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Optimisation of Antibiotic Selection: ABC and VED Analysis of Medicines Against Intracellular Microorganisms

Antibiotic therapy is one of the key methods of treating bacterial infections, including intracellular pathogens and tuberculosis. The choice of effective antibacterial drugs largely depends on their ability to penetrate cells and destroy pathogens that persist in macrophages and body tissues.

Objective – to conduct ABC (Always Better Control) and VED (Vital, Essential, Desirable) analysis of antibiotics active against intracellular microorganisms and tuberculosis; to characterise the clinical and pharmacological groups of macrolides, fluoroquinolones and rifampicins, to determine their role in the pharmacotherapy of tuberculosis and other intracellular infections; to assess the feasibility of using these antibiotics, considering their effectiveness, safety, pharmacokinetic properties and compliance with modern clinical guidelines.

Materials and methods. For the study, data on annual consumption and costs of antibiotics active against intracellular microorganisms and tuberculosis were collected in the period 2020–2024. The obtained data were systematised and entered into an MS spreadsheet. Statistical analysis was carried out using the built-in statistical functions of MS Excel.

ABC analysis. Annual costs for individual drugs were arranged in descending order. The total cost of all drugs was calculated, as well as their percentage contribution to total costs. The resulting list was divided into three categories: category A – antibiotics which account for approximately 70 % of the total cost of consumption; category B – drugs accounting for about 20 % of costs; category C – antibiotics with the lowest level of costs (about 10 %).

VED analysis. The assessment of the criticality of antibiotics was carried out by classifying drugs into three groups: vital (V), essential (E) and desirable (D). To determine the criticality of medicines, the following were conducted: a survey of doctors involved in pharmacotherapy of patients with intracellular infections and tuberculosis; a survey of pharmacists regarding the availability of medicines on the Ukrainian pharmaceutical; regulatory analysis. Group V includes medicines that are critically important for the survival of patients and must be available at any time. Group E includes medicines whose short-term absence will not lead to serious complications. Group D includes antibiotics with the least criticality, the absence of which will not have a significant impact on the treatment process. The final distribution of antibiotics by VED categories was discussed by an expert group consisting of physicians, surgeons, pulmonologists, phthisiologists and clinical pharmacists.

Results and discussion. In the process of conducting ABC and VED analysis, a group of antibiotics active against intracellular microorganisms and tuberculosis was considered. This group includes drugs from different pharmacological classes, in particular: macrolides (erythromycin, spiramycin, clarithromycin); fluoroquinolones (levofloxacin, moxifloxacin); rifampicins (rifampicin combinations). The selection of medicines for the treatment of tuberculosis and intracellular infections was carried out by a multidisciplinary commission consisting of doctors and pharmacists. When selecting drugs, the commission considered the following key criteria: the presence of state registration in Ukraine; form of release; concentration of the active substance; pharmacological features. 42 antibiotics were selected. For each medicine, its trade name, dosage form, composition of the active substance, manufacturer and registration certificate in Ukraine are indicated. All drugs have valid licenses and registrations, which confirms their availability for medical use.

Conclusions. Analysis of the distribution of antibiotics by categories A, B, C and VED allows us to assess the effectiveness of their use and the costs of pharmacotherapy in the treatment of intracellular infections and tuberculosis. The highest costs are for category A drugs, which confirms their importance in the treatment of these diseases. Category B drugs occupy the middle position in terms of costs, and category C account for the smallest share. The analysis also showed that most antibiotics are essential, which highlights their critical role in medical treatment. This allows for cost optimisation and improved pharmacotherapy in medical institutions.

Keywords

Tuberculosis, intracellular infections, ABC-VED analysis, pharmacotherapy, cost-effectiveness, optimisation of antibiotic selection, treatment of infections.

Antibiotic therapy is one of the key methods of treating bacterial infections, including intracellular pathogens and tuberculosis [1–3]. Tuberculosis is one of the main threats to human health today. The weakening of the fight against this disease in many economically developed countries was premature and led to the situation getting out of control, because of which this disease has not been eliminated in the world [16–18].

The choice of effective antibacterial drugs largely depends on their ability to penetrate cells and destroy pathogens that persist in macrophages and body tissues [3, 8].

In the process of conducting ABC (Always Better Control) and VED (Vital, Essential, Desirable) analysis, a group of antibiotics active against intracellular microorganisms and tuberculosis was considered [2, 6].

This group includes drugs from various pharmacological classes, in particular [4, 5]:

- Macrolides: erythromycin, spiramycin, clarithromycin.
- Fluoroquinolones: levofloxacin, moxifloxacin.
- Rifampicins: rifampicin and its combinations.

Each of these groups has unique mechanisms of action, spectrum of activity, and importance in the pharmacotherapy of intracellular infections and tuberculosis.

Macrolides

Macrolide antibiotics are bacteriostatic agents that act by inhibiting protein synthesis at the level of the 50S subunit of the bacterial ribosome. They are characterised by good penetration into cells and tissues, which makes them effective in the treatment of infections caused by intracellular pathogens such as *Chlamydia spp.*, *Mycoplasma pneumoniae*, *Legionella pneumophila* and *Rickettsia spp.*

- Erythromycin is one of the first macrolides to have activity against gram-positive and some gram-negative bacteria. It is used in the treatment of legionellosis, diphtheria and respiratory chlamydia.
- Spiramycin has less activity against *Mycoplasma* and *Chlamydia*, but has advantages in the

treatment of toxoplasmosis and is used during pregnancy to prevent foetal transmission.

- Clarithromycin has improved pharmacokinetics compared to Erythromycin and is effective against *Helicobacter pylori*, atypical mycobacteria and respiratory pathogens. In tuberculosis treatment regimens, it can be used as an additional agent in cases of resistance to basic drugs.

Macrolides are important for the treatment of intracellular infections due to their high bioavailability and activity in foci of inflammation, which makes them indispensable in respiratory and systemic diseases.

Fluoroquinolones

Fluoroquinolones are a group of synthetic antibiotics that act by inhibiting the enzymes deoxyribonucleic acid (DNA) gyrase and topoisomerase IV, which leads to the death of bacteria. These drugs have high activity against gram-negative bacteria as well as some effect on intracellular pathogens, including *Mycobacterium tuberculosis*.

- Levofloxacin is a third-generation fluoroquinolone used in the treatment of tuberculosis, especially multidrug-resistant forms. Due to its ability to penetrate lung tissue and macrophages, it is effective in the treatment of extrapulmonary tuberculosis.
- Moxifloxacin is characterised by increased activity against gram-positive pathogens, including *Streptococcus pneumoniae*, as well as intracellular pathogens. It is used in combination with other anti-tuberculosis drugs in resistant forms of infection.

Fluoroquinolones are an important component of the treatment of tuberculosis, especially in conditions of resistance to Rifampicin and isoniazid. They are also used in severe bacterial pneumonia and systemic infections.

Rifampicins

Rifampicin and its derivatives are the main drugs for the treatment of tuberculosis. They act by blocking DNA-dependent ribonucleic acid (RNA) polymerase, which disrupts transcription and leads to the death of mycobacteria. Due to their high activity

against *Mycobacterium tuberculosis*, these drugs are included in standard therapy regimens.

- Rifampicin is a key component of first-line anti-tuberculosis treatment. It rapidly reduces the bacterial load, preventing the development of resistance in combination therapy.
- Combination drugs with Rifampicin (e.g., Rifampicin + isoniazid) are used to improve compliance and reduce the likelihood of developing resistance.
- Rifampicins are indispensable for the treatment of tuberculosis but they have several features, including the induction of liver enzymes, which can affect the effectiveness of other drugs.

Given the ABC and VED analysis methods, macrolides, fluoroquinolones and Rifampicins play an important role in the treatment of intracellular infections and tuberculosis. They have high efficacy, good penetration into tissues and macrophages, which makes them indispensable in clinical practice. Further research into their use, optimal combinations and resistance mechanisms will help improve treatment strategies for these serious infectious diseases.

Objective – to conduct ABC and VED analysis of antibiotics active against intracellular microorganisms and tuberculosis; to characterise the clinical and pharmacological groups of macrolides, fluoroquinolones and rifampicins, to determine their role in the pharmacotherapy of tuberculosis and other intracellular infections; to assess the feasibility of using these antibiotics, considering their effectiveness, safety, pharmacokinetic properties and compliance with modern clinical guidelines.

Materials and methods

For the study, data on annual consumption and costs of antibiotics active against intracellular microorganisms and tuberculosis were collected in the period 2020–2024. The ABC/VED analysis methodology was carried out using the developments of domestic and foreign authors [9–15, 19, 20].

The obtained data were systematized and entered an MS Excel spreadsheet. Statistical analysis was carried out using the built-in statistical functions of MS Excel.

ABC analysis

Annual costs for individual drugs were arranged in descending order. The total cost of all drugs was calculated, as well as their percentage contribution to total costs. The resulting list was divided into three categories:

- *Category A* – antibiotics, which account for approximately 70 % of the total cost of consumption;
- *Category B* – medicines, which account for about 20 % of costs;

- *Category C* – antibiotics with the lowest level of costs (about 10 %).

VED analysis

The assessment of the criticality of antibiotics was carried out by classifying drugs into three groups: vital (V), essential (E) and desirable (D). To determine the criticality of drugs, the following were conducted:

- a survey of doctors involved in pharmacotherapy of patients with intracellular infections and tuberculosis;
- a survey of pharmacists regarding the availability of medicines on the pharmaceutical market of Ukraine;
- regulatory analysis based on their inclusion in the Protocols for the treatment of intracellular infections and tuberculosis, the State Formulary of medicines and the National List of essential medicines.

Group V includes medicines that are critically important for the survival of patients and must be available at any time. Group E includes medicines whose absence for a short period will not lead to serious complications. Group D includes antibiotics with the least criticality, the absence of which will not have a significant impact on the treatment process. The final distribution of antibiotics by VED categories was discussed by an expert group consisting of physicians, surgeons, pulmonologists, phthisiologists and clinical pharmacists.

The study presented in this article is a fragment of research works of Private Scientific Institution «Scientific and Research University of Medical and Pharmaceutical Law» and Danylo Halytsky Lviv National Medical University on the topic «Diagnosis, treatment, pharmacotherapy of inflammatory, traumatic and onco-thoracic pathology using instrumental methods» (state registration number 0125U000071, implementation period 2025–2031) and «Multi-disciplinary research of post-traumatic stress disorders during war among patients (primarily combatants)» (state registration number 0124U002540, implementation period 2024–2029); Lviv Medical Institute on the topic of «Improving the system of circulation of drugs during pharmacotherapy on the basis of evidentiary and forensic pharmacy, organisation, technology, biopharmacy and pharmaceutical law» (state registration number 0120U105348, implementation period 2021–2026).

Results and discussion

In the process of conducting ABC and VED analysis, a group of antibiotics active against intracellular microorganisms and tuberculosis was considered. This group includes drugs from different pharmacological classes, in particular:

- *Macrolides*: erythromycin, spiramycin, clarithromycin;
- *Fluoroquinolones*: levofloxacin, moxifloxacin;
- *Rifampicins*: rifampicin combinations.

The selection of drugs for the treatment of tuberculosis and intracellular infections was carried out by a multidisciplinary commission consisting of doctors and pharmacists. The commission conducted an analysis and selection of drugs for the treatment of tuberculosis and intracellular infections. When selecting drugs, the commission considered the following key criteria:

- *Availability of state registration in Ukraine* – the list includes only those drugs that have a valid registration certificate without restrictions on the validity period.

- *Release form* – only tablets and capsules were considered, which ensure ease of administration and high adherence to therapy.

- *Concentration of the active substance* – preference was given to drugs with the maximum content of the active component, which ensures the effectiveness of treatment.

- *Pharmacological features* – the commission preferred combined drugs or modified-release tablets, which help reduce the frequency of administration and improves the pharmacotherapy of patients.

Considering the above criteria, drugs were selected that meet the requirements of effectiveness, safety and ease of use. The list of drugs is given in Table 1.

Table 1. List of antibiotics active against intracellular microorganisms and tuberculosis

Name	Dosage form	Composition	Manufacturer	Registration certificate
Macrolides: erythromycin, spiramycin, clarithromycin				
Erythromycin	Tablets	1 tablet contains Erythromycin 100 mg	Public Joint Stock Company «Scientific and Production Center “Borshchagov Chemical and Pharmaceutical Plant”», Ukraine	UA/3701/01/01 unlimited from 13.05.2020
Erythromycin	Tablets	1 tablet contains Erythromycin 100 mg	JSC «VITAMINS», Ukraine	UA/8709/01/01 unlimited from 15.06.2018
Doramycin	Tablets	1 tablet contains Spiramycin 3,000,000 IU	WORLD MEDICINE DRUG SAN. VE TIDZ. A.Sh., Turkey	UA/14899/01/01 unlimited from 26.01.2021
Spiracyn	Tablets	1 tablet contains Spiramycin 3,000,000 IU	Simpex Pharma Pvt. Ltd., India	UA/17331/01/02 04.04.2019 04.04.2025
Rovamycin	Tablets	1 tablet contains Spiramycin 3,000,000 IU	SANOFI S.R.L., Italy	UA/6053/01/02 unlimited from 03.02.2021
Clarithromycin-Astrapharm	Tablets	1 tablet contains Clarithromycin 500 mg	L.O.V. «ASTRAPHARM», Ukraine	UA/14154/01/02 unlimited from 09.04.2020
Clarithromycin-Darnytsya	Tablets	1 tablet contains Clarithromycin 500 mg	PrJSC «Pharmaceutical Firm «Darnitsa», Ukraine	UA/0279/01/02 unlimited from 30.08.2018
Clarithromycin-Zdorov'ya	Tablets	1 tablet contains Clarithromycin 500 mg	Limited Liability Company «Pharmaceutical Company “Zdorovya”» (all stages of production, quality control, batch release), Ukraine	UA/9712/01/02 unlimited from 30.11.2018
Fromilid Uno	Tablets	1 tablet contains Clarithromycin 500 mg	Limited Liability Company «PHARMEX GROUP» (all stages of production, quality control, batch release), Ukraine	UA/9540/01/01 unlimited from 21.03.2019
Clarithromycin-Ananta	Tablets	1 tablet contains Clarithromycin 500 mg	KRKA, dd, Novo mesto, Slovenia	UA/12435/01/02 unlimited from 25.04.2023
Clarithromycin	Tablets	1 tablet contains Clarithromycin 500 mg	Artura Pharmaceuticals Pvt. Ltd., India	UA/2547/01/02 unlimited from 22.07.2019
Oradro	Tablets	1 tablet contains Clarithromycin 500 mg	PJSC «Kyivmedpreparat», Ukraine	UA/17328/01/02 unlimited from 18.10.2023
Klabel 500	Tablets	1 tablet contains Clarithromycin 500 mg	WORLD MEDICINE DRUG SAN. VE TIJ. A.Ş., Turkey	UA/7034/01/01 unlimited from 11.10.2017
Meristat-Sanovel Long	Tablets	1 tablet contains Clarithromycin 500 mg	NOBEL İLAC SANAYI VE TİÇARET A.Ş., Turkey	UA/10713/02/01 unlimited from 28.06.2021
Aziklar 500	Tablets	1 tablet contains Clarithromycin 500 mg	Sanovel İlac Sanayi ve Tıçaret A.Ş., Turkey	UA/1984/01/01 unlimited from 30.08.2019
Klatinol	Tablets	1 tablet contains Clarithromycin 500 mg	Flamingo Pharmaceuticals Ltd., India	UA/5974/01/01 unlimited from 02.03.2017

Name	Dosage form	Composition	Manufacturer	Registration certificate
Pilobact Neo	Tablets	1 tablet contains Clarithromycin 250 mg; Tinidazole 500 mg	Evertogen Life Sciences Limited, India	UA/0130/01/01 unlimited from 02.06.2021
Klacid SR	Tablets	1 tablet contains Amoxicillin 1000 mg; Clarithromycin 500 mg	San Pharmaceutical Industries Limited, India	UA/2920/01/01 unlimited from 17.10.2019
Klabax OD	Tablets	1 tablet contains Clarithromycin 500 mg	Abbvi S.r.l., Italy	UA/2237/02/01 unlimited from 23.09.2021
Fluoroquinolones: levofloxacin, moxifloxacin				
Taigeron	Tablets	1 tablet contains Levofloxacin 750 mg	KUSUM HEALTHCARE PVT LTD, India	UA/9539/02/02 unlimited from 26.04.2019
Novox-750	Tablets	1 tablet contains Levofloxacin 750 mg	Evertogen Life Sciences Limited, India	UA/12673/01/02 unlimited from 11.10.2017
Levox-750	Tablets	1 tablet contains Levofloxacin 750 mg	Tulip Lab Pvt. Ltd., India	UA/15680/01/02 unlimited from 21.06.2023
Levomac 750	Tablets	1 tablet contains Levofloxacin 750 mg	Mcleods Pharmaceuticals Limited, India	UA/15561/01/01 unlimited from 23.02.2022
Levolet	Tablets	1 tablet contains Levofloxacin 750 mg	Dr. Reddy's Laboratories Ltd., FTO – II, India	UA/9474/01/03 unlimited from 22.07.2019
Levofloxacin 750	Tablets	1 tablet contains Levofloxacin 750 mg	Mcleods Pharmaceuticals Limited, India	UA/15003/01/03 unlimited from 10.09.2021
Moxin	Tablets	1 tablet contains Moxifloxacin 436.8 mg	Bafna Pharmaceuticals Ltd., India	UA/11530/01/01 unlimited from 12.06.2017
Moxiftor 400	Tablets	1 tablet contains Moxifloxacin 400 mg	Torrent Pharmaceuticals Ltd., India	UA/12270/01/01 unlimited from 13.03.2018
Moxivar	Tablets	1 tablet contains Moxifloxacin 400 mg	Aurobindo Pharma Limited – Unit VII, India	UA/14296/01/01 unlimited from 04.02.2020
Moflaxa	Tablets	1 tablet contains 400 mg Moxifloxacin	KRKA, d.d., Novo mesto (responsible for the full production cycle, including batch release)/KRKA, d.d., Novo mesto (responsible for batch control), Slovenia KRKA-PHARMA d.o.o. (responsible for primary and secondary packaging, batch control and batch release), Croatia TAD Pharma GmbH (responsible for primary and secondary packaging, batch control and batch release), Germany Labor LS SE & Co. KG (responsible for microbiological batch control (in case of batch control TAD Pharma GmbH), Germany	UA/14876/01/01 unlimited from 22.12.2020
Moxetero	Tablets	1 tablet contains Moxifloxacin 400 mg	Hetero Labs Limited, India	UA/15685/01/01 unlimited from 16.11.2021
Moxifloxacin Sandoz	Tablets	1 tablet contains 400 mg Moxifloxacin	Sandoz S.R.L., Romania	UA/16489/01/01 unlimited from 19.10.2022
Moxifloxacin-Pharmex	Tablets	1 tablet contains 436.8 mg Moxifloxacin	PHARMEX GROUP LLC, Ukraine	UA/16662/01/01 unlimited from 15.12.2022
Moximac	Tablets	1 tablet contains Moxifloxacin 400 mg	McLeods Pharmaceuticals Limited, India	UA/17579/01/01 unlimited from 01.05.2024
Timoxi	Tablets	1 tablet contains Moxifloxacin 400 mg	ALKALOID AD Skopje, Republic of North Macedonia	UA/17582/01/01 unlimited from 31.07.2024
Moxifloxacin	Tablets	1 tablet contains 436.8 mg Moxifloxacin	PrAJ «Technolog», Ukraine	UA/17766/01/01 unlimited from 13.08.2024
Moxicum	Tablets	1 tablet contains Moxifloxacin (as Moxifloxacin hydrochloride) 400 mg	WORLD MEDICINE ILAC SAN. VE TIG. A.Sh., Turkey	UA/17788/01/01 unlimited from 21.08.2024

End of the Table 1

Name	Dosage form	Composition	Manufacturer	Registration certificate
Atovax	Tablets	1 tablet contains Moxifloxacin	KUSUM PHARM LLC, Ukraine	UA/18049/01/01 unlimited from 18.12.2024
Avelox	Tablets	1 tablet contains 436.8 mg of Moxifloxacin	Bayer AG (full production cycle (bulk production, primary packaging, secondary packaging, quality control, batch production)), Germany Bayer Helsker Manufacturing S.R.L. (alternative manufacturer (bulk production, primary packaging, secondary packaging, quality control, batch production)), Italy Stegemann GmbH & Co. KG, Germany (alternative manufacturer (secondary packaging), Germany)	UA/4071/01/01 unlimited from 18.11.2020
Rifamycins: rifampicin combinations				
Rifampicin/Isoniazid	Tablets	1 tablet contains Rifampicin 150 mg, Isoniazid 75 mg	McLeods Pharmaceuticals Limited, India	UA/16427/01/01 unlimited from 18.10.2023
Rifampicin 75 mg /Isoniazid 50 mg /Pyrazinamide 150 mg	Dispersed tablets	1 tablet contains Rifampicin 75 mg, Isoniazid 50 mg, Pyrazinamide 150 mg	McLeods Pharmaceuticals Limited, India	UA/17008/01/01 unlimited from 18.10.2023
Makox 300	Capsules	1 capsule contains Rifampicin 300 mg	McLeods Pharmaceuticals Limited, India	UA/6797/01/02 unlimited from 04.07.2017
Forekox Trek	Tablets	1 tablet contains Rifampicin 150 mg, Pyrazinamide 400 mg, Ethambutol hydrochloride 275 mg, Isoniazid 75 mg	McLeods Pharmaceuticals Limited, India	UA/7796/01/01 unlimited from 26.04.2019

Table 1 contains information on antibiotics active against intracellular microorganisms and tuberculosis, divided by class. It includes 42 drugs belonging to three main groups:

1. **Macrolides** (erythromycin, spiramycin, clarithromycin) – 19 drugs available in tablet form.
2. **Fluoroquinolones** (levofloxacin, moxifloxacin) – 19 drugs in tablet form.
3. **Rifamycins** (rifampicin combinations) – 4 drugs in tablet and capsule form.

For each drug, its trade name, dosage form, active ingredient composition, manufacturer and registration certificate in Ukraine are indicated. All drugs have valid licenses and registrations, which confirms their availability for medical use.

Table 1 data form the basis for further analysis and distribution of antibiotics by ABC-VED categories, which allows determining the priority of their supply and use in medical institutions.

ABC analysis

Table 2 presents the distribution of drugs by ABC categories based on their cost and share in total

costs. Antibiotics are divided into three categories depending on their share in total drug costs:

- *Category A* includes drugs that account for 70 % of the total cost of consumption. These are the most expensive antibiotics.
- *Category B* includes drugs that account for 20 % of costs.
- *Category C* includes drugs with the lowest share, up to 10 % of the total cost.

This classification allows a clear assessment of the impact of each group of antibiotics on total costs and simplifies the analysis of drug costs.

Table 2 contains information about drugs, which are divided into three categories (A, B, C) depending on their cost and share in total costs. Here is an analysis of the data by category:

Category A (highest costs):

- It contains the most expensive drugs, which account for 70.90 % of total costs (7113.92UAH).
- Category A medicines include such drugs as Klatinol (783.20 UAH), Pylobact Neo (585.90 UAH), Forecox Trek 350.50 UAH), Moxifloxacin (321.90 UAH) and others.

Table 2. ABC analysis of antibiotics for the treatment of intracellular infections and tuberculosis

Name	Dosage form	Cost, UAH	Distribution (%)	ABC category
Klatinol	Tablets	783.20	7.81	A
Pilobact Neo	Tablets	585.90	5.84	A
Forekox Trek	Tablets	350.50	3.49	A
Moxifloxacin	Tablets	321.90	3.21	A
Timoxi	Tablets	319.80	3.19	A
Moflaxa	Tablets	315.60	3.15	A
Clarithromycin-Darnytsya	Tablets	314.00	3.13	A
Makox 300	Capsules	312.00	3.11	A
Clarithromycin-Astrapharm	Tablets	310.18	3.09	A
Avelox	Tablets	310.00	3.09	A
Moxivar	Tablets	302.00	3.01	A
Oradro	Tablets	300.00	2.99	A
Doramycin	Tablets	297.72	2.97	A
Rovamycin	Tablets	288.37	2.87	A
Moxicum	Tablets	282.40	2.81	A
Klacid SR	Tablets	280.70	2.80	A
Aziklar 500	Tablets	270.80	2.70	A
Meristat-Sanovel Long	Tablets	268.90	2.68	A
Taigeron	Tablets	233.55	2.33	A
Levox-750	Tablets	229.40	2.29	A
Levofloxacin 750	Tablets	220.00	2.19	A
Levolet	Tablets	217.00	2.16	A
Total by category A		7113.92	70.90	
Rifampicin 75 mg/Isoniazid 50 mg/ Pyrazinamide 150 mg	Dispersed tablets	210.30	2.10	B
Fromilid Uno	Tablets	201.90	2.01	B
Klabel 500	Tablets	200.50	2.00	B
Levomac 750	Tablets	185.20	1.85	B
Moxin	Tablets	175.05	1.74	B
Clarithromycin Ananta	Tablets	174.10	1.74	B
Atovax	Tablets	160.00	1.59	B
Rifampicin/Isoniazid	Tablets	150.50	1.50	B
Moximac	Tablets	147.80	1.47	B
Clarithromycin	Tablets	146.90	1.46	B
Moxiftor 400	Tablets	140.40	1.40	B
Total by category B		2033.05	20.26	
Total by categories AB		9146.97	91.16	
Moxetero	Tablets	140.40	1.40	C
Moxifloxacin Sandoz	Tablets	140.00	1.40	C
Novox-750	Tablets	135.90	1.35	C
Clarithromycin-Zdorov'ya	Tablets	133.02	1.33	C
Moxifloxacin-Pharmex	Tablets	133.00	1.33	C
Spiracyn	Tablets	120.80	1.20	C
Klabax OD	Tablets	119.96	1.20	C
Erythromycin	Tablets	65.00	0.65	C
Erythromycin	Tablets	38.90	0.39	C
Total by category C		886.58	8.84	
Total by categories ABC		10033.55	100.00	

- These drugs have a high cost and are widely used, which determines their high share in total costs. Category B (average costs):
- Drugs in this category account for 20.26 % of total costs (2033.05 UAH).
- They are slightly cheaper than category A drugs but still have a significant role in treatment. This group includes, for example, Rifampicin 75 mg/Isoniazid 50 mg/Pyrazinamide 150 mg (210.30 UAH) and Fromilid Uno (201.90 UAH). Category C (lowest cost):
- Drugs in this category account for only 8.84 % of total costs (886.58 UAH).
- These are the drugs with the lowest cost. For example, Moxetero (140.40 UAH), Moxifloxacin Sandoz (140.00 UAH) and Novox-750 (135.90 UAH).
- These drugs are less expensive, which makes them more affordable, but they have the smallest share in total costs.

The total cost of all antibiotics is 10033.55 UAH, which includes the costs of drugs from all three categories (A, B, C).

VED analysis

For further research and VED analysis of antibiotics used for the treatment of intracellular infections and tuberculosis, a multidisciplinary committee was surveyed to determine the priority of antibiotics for pharmacotherapy. This survey involved doctors of various specialties who have experience in the treatment of infectious diseases and the use of antibiotics. Normative analysis data were also used based on their inclusion in the Intracellular Infection Treatment Protocols, the State Formulary of Medicines and the National List of Essential Medicines. According to the survey results, doctors classified antibiotics into VED categories (Table 3).

- *V (Vital)* – drugs that are critically important for therapy and are used in severe or potentially life-threatening conditions;
- *E (Essential)* – drugs that are used to treat most diseases but are not mandatory for the treatment of every case;
- *D (Desirable)* – drugs that are rarely used and are less important compared to other drugs.

The data obtained from this analysis are the basis for determining the priority of antibiotic use in practice and optimising pharmacotherapy.

Table 3 presents antibiotics, divided by VED categories:

Category V (Vital): Erythromycin, Erythromycin (JSC «Vitamyne», Ukraine), Clarithromycin-Astrapharm, Clarithromycin-Darnytsya, Clarithromycin-Zdorov'ya, Fromilid Uno, Clarithromycin Ananta, Clarithromycin, Oradro, Klablet 500, Meristat-

Table 3. VED- analysis of antibiotics for the treatment of intracellular infections and tuberculosis.

Name	Dosage form	VED category
Erythromycin	Tablets	V
Erythromycin	Tablets	V
Clarithromycin-Astrapharm	Tablets	V
Clarithromycin-Darnytsya	Tablets	V
Clarithromycin-Zdorov'ya	Tablets	V
Fromilid Uno	Tablets	V
Clarithromycin Ananta	Tablets	V
Clarithromycin	Tablets	V
Oradro	Tablets	V
Klablet 500	Tablets	V
Meristat-Sanovel Long	Tablets	V
Aziklar 500	Tablets	V
Klatinol	Tablets	V
Pilobact Neo	Tablets	V
Klacid SR	Tablets	V
Klabax OD	Tablets	V
Moxin	Tablets	V
Moxiflor 400	Tablets	V
Moxivar	Tablets	V
Moflaxa	Tablets	V
Moxetero	Tablets	V
Moxifloxacin Sandoz	Tablets	V
Moxifloxacin-Pharmex	Tablets	V
Moximac	Tablets	V
Timoxi	Tablets	V
Moxifloxacin	Tablets	V
Moxicum	Tablets	V
Atovax	Tablets	V
Avelox	Tablets	V
Rifampicin/Isoniazid	Tablets	V
Rifampicin 75 mg/Isoniazid 50 mg/Pyrazinamide 150 mg	Dispersed tablets	V
Makox 300	Capsules	V
Forekox Trek	Tablets	V
Taigeron	Tablets	E
Novox-750	Tablets	E
Levox-750	Tablets	E
Levomac 750	Tablets	E
Levolet	Tablets	E
Levofloxacin 750	Tablets	E
Doramycin	Tablets	D
Spiracyn	Tablets	D
Rovamycin	Tablets	D

Sanovel Long, Aziklar 500, Klatinol, Pilobact Neo, Klacid SR, Klabax OD, Moxin, Moxiflor 400, Moxivar, Moflaxa, Moxetero, Moxifloxacin Sandoz, Moxifloxacin-Pharmex, Moximac, Timoxi, Moxifloxacin, Moxicum, Atovax, Avelox, Rifampicin/Isoniazid, Rifampicin 75 mg/Isoniazid 50 mg/Pyrazinamide 150 mg, Makox 300, Forekox Trek.

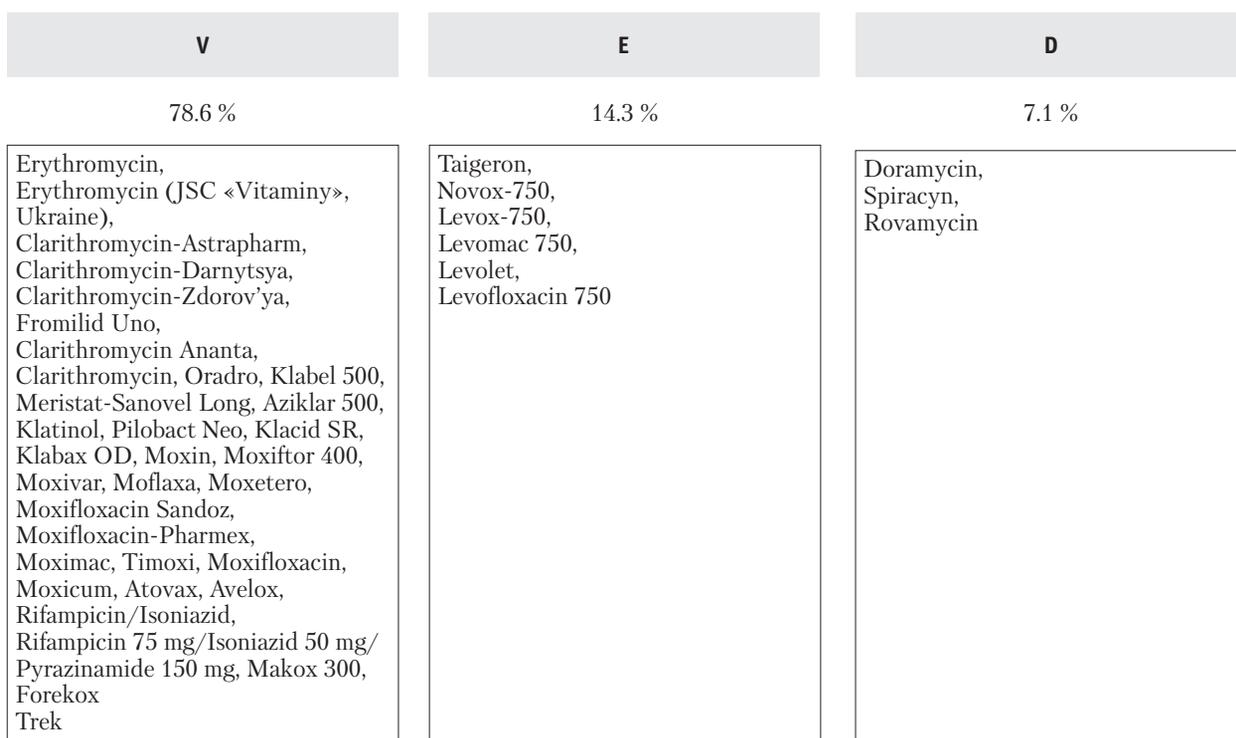


Fig. 1. Distribution according to the results of VED analysis of the studied antibiotics for the treatment of intracellular infections and tuberculosis

Table 4. ABC-VED matrix

Category	Quantity	V		Quantity	E		Quantity	D	
		Purpose			Purpose			Purpose	
		UAH	%		UAH	%		UAH	%
A	16	5627.88	56.1	4	899.95	8.97	2	586.09	5.83
B	10	1707.45	17.0	1	185.20	1.85	—	—	—
C	7	770.28	7.7	1	135.90	1.35	1	120.80	1.20
Total	33	8105.61	80.8	6	1221.05	12.17	3	706.89	7.03

Category E (Essential): Taigeron, Novox-750, Levox-750, Levomac 750, Levolet, Levofloxacin 750.

Category D (Desirable): Doramycin, Spiracyn, Rovamycin.

This division of drugs into categories allows you to optimise pharmacotherapy by identifying the most important drugs for the treatment of patients with bacterial infections.

The specific proportion of each category and the list of drugs in it are given in Fig. 1.

Analysis of the ABC-VED matrix

Based on the conducted ABC/VED analysis, a matrix of the combined ABC/VED analysis was developed. The matrix of the combined ABC-VED analysis of antibiotics for the treatment of intracellular infections (Table 4).

The conducted studies show that:

- Category A accounted for the largest share of expenses by category: A/V – 56.1 %, A/E – 8.97 %, A/D – 5.83 %.
- Category B had the following indicators: B/V – 17.0 %, B/E – 1.85 %, B/D – 0 %.
- Category C demonstrated the following indicators: C/V – 7.7 %, C/E – 1.35 %, C/D – 1.20 %.

The share of expenses for medicines in the combined ABC/VED analysis is shown in Fig. 2.

Conclusions

The analysis of the distribution of antibiotics by categories A, B, C and VED enables important conclusions to be drawn regarding the effectiveness of antibiotic use and the cost of pharmacotherapy of intracellular infections and tuberculosis.

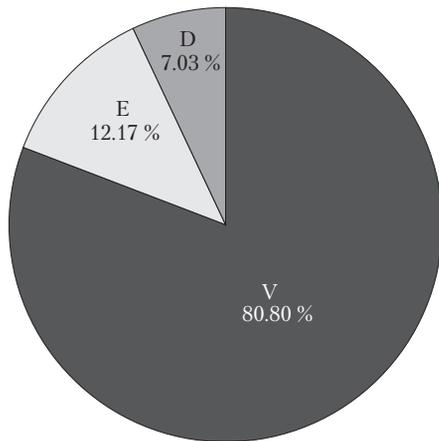


Fig. 2. Share of antibiotic costs in the combined ABC/VED analysis

Most of the costs are for medicines of category A which indicates their vital need in the treatment of intracellular infections and tuberculosis and a high level of consumption.

There is no conflict of interest.

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Оптимізація вибору антибіотиків: ABC та VED-аналіз препаратів проти внутрішньоклітинних мікроорганізмів

Антибіотикотерапія є одним із ключових методів лікування бактеріальних інфекцій, зокрема внутрішньоклітинних збудників та туберкульозу. Вибір ефективних антибактеріальних препаратів значною мірою залежить від їхньої здатності проникати всередину клітин і знищувати патогени, які персистують у макрофагах і тканинах організму.

Мета роботи — провести ABC (Always Better Control) та VED (Vital, Essential, Desirable) аналіз антибіотиків, активних щодо внутрішньоклітинних мікроорганізмів та туберкульозу, схарактеризувати клініко-фармакологічні групи макролідів, фторхінолонів і рифампіцинів, визначити їхню роль у фармакотерапії туберкульозу та інших внутрішньоклітинних інфекцій, оцінити доцільність використання цих антибіотиків з урахуванням їхньої ефективності, безпечності, фармакокінетичних властивостей і відповідності сучасним клінічним рекомендаціям.

Матеріали та методи. Для проведення дослідження зібрано дані про річне споживання та витрати на антибіотики, активні щодо внутрішньоклітинних мікроорганізмів і туберкульозу, у 2020—2024 рр. Отримані дані були систематизовані та внесені в електронну таблицю MS Excel. Статистичний аналіз проведено за допомогою вбудованих статистичних функцій MS Excel.

ABC-аналіз. Розраховано сукупну вартість усіх лікарських засобів, а також їхній відсотковий внесок у загальні витрати. Отриманий список було поділено на три категорії: категорія А — антибіотики, на які припадає близько 70 % від загальної вартості споживання, категорія В — препарати, на які припадає близько 20 % витрат, категорія С — антибіотики з найнижчим рівнем витрат (близько 10 %).

VED-аналіз. Оцінку критичності антибіотиків здійснювали шляхом класифікації препаратів на три групи: життєво важливі (V), необхідні (E) та бажані (D). Для визначення критичності препаратів проведено опитування лікарів, які займаються фармакотерапією пацієнтів із внутрішньоклітинними інфекціями та туберкульозом, опитування фармацевтів щодо наявності препаратів на фармацевтичному ринку України та нормативний аналіз. До групи V віднесено препарати, які є критично важливими для виживання пацієнтів та мають бути доступні в будь-який час, до групи E — препарати, відсутність яких протягом короткого періоду не призведе до серйозних ускладнень, до групи D — антибіотики з найменшою критичністю, відсутність яких не матиме значного впливу на лікувальний процес. Остаточний розподіл антибіотиків за категоріями VED обговорювався експертною групою, до складу якої входили лікарі, хірурги, пульмонологи, фтизіатри та клінічні фармацевти.

Результати та обговорення. Під час проведення ABC та VED-аналізу розглянуто групу антибіотиків, активних щодо внутрішньоклітинних мікроорганізмів і туберкульозу. До цієї групи належать препарати з різних фармакологічних класів, зокрема: макроліди (еритроміцин, спірамідин, кларитроміцин); фторхінолони (левофлоксацин, моксифлоксацин); рифампіцини (рифампіцин, комбінації). Вибір препаратів для лікування туберкульозу та внутрішньоклітинних інфекцій проводила мультидисциплінарна комісія, що складалася з лікарів і фармацевтів. При виборі препаратів

комісія враховувала такі ключові критерії, як наявність державної реєстрації в Україні, форма випуску, концентрація діючої речовини, фармакологічні особливості. Відібрано 42 антибіотики. Для кожного препарату зазначено торговельну назву, лікарську форму, склад активної речовини, виробника та реєстраційне посвідчення в Україні. Усі препарати мають чинні ліцензії та реєстрації, що підтверджує їхню доступність для медичного використання.

Висновки. Аналіз розподілу антибіотиків за категоріями А, В, С та VED дає змогу оцінити ефективність їхнього використання та витрати на фармакотерапію при лікуванні внутрішньоклітинних інфекцій і туберкульозу. Найбільші витрати припадають на препарати категорії А, що підтверджує їхню важливість у лікуванні цих захворювань, середні витрати — на препарати категорії В, мінімальні — на препарати категорії С. Аналіз також показав, що більшість антибіотиків є життєво необхідними, що свідчить про їхню критичну роль у медичному лікуванні. Це дає змогу оптимізувати витрати та поліпшити фармакотерапію в медичних закладах.

Ключові слова: туберкульоз, внутрішньоклітинні інфекції, ABC-VED аналіз, фармакотерапія, економічна ефективність, оптимізація вибору антибіотиків, лікування інфекцій.

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