companion animal visits to the clinic involved the use of antimicrobial drugs. On average, the veterinary clinic served (9877.4±426.5) visits per year. A high degree of correlation was statistically established between the total number of visits conducted year by year and the number of visits involving the use of antimicrobial drugs, with a correlation coefficient of 0.83. During the treatment of companion animals, single-component antimicrobial drugs were used more frequently (8953 cases, 18.1% of the total number of visits) compared to combined ones (4817 cases, 9.75% of the total number of visits). The most frequently used antibiotics in the veterinary clinic were beta-lactams – 27.32% of cases, cephalosporins – 24.3% of cases, macrolides – 22.6% of cases, and fluoroquinolones – 18.36% of cases.

Keywords: big data, pharmacoepidemiology, antimicrobial drugs, microbiome, antibiotic resistance.

Big Data impact all aspects of human life as well as all science branches. Information steers human life to an ever-increasing extent, and we cannot oversee the value of analytical insights based on Big Data. In the context of One Health, special attention should be paid to Big Data concerning the microbiome of companion animals and the factors impacting it. Modern information systems make it possible to track down and register a huge number of facts, events, features, specifications, etc.

Molecular research methods focused on the 16S pPHK gene demonstrate that the gastrointestinal tract of dogs and cats has a very complicated microbial ecosystem comprising several hundred various bacterial phylotypes (Handl et al., 2011).

A well-balanced microbial ecosystem is crucial for the health of animals, since it boosts the immune system, helps protect the organism against enteropathogens, and ensure the proper functioning of the gastrointestinal tract (Suchodolski JS, 2016).

Companion animals, especially dogs, are getting increasingly immune to antibiotics. Numerous antibiotics used in veterinary medicine resemble antibiotics used to treat humans (Yaovi et al, 2022). A lot of strains have been found to be circulating that are impervious to most widespread modern antibiotics (ampicillin, ampicillin/cloxacillin, tetracycline, penicillin,

amoxicillin, trimethoprim/sulfamethoxazole, chloramphenicol, ciprofloxacin) used for treating humans (Okpara et al. 2018).

Companion animals hosting antibiotic-resistant microorganisms serve as their source for the humans they live with. Since they also have an impact on the human microbiome, we decided to research the amount and type of antibiotics used by an average veterinary clinic to treat companion animals.

The purposeof the research was to analyze and to estimate the amount of anti-microbial drugs used in the veterinary treatment of smaller animals based on a specific veterinary clinic.

Materials and methods. As part of the research, the database of a licensed private veterinary clinic on the Bucha district of Kyiv region and its treatment logs were analysed.

The research was focused on antimicrobial medicines (AMM) belonging to the following groups: aminoglycoside, beta-lactam, lincosamides, macrolides, nitroimidazole derivatives, sulfonamides, tetracyclines, phenicols, quinolone antibiotics, polymyxins, cephalosporins (generations III and IV). Both single-component and combined antimicrobial medicines were subject to research (Fig. 1).

Research results. In the period from 01 January 2019 to 31 December 2023, the veterinary clinic treated 49,387 animals (Fig. 2).

At least one AMM was injected for 13,770 animals. Thus, 27.88% of the animals had antimicrobial treatment in the mentioned 5-year period.

The veterinary clinic that was subject to the research had 9877.4±426.5 visits per year on average, antimicrobial therapy was applied for the animals in 2754 cases on average (table 1). In our opinion, this number is rather significant and requires further research.

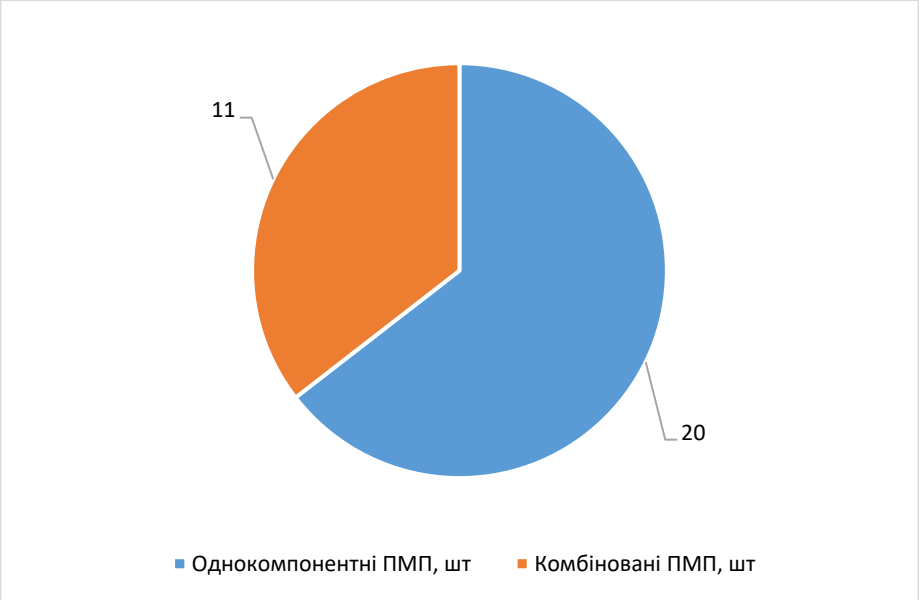

Figure 1. Quantitative rate of single-component and combined AMM in the analysed veterinary clinic in the period from 01 January 2019 to 31 December 2023

The medicines used for the antimicrobial therapy contained one or several of the following substances: amoxicillin, amoxicillin with clavulanic acid, benzylpenicillin procaine, dihydrostreptomycine sulfate, gentamicin sulfate, doxycycline, enrofloxacin, levofloxacin, lincomycin, spectinomycin, marbofloxacin, metronidazole, oxytetracycline, ornidazole, benzathine benzylpenicillin, sulfamethazine, trimethoprim, tylosin, florfenicol, cefquinome

sulfate, ceftazidime, ceftriaxone, ciprofloxacin, colistin sulfate. Pharmacoepidemiological and biometrical methods were applied for the research.

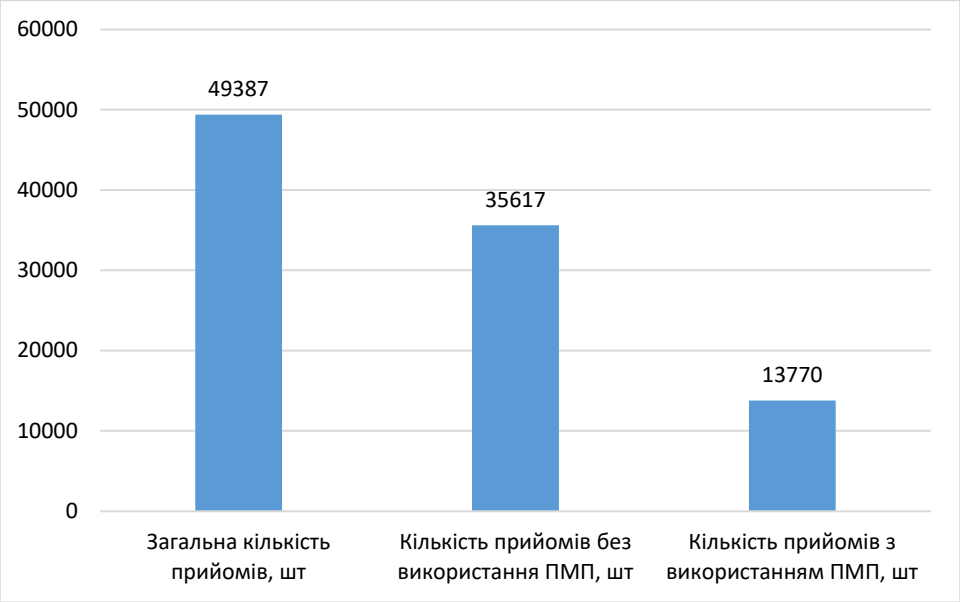

Figure 2. Total number of animal treatment cases at the veterinary clinic in the period from 01 January 2019 to 31 December 2023

The share of treatments using AMM was volatile depending on the year: 2019 – 31.8%, 2020 – 29.4%, 2021 – 31.6%, 2022 – 24.7%, 2023 – 20.5%. It shall be noted that the coefficient of correlation between the total number of treatments and treatments based on AMM was equal to 0.83, which means a high level of correlation between between the total number of treatment and AMM-based treatments.

Table 1

Number of treatments at the analysed veterinary clinic, by years

Value	Year					Average per year, (M±m)
	2019	2020	2021	2022	2023	
Number of treatments	9,801	11,391	10,066	9,066	9,060	9,877.4±426.5
Number of treatments using antimicrobial medicines (AMM)	3,126	3,357	3,183	2,241	1,863	2,754±351.8

The category of the used AMM is an important factor for the conducted analysis. According to the data obtained, the veterinary clinic conducted 8,953 medications using single-component AMM (18.1% of the total number) and 4,817 medications using combined AMM (9.75%) in the period from 01 January 2019 to 31 December 2023 (Fig. 3).

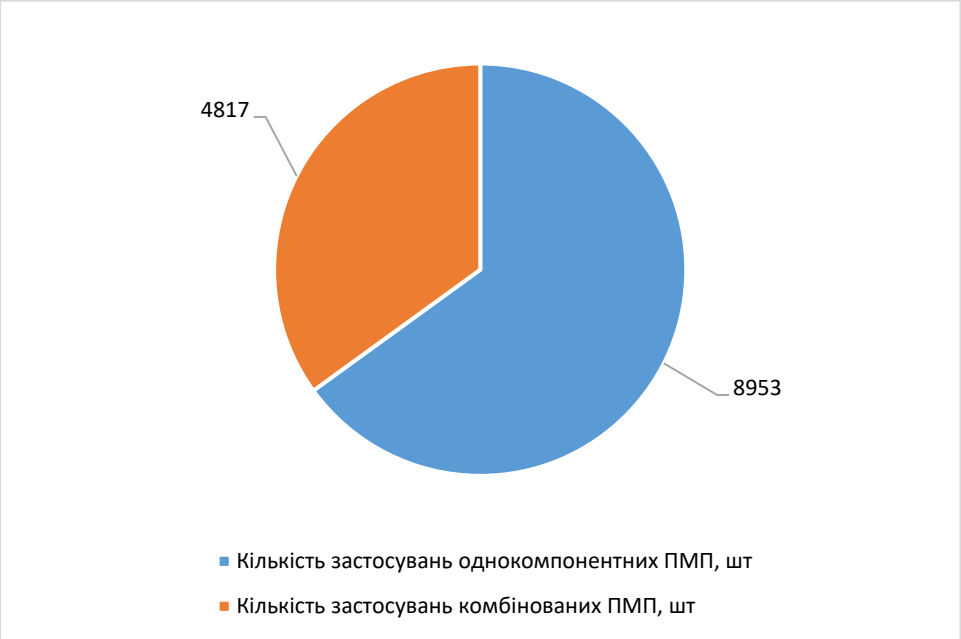

Figure 3. Number of medications based on single-component and combined AMM at the analysed veterinary clinic in the period from 01 January 2019 to 31 December 2023

According to the available statistical data, beta-lactams were the most often used antibiotic for companion animals at the analysed veterinary clinic (3019 cases or 27.32% of all medications) (Fig. 4).

In the total frequency ranking, beta-lactams were followed by cephalosporins – 2683 medications (24.3%), macrolides – 2497 medications (22.6%), and quinolones – 2028 medications (18.36%). Nitroimidazole derivatives, tetracyclines, and aminoglycosides accounted for fewer than 10% of the medications in total.

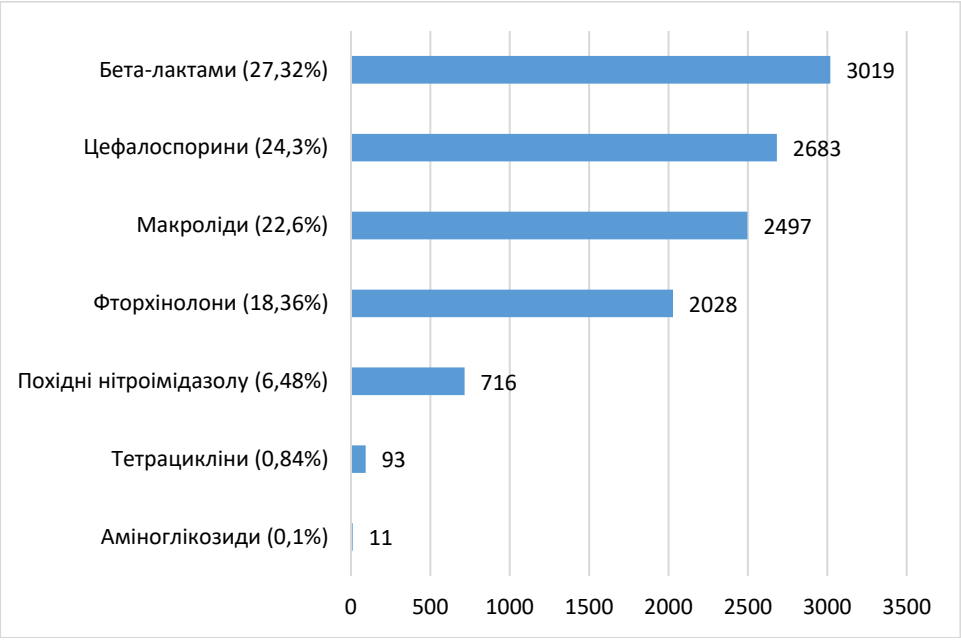

Figure 4. The absolute number and percentage of medications using different AMM groups at the analysed veterinary clinic in the period from 01 January 2019 to 31 December 2023

Opinion. Given the importance of controlling the turnover and irregular use of antibiotics, we wanted to clarify the amount of AMM used for treating companion animals. The unjustified and non-systemic use of antibiotics to treat these animals poses a direct risk for their owners and affects their microbiome. We could not find any official statistics from open sources concerning the amount of AMM used to treat companion animals. As we know, the owners of registration certificates for antimicrobial medicines report the names and the sold volume of medicines on an annual basis. However, these reports do not refer to specific animals treated with these medicines. Based on one licensed private veterinary clinic, we tried to analyse and structure data concerning the use of antimicrobial medicines. It was found that almost one in three treatment of companion animals at the veterinary clinic comes along with the injection of antimicrobial medicines. In addition, a direct correlation was detected between the total number of companion animal medications and the number of AMM jabs (correlation coefficient: 0.83). We also calculated the frequency of using different groups of antimicrobial medicines.

In our opinion, the available values are not sufficient. We also found it impossible to compare the data that we had obtained with the data from other clinics for different periods, etc. We deem it necessary to implement standardized values like those proposed by the World Health Organisation and similar to ATC and DDD based on the pharmacoepidemiologic methods (Layton D et al. 2011, Elseviers M et al. 2016, Strom B L et al. 2020, Strom B L et al. 2022). Hence, it would be promising to analyse the use of antimicrobial medicines (AMM) at several veterinary clinics based on standard values.

Conclusions. 1. In the 5-year period of our research, 27.88% of companion animals were treated with antimicrobial medicines. The reference veterinary clinic had (9,877.4±426.5) visits per year on average.

2. A high degree of correlation was statistically established between the total number of visits conducted year by year and the number of visits involving the use of antimicrobial drugs, with a correlation coefficient of 0.83.

3. During the treatment of companion animals in the said period, single-component antimicrobial drugs were used more frequently (8953 cases, 18.1% of the total number of visits) compared to combined ones (4817 cases, 9.75% of the total number of visits).

4. The most frequently used antibiotics in the veterinary clinic were beta-lactams – 27.32% of cases, cephalosporins – 24.3% of cases, macrolides – 22.6% of cases, and fluoroquinolones – 18.36% of cases.

Ethical standards. The research was self-funded. No grants or funding were received from third parties. This article meets all ethical standards of research without any direct contact with humans or animals. The involved veterinary clinic is duly licensed to operate as a provider of veterinary services and pursues its activities in accordance with the law of Ukraine.

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ОЦІНКА ОБ'ЄМІВ ВИКОРИСТАННЯ ПРОТИМІКРОБНИХ ПРЕПАРАТІВ У ВЕТЕРИНАРНІЙ ПРАКТИЦІ ТВАРИН-КОМПАНЬЙОНІВ

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Резюме. *Сучасні інформаційні системи дозволяють фіксувати та відслідковувати багато параметрів ветеринарної практики майже в режимі реального часу. Цей потужний інструмент, який за вірного налагодження робочих процесів, є джерелом цінної інформації, в тому числі про структуру та кількість використання протимікробних препаратів. Дана інформація є особливо цінною при реалізації принципів єдиного здоров'я.*

Проведено аналіз та оцінку об'ємів використання протимікробних препаратів у ветеринарній практиці дрібних тварин на прикладі конкретної клініки ветеринарної медицини за останні п'ять років. Інформацію отримано з бази даних ліцензованої приватної клініки ветеринарної медицини, що розташована на території Бучанського району Київської області. Досліджували кількість та частоту застосування протимікробних препаратів наступних груп: аміноглікозиди, бета-лактами, лінкозаміди, макроліди, похідні нітроімідазолу, сульфаніламіди, тетрацикліни, феніколи, фторхінолони, поліміксини, цефалоспорини III та цефалоспорини IV поколінь.

Встановлено, що за п'ять років 27,88% прийомів тварин-компаньйонів в клініці супроводжувалися використанням протимікробних препаратів. В середньому, ветеринарна клініка, проводила (9877,4±426,5) прийомів за рік. Статистично встановлено високу ступінь залежності між загальною кількістю проведених прийомів, від року до року, та кількістю прийомів з використанням протимікробних препаратів, коефіцієнт кореляції 0,83. Під час лікування тварин-компаньйонів, частіше використовували однокомпонентні протимікробні препарати (8953 випадки, 18,1% від загальної кількості прийомів), у порівнянні із комбінованими (4817 випадків, 9,75% від загальної кількості прийомів). Найчастіше в ветеринарній клініці ветеринарної медицини застосовували антибіотики групи бета-лактамів – 27,32% випадків, цефалоспорини – 24,3% випадків, макроліди – 22,6% випадків та фторхінолони – 18,36% випадків.

Ключові слова: великі дані, фармакоепідеміологія, протимікробні препарати, мікробіом, антибіотикорезистентність.

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