Comprehensive pharmacoepidemiological and clinical-economic analysis of antibacterial drugs consumed during the pandemic at the hospital level in Aktobe, Kazakhstan

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Abstract

Aim: The study aimed to analyze the frequency and structure of antibacterial drug consumption during the COVID-19 pandemic at a dispensary hospital in Aktobe, Kazakhstan. It sought to identify the most frequently used and most costly antibacterial drugs, assessing their economic impact and usage patterns.

Methods: This descriptive, retrospective clinical, economic, and pharmacoepidemiological study was conducted using data from the dispensary hospital's pharmacy and patient records between March 13, 2020, and December 31, 2020. The ABC/VEN analysis and ATC/DDD methodology were applied to evaluate the consumption of antibacterial drugs. Antibiotics were classified according to WHO AWaRe criteria.

Results: The study found that 27 different antibacterial drugs were used, representing 2.2% of all medications. The ABC/VEN analysis revealed that the majority of the budget was spent on a few high-cost drugs. Ceftriaxone was the most commonly used antibiotic, with a significant financial impact. According to the WHO AWaRe classification, most antibiotics fell into the Access and Watch categories.

Conclusion: The study highlights a high rate of antibacterial drug usage, with significant financial implications for the hospital. The predominance of certain high-cost antibiotics, like ceftriaxone, indicates a need for more rational and cost-effective use of these medications. The findings call for improved adherence to clinical guidelines, enhanced education for medical professionals, and optimized antibiotic utilization to prevent resistance development and ensure better patient outcomes, especially in pandemic situations.

Keywords: antibacterial drugs, COVID-19, clinical and economic research, pharmacoepidemiology, WHO AWaRe methodology.

Introduction

In 2020, humanity faced a new pandemic of coronavirus infection (COVID-19), which has claimed the lives of millions of people to date. According to many data, the majority of hospitalized COVID-19 patients used extensive empirical antibiotic use during the pandemic [1-5].

Over-prescribing antibiotics can have significant financial consequences for individuals and health systems. When antibiotics are over-prescribed, not only can they become less effective due to the development of resistance to them, but they can also cause side effects that lead to further medical expenses. As antibiotic resistance increases, the cost of treating infections increases as more expensive and effective drugs are required. The World Health Organization (WHO) recommends reducing the global number of antibiotic prescriptions by 20% to combat the development of antibiotic resistance [6]. In recent years, numerous awareness-raising activities have been undertaken to educate both the public and medical professionals about the problem of unjustified consumption of antibiotics, which remains a serious public health problem. Kazakhstan, as part of the global community, adheres to WHO recommendations. Despite a slight decrease in the consumption of antibiotics for systemic use, the irrational use of these drugs is still widespread in Kazakhstan. This is due to the availability of 27.5% of over-the-counter antibiotics and over-prescribing by medical professionals, while 29.9% of all prescribed drugs are antibiotics [7]. At the same time, practical healthcare requires the most rational use of funds, which dictates effective, but also cost-effective treatment [8].

During the COVID-19 pandemic, clinical practice guidelines were constantly changing to reflect the best available evidence for the existence of a new virus. In Kazakhstan, national clinical guidelines for the care of patients with COVID-19 have been regularly modified, and it is unknown whether or to what extent these recommendations have been followed in practice. Given the ongoing tensions over COVID-19 in the world and in the Republic of Kazakhstan, we believe that it is necessary to conduct a clinical, economic and pharmacoepidemiological study of an antibacterial drug.

The purpose of the study: to study the frequency and structure of consumption of antibacterial drugs during the pandemic of the outpatient hospital in Aktobe, to identify the most frequently consumed and most expensive antibacterial drugs.

Research objectives:
● To study the structure of antibacterial drugs used in 2020.
● To conduct a clinical and economic assessment of the consumption of antibacterial drugs in a dispensary hospital in Aktobe in 2020.
● To conduct a pharmacoepidemiological assessment of the consumption of antibacterial drugs in a dispensary hospital in Aktobe in 2020.
● Evaluation of antibacterial drugs according to the WHO AWaRe classification.

Material and methods

The study was performed on the basis of a dispensary hospital in Aktobe using data on the movement of medicines in the organization for the period from March 13, 2020 to December 31, 2020 from a pharmacy for medicines and medical records of patients. To analyze the consumption of antibacterial drugs (J01), a comprehensive pharmacoepidemiological and clinical-economic study was conducted and antibiotics were classified according to WHO AWARe.

ABC/VEN analysis
A clinical and economic ABC/VEN analysis was performed, which is the method of choice for calculating the financial needs of organizations. At the same time, all antibiotics were divided by cost, taking into account their international nonproprietary names (INN), into three classes: class A - for which 80% of the funds were spent, Class B - for which 15% of the funds were spent, and Class C - for which 5% of the funds were spent (Figure 1).
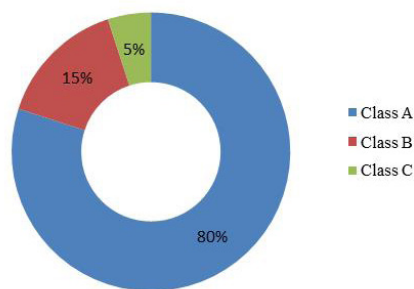

Figure 1 – Separation of antibiotics by cost

At the same time, 3 indices were used V (Vital) - important for saving lives; having life-threatening withdrawal syndrome, constantly necessary to maintain life; E (Necessary / Essential) -effective in the treatment of less dangerous but serious diseases; importance is high, but not absolute; N (Secondary/Non-essential) - for the treatment of mild diseases, medicines with questionable effectiveness, expensive medicines for symptomatic indications [9].

ATC/DDD analysis
Pharmacoepidemiological assessment was performed using the ATC/DDD methodology (English anatomical therapeutic chemical (ATC) classification system – anatomical therapeutic chemical classification) recommended by the World Health Organization, according to the DDD indicator for 100 bed days, which allows aggregating data on the use of drugs, taking into account differences in dosages and activity of the active substance [10].

Classification AWaRe
The AWaRe Antibiotic Classification was developed in 2017 by the WHO Committee of Experts on the Selection and Use of Essential Medicines as a tool to support efforts for the rational use of antibiotics at the local, national and global levels. The consumption of antibiotics was classified into categories: available (Access), observational (Watch), Reserve (Reserve) [11].

Study design: a descriptive, retrospective clinical, economic and pharmacoepidemiological study.

Statistical processing: The data was processed using a computer program

Excel (Microsoft, USA). The program was used to distribute LP into ABC analysis groups. Using the program, an ATC/DDD analysis was performed, calculating the DDD index for 100 bed days.

Criteria for inclusion in the study:
- inpatient records of patients over the age of 18
- patients with COVID -19 positive and negative results
- identified bacterial pneumonia
Criteria for exclusion from the study:
- children (under 18 years old)
- pregnant and birthing women
- cancer patients

Results
According to the results of our study, in 2020, a total of

27 antibacterial drugs (J01) were used in the outpatient hospital in Aktobe. Antibiotics accounted for 2.2% of the total number of 1,283 medicines. According to the results of ABC/VEN analysis, 80% of the total cost of group A includes 9 antibacterial drugs: meropenem (21.2%), ceftriaxone (13.2%), cefepim (11.5%), amoxicillin sodium and potassium clavulanate (7.5%), ertapenem (7.4%), metronidazole (5.9%), clarithromycin (5.6%), cefotaxime (4.2%), levofloxacin (3.9%) (Figure 2).
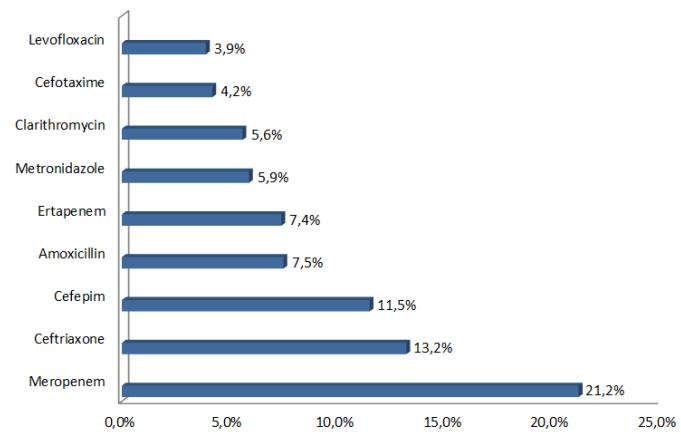
Figure 2 – Costs of class A antibacterial drugs

5 antibacterial drugs were used in the group of 15% of the total cost of antibiotics: doripenem (3.6%), ciprofloxacin (2.5%), cefuroxime (2.4%), cefazolin (2.3%), piperacillin (2.2%) (Figure 3).
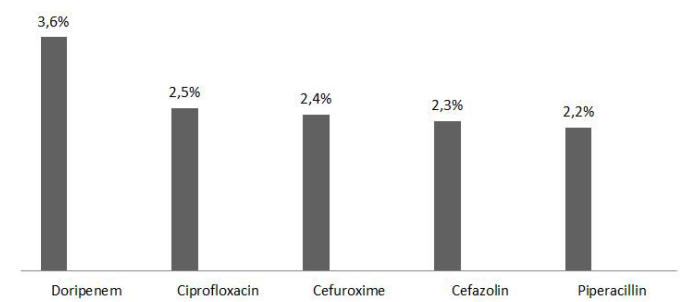
Figure 3 – Costs of class B antibacterial drugs

14 antibacterial drugs included in group "C" 5% of funds were spent: caspofungin (2.1%), fluconazole (1.2%), azithromycin (1.0%), moxifloxacin (0.63), vancomycin (0.6%), ampicillin (0.4%), amikacin (0.3%), gentamicin (0.1%), imipenem cilastatin (0.1%), ofloxacin (0.09%), thiamphenicol glycinate acetylcysteinate (0.03%), erythromycin (0.02%), amoxicillin (0.005%), lincomycin (0.003%).

All antibacterial drugs were classified as category V (Vital) – important for saving lives. Category N (Secondary/Non-essential) included caspofugin, erythromycin, thiamphenicol glycinate acetylcysteinate, lincomycin, i.e. included in group C.

According to the results of the pharmacoepidemiological analysis of the most commonly used antibiotics, the following drugs were identified (Table 1).

To optimize the rational use of antibiotics and support monitoring, in March 2017, WHO presented a detailed classification of antibiotics, designated "Access", "Surveillance" and "Reserve". According to the WHO AWaRe classification as a result of our study: 7 -to the Access group, 19 - to the Watch

Table 1	Commonly used antibiotics	
1	Ceftriaxone	19,043 DDD/100 bed days
2	Metronidazole	6,906 DDD/100 bed days
3	Cefotaxime	6,001 DDD/100 bed days
4	Cefosalin	4,204 DDD/100 bed days
5	Levofloxacin	3,389 DDD/100 bed days
6	Ciprofloxacin	2,872 DDD/100 bed days
7	Amoccicillin clavulanic acid	2,026 DDD/100 bed days
8	Gentamicin	1,811 DDD/100 bed days
9	Cefuroxime	0.688 DDD/100 bed days
10	Meropenem	0.404 DDD/100 bed days

group, to the Reserve group - it was not revealed. 16 are included in the WHO List of Essential Medicines, and 10 are not included in the WHO List of Essential Medicines.

Discussion

For the first time in Aktobe, the structure of antibacterial drugs used during the pandemic was studied in a dispensary hospital, and a comprehensive clinical, economic, pharmacoepidemiological study was conducted for the first time. According to the results of our study shown above, it can be noted that the drug meropenem, which was the most expensive in 2020, was used infrequently. But the drug ceftriaxone, which accounted for 80% of the costs, ranked first among the most commonly used in 2020. As we can see, more than half of the hospitalized patients in our study received antibiotics, and cephalosporin antibiotics were most often prescribed. As well as the antibiotic levofloxacin, which is not included in the List of medicines of the World Health Organization, was often used.

That is, during the pandemic, 72% of the "Observation" group of patients were prescribed antibiotics in antibacterial therapy. These figures are high, but below the global estimate of 75% of patients with COVID-19 who received prescriptions for antibiotics [12]. Overuse of antibiotics can contribute to the development of resistance to antibacterial drugs, which is a global public health problem. This finding is consistent with other studies highlighting problems in the management of antibacterial drugs during the pandemic. And, as in our study, in 2020, cephalosporin antibiotics were the most commonly prescribed antibacterial drugs in Almaty, followed by fluoroquinolones [13].

A study in Pakistan, Jordan, and South Asian countries showed that ceftriaxone and azithromycin, ciprofloxacin were often used during the pandemic [14-16]. SARS-CoV-2 was detected in our country in March 2020. Since that moment, on the basis of the order of the regional health department of Aktobe region No. 68-5 dated 2020, the multidisciplinary hospital in Aktobe has been redesignated into a 400-bed dispensary hospital for the treatment of patients with severe pneumonia. On the basis of a multidisciplinary dispensary, 2,223 patients with severe pneumonia in combination with various concomitant diseases COVID-19 received inpatient treatment.

2020 is the first year of the outbreak of the pandemic in the country. The first version of the COVID-19 diagnostic and treatment protocol was developed on February 3, 2020 and has been revised several times since then. Kazakhstan, as part of the global community, adheres to WHO recommendations. However, despite a slight decrease in the consumption of

systemic antimicrobials in recent years, the irrational use of antibiotics continues to persist in Kazakhstan. In addition, we are concerned that this trend will increase as a result of the widespread empirical use of antibiotics during the COVID-19 pandemic [17].

In conclusion, this study highlights the need for more effective implementation of developing clinical practice guidelines for people hospitalized with COVID-19 in Aktobe, Kazakhstan. Efforts are needed to improve communication, education, and support for physicians to ensure the continued and consistent use of evidence-based therapies, promote the proper use of medicines, and optimize patient outcomes in any pandemic response.

Conclusion

A comprehensive analysis of ABP in a dispensary hospital during the pandemic showed that the highest proportion of costs during the study period and the most commonly used antibiotics during the pandemic came from the group of carbapenems, cephalosporins, as well as the group of fluoroquinolones.

Antibiotic abuse was noticeably high throughout the period. Monitoring the consumption of antibacterial drugs in a dispensary hospital allows you to make strategic decisions to optimize antibiotic therapy and bring the number and assortment of antibiotics used in line with the profile of the hospital units. The comprehensive ABC analysis and DDD analysis allows us to compare the data on the priority of financial costs and the level of consumption of ABP, which makes it possible to optimize the use of antibiotics in a multidisciplinary medical facility.

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