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Assessment of The Pharmacoeconomic Efficiency of Medicines Used in The Treatment of Pneumonia

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Abstract

Pneumonia is one of the most common and clinically significant diseases of the respiratory system, requiring, especially in severe cases, inpatient treatment, multicomponent drug therapy, and substantial medical resources. The continuously expanding range of medicines, the introduction of modern antiviral and antibacterial drugs into clinical practice, as well as the widespread use of symptomatic and supportive treatment agents, demand efficient and rational use of the financial and material resources available in the healthcare system. From this standpoint, applying pharmacoeconomic approaches to the treatment of pneumonia makes it possible to

comprehensively assess both the clinical significance of medicines and the funds spent on them.

This article discusses the theoretical and practical aspects of using cost analysis, ABC analysis, VEN analysis, and the ABC/VEN matrix in the pharmacoeconomic evaluation of medicines used in the treatment of patients with pneumonia. In cost analysis, the total cost is calculated based on the unit price of a medicine and the quantity consumed. ABC analysis makes it possible to divide medicines into groups A, B, and C according to their share of total costs, while VEN analysis assesses their clinical significance as V — vital, E — essential, and N — non-essential agents. The ABC/VEN matrix, in turn, allows for an integrated assessment of economic and clinical indicators.

The results of the analysis show that the bulk of medicine costs in the treatment of pneumonia falls on a limited number of drugs, and that some medicines may be highly costly while having low clinical significance. For this reason, pharmacoeconomic analysis is an important tool for shaping rational pharmacotherapy in pneumonia therapy, planning medicine procurement, and improving the budget efficiency of healthcare institutions.

Keywords: Pneumonia, pharmacoeconomics, pharmacoeconomic analysis, medicines, cost analysis, ABC analysis, VEN analysis, ABC/VEN matrix, rational pharmacotherapy, antibacterial therapy.

1. Introduction

Pneumonia is one of the important medical and social problems in modern medical practice. The clinical course of the disease depends on the patient's age, comorbidities, infection etiology, immune status, pathogen sensitivity to antibiotics, and many other factors. While mild forms of pneumonia can be treated on an outpatient basis, severe cases require hospitalization, parenteral antibacterial therapy, oxygen therapy, infusion and symptomatic treatment, and, in some cases, intensive care measures.

Medicines play an important role in the treatment of pneumonia. However, the choice of a drug should not be limited to its clinical efficacy alone. The price of the medicine, duration of use, dosage, volume of consumption, the possibility of preventing complications, the availability of alternative drugs, and the impact on the medical institution's budget must also be taken into account.

In the modern healthcare system, resources are not sufficient to simultaneously provide all patients with the most expensive available technologies. Therefore, it is important to direct available financial resources toward technologies that are the most clinically justified and economically optimal. One of the main tasks of pharmacoeconomics is to ensure the rational use of resources by comparing the clinical outcomes of medical interventions with the costs incurred for them.

Pharmacoeconomic analysis is a methodology for comparatively evaluating two or more alternative treatment options with medicines from the standpoint of cost and clinical outcome. Such an analysis makes it possible to assess not only whether a particular drug is expensive or cheap, but also its clinical value relative to the funds spent on it.

The significance of this approach is particularly high in pneumonia, since antibacterial, anti-inflammatory, symptomatic, mucolytic, infusion, and other agents are used simultaneously in treating patients. This leads to an increase in the number of medicines used and, consequently, an increase in overall treatment costs.

Irrational use of antibacterial drugs causes not only economic but also clinical problems. The World Health Organization emphasizes that excessive and improper use of antibiotics is one of the main factors in the development of antibacterial resistance, and such situations lead to additional expenditure of funds. For this reason, when selecting antibacterial agents, the principles of rational use must be taken into account alongside clinical efficacy.

The issue of controlling costs and using medicines rationally in pneumonia therapy is also relevant in international practice. In particular, when assessing the costs of treating pneumonia, expenses related to medicines, diagnostic examinations, oxygen supply, and hospital stay may be taken into account.

In this regard, a comprehensive study of the cost structure, economic significance, and clinical necessity of the medicines used in treating patients with pneumonia is of significant scientific and practical importance.

Research Aim

To comprehensively assess the economic significance and clinical necessity of the medicines used in the treatment of patients with pneumonia, to identify high-cost and clinically important drugs, to determine opportunities for the rational use of medicines, and to develop scientific and practical recommendations for the efficient allocation of healthcare system resources.

2. Materials and Methods

The study used retrospective data on the medicines used in the treatment of patients with pneumonia. The basis of the research approach consisted of determining the costs incurred for

medicines, grouping them according to their economic significance, and comparing them with the degree of clinical necessity.

The pharmacoeconomic assessment envisaged the use of four complementary main methods:

cost analysis;

ABC analysis;

VEN analysis;

ABC/VEN matrix.

The combined use of these approaches makes it possible to assess medicines not only by their price or volume of consumption, but simultaneously by their economic and clinical significance.

Cost Analysis

Cost analysis was the first stage of the study and was aimed at determining the total volume and structure of medicine costs incurred in treating pneumonia over a given period.

The total cost for each medicine is determined using the following formula:

$$C_i = P_i \times Q_i$$

where:

C_i — total cost for medicine i;

P_i — unit price of the medicine;

Q_i — total quantity of the medicine consumed during the period analyzed.

The share of a medicine in total costs is calculated using the following formula:

$$S_i = C_i / \Sigma C \times 100\%$$

Where S_i is the percentage share of a given medicine in total costs.

In calculating costs, the study adopted an approach using the official price registry, reports from the medical institution's pharmacy warehouse, and the results of public procurement. This approach makes it possible to assess the real consumption volume of medicines together with their price.

Correctly classifying costs is also important in pharmacoeconomic studies. They can be divided into direct medical, direct non-medical, and indirect costs. Direct medical costs include diagnostics, treatment, medicines, medical procedures, healthcare personnel labor, and inpatient treatment costs.

When assessing medicine costs in inpatient settings, it is advisable to use wholesale prices or the procurement prices applied at the institution, and using average price indicators increases the stability of the analysis.

ABC Analysis

ABC analysis is a method of grouping funds spent on medicines according to their share of total costs. This method is based on the Pareto principle, which shows that a relatively small proportion of medicines may account for a large share of total costs.

When conducting ABC analysis, the total cost for each medicine is first determined. The drugs are then arranged in decreasing order of cost amount, and the cumulative cost share is calculated.

Group A usually includes drugs that form approximately up to 80 percent of total costs. Group B covers the next 10 percent, and Group C covers the remaining 10 percent. In the research methodology, drugs belonging to Group A are assessed as the medicines with the greatest economic significance.

In pneumonia therapy, it is important to specifically monitor the drugs belonging to Group A. Although the number of drugs in this group may not be large, they constitute the main part of overall pharmaceutical costs.

For example, the analysis may include antibacterial drugs such as ceftriaxone, cefepime, cefoperazone/sulbactam, meropenem, and levofloxacin, which are agents affecting high costs. Since some of these have a high price, the frequency of their use and their compliance with clinical indications must be monitored separately.

An important aspect of ABC analysis is that a drug's inclusion in Group A does not automatically mean that it is the “best” or “most effective” medicine. Group A only indicates economic significance. For this reason, ABC analysis needs to be applied together with VEN analysis, which assesses clinical significance.

VEN Analysis

VEN analysis makes it possible to group medicines according to their clinical significance and degree of necessity.

V — Vital — vital medicines.

E — Essential — essential medicines.

N — Non-essential — secondary or non-mandatory medicines.

Unlike ABC analysis, VEN analysis assesses not how much money a drug requires, but its clinical significance in treating a particular disease.

In VEN classification for pneumonia, factors such as the clinical efficacy of the drug, its place in treatment standards, its significance at different severity levels, the availability of alternative agents, and its importance for the patient's life may be taken into account.

For example, in severe pneumonia, antibacterial drugs vital for life, agents related to oxygen therapy, and other necessary therapeutic components may be included in Group V. Drugs that are clinically justified but can be replaced in certain situations may be included in Group E, while agents with a limited evidence base or that are non-mandatory may be included in Group N.

In VEN analysis, it is advisable to jointly apply formal and expert approaches. The formal approach takes into account national essential medicines lists and regulatory documents, while in the expert approach, specialists assess the specific significance of a given drug in treating pneumonia.

This approach is particularly important in pneumonia, because a drug being considered important in general medical practice does not mean it is equally necessary in every case of pneumonia.

ABC/VEN Matrix

The ABC/VEN matrix is a comprehensive method combining economic and clinical indicators.

The intersection of the ABC and VEN classifications forms 9 categories:

AV;

AE;

AN;

BV;

BE;

BN;

CV;

CE;

CN.

Each of them has a different significance from the standpoint of medicine management.

AV — high-cost and vital drugs. This group is of particular strategic importance, since substantial financial resources are directed toward clinically necessary agents.

AE — high-cost and essential drugs. Their use should be compared against clinical indications and alternative therapy.

AN — high-cost drugs with low clinical significance. This category requires the most attention from a pharmacoeconomic standpoint, because the presence of drugs that require substantial funds but are not clinically mandatory indicates the possibility of irrational expenditures.

Drugs in the BV and BE groups are moderate-cost agents with high or essential clinical significance.

BN covers moderate-cost drugs with low clinical significance.

CV — drugs with a low cost share but that are clinically vital. Particular attention should be paid to the risk of supply interruption in this group.

The CE and CN groups consist of low-cost drugs, and management decisions are made according to their clinical significance.

Thus, the ABC/VEN matrix makes it possible to answer not only the question “how much money was spent?” but also the important question “was this money spent on a clinically justified drug?”

Pharmacoeconomic Significance of Medicine Costs in Pneumonia

One of the main objects of pharmacoeconomic assessment in the treatment of pneumonia is antibacterial therapy. Antibiotics are the main etiotropic agent in the bacterial etiology of pneumonia, and drug selection depends on the severity of the disease, the probable causative agent, the risk of resistance, and the individual characteristics of the patient.

At the same time, the unjustified use of broad-spectrum and high-priced antibiotics may increase overall treatment costs. Furthermore, excessive use of antibiotics increases the risk of antimicrobial resistance. WHO identifies the optimal selection and use of antibiotics as an important part of combating antimicrobial resistance.

The WHO AWaRe approach divides antibiotics into Access, Watch, and Reserve groups, supporting the monitoring of their consumption and the rational use of antibiotics.

For this reason, combining ABC/VEN analysis in pneumonia with methods for assessing the rational use of antibiotics may be an important direction in the future.

In pneumonia therapy, in addition to antibacterial drugs, symptomatic agents may also be used. These include antipyretics, analgesics, bronchodilators, mucolytics, and other drugs. Each of them may constitute a small share of the total cost, but as the number of drugs increases, the overall cost also rises.

From this standpoint, drugs in Group C should also not be completely overlooked. Although each of them individually requires a small expenditure, the cumulative cost can be significant when the number of drugs is large.

The Role of Cost-Effectiveness Analysis

Although ABC and VEN analyses make it possible to group medicines according to their economic and clinical significance, they do not directly measure clinical efficacy. For this reason, cost-effectiveness analysis (CEA) can be used at the next stage of pharmacoeconomic research.

In the CEA method, the costs incurred for treatment are compared with a specific clinical efficacy indicator. For example, in pneumonia, the following criteria can be used as indicators of efficacy:

the proportion of clinically cured patients;

reduction in the duration of hospitalization;

reduction in the frequency of complications;

reduction in cases of readmission;

decrease in mortality rate

and similar criteria can be used.

According to the methodological approach presented in the source material, CEA makes it possible to assess costs relative to a measurable unit of health outcome.

CEA formula:

CEA = (DC + AC) / Ef

where:

DC — direct costs;

AC — indirect costs;

Ef — efficacy indicator.

In pneumonia, this method is of significant importance when comparing different antibacterial therapy options. For example, if a more expensive drug provides a higher clinical effect in a shorter time, its additional cost may be justified by the clinical outcome. Conversely, if an expensive drug does not provide a superior effect compared to a cheaper alternative, its widespread use may not be economically appropriate.

Thus, ABC/VEN analysis can be used as a screening tool for cost management, while CEA can be used for a deeper assessment of the clinical and economic efficiency of alternative therapeutic strategies.

Cost Management in Pneumonia

In optimizing the costs of treating pneumonia, striving only to reduce the price of medicines may be an incorrect approach. The main goal is to rationally manage overall costs while maintaining clinical efficacy.

For this, the following approaches are important:

selecting evidence-based antibacterial therapy;

reducing unjustified combinations of antibiotics;

adapting the duration of treatment to clinical need;

assessing, when necessary, the possibility of switching from parenteral to oral therapy;

monitoring the use of high-cost drugs;

ensuring a constant reserve of vital drugs;

re-evaluating drugs with low clinical significance and high cost.

WHO also emphasizes the importance of reducing the excessive and improper use of antibiotics while at the same time ensuring that patients who need quality antibiotics have access to them.

As the clinical condition of patients with pneumonia becomes more severe, the need for medicines and medical services may also increase. For this reason, pharmacoeconomic analysis can also be conducted separately according to the severity levels of the disease.

This approach makes it possible to identify differences in medicine consumption and cost structure in mild, moderate, and severe pneumonia.

3. Discussion

The rational use of medicines in the treatment of pneumonia requires making clinical and economic decisions jointly. Neither choosing only the cheapest drug nor choosing only the newest and most expensive drug is a universally correct approach.

The advantage of the pharmacoeconomic approach is that it allows for a comprehensive assessment of clinical efficacy, safety, and costs. The methodology of pharmacoeconomic analysis requires clearly defining the research objective, perspective, design, analysis method, alternative treatment options, and efficacy criteria.

In pneumonia, ABC analysis determines which drugs account for the main part of medicine costs, while VEN analysis determines the clinical necessity of these drugs. By combining the two methods, it is possible to determine which directions of resource use are priorities.

For example, for drugs in the AV group, continuity of supply and budget planning are priority tasks. Drugs in the AN group require re-evaluation from a clinical standpoint. For drugs in the CV group, although the cost is small, their availability may be of strategic importance.

Pharmacoeconomic analysis also serves to improve the medicine procurement process. In a healthcare system with a limited budget, jointly assessing the clinical significance, cost, and consumption volume of drugs allows for informed decision-making in procurement planning.

The WHO-CHOICE approach also shows that cost-effectiveness assessment can be applied in resource allocation and in determining priority directions; in this case, it is important to take into account local prices and epidemiological conditions.

Interest in jointly assessing clinical and economic indicators is also growing in modern research on pneumonia. For example, a study published in 2026 assessed the clinical and cost indicators of community-acquired pneumonia within the framework of an antimicrobial stewardship approach.

However, ABC/VEN analysis also has limitations. ABC analysis groups drugs only by their cost share and does not directly measure clinical outcome. For this reason, it is advisable to view it not as a replacement for CEA, CUA, or other clinical-economic methods, but as a method that complements them.

4. Conclusion

Applying pharmacoeconomic approaches in treating patients with pneumonia makes it possible to rationally use medicines and optimally allocate the financial resources available in the healthcare system.

Cost analysis serves to determine the total funds spent on medicines in pneumonia therapy and their structure. ABC analysis, in turn, shows which drugs account for the main part of total costs.

VEN analysis assesses medicines according to their clinical significance, making it possible to distinguish vital, essential, and secondary drugs. The ABC/VEN matrix, by integrating these two approaches, makes it possible to identify medicines that are economically and clinically priority or problematic.

In pneumonia therapy, the clinical necessity of high-cost drugs should be assessed separately, the continuous supply of vital drugs should be ensured, and unjustified use of drugs with low clinical significance should be limited.

The results of pharmacoeconomic analysis can be applied in improving clinical protocols, medicine formularies, and the procurement policy of medical institutions. In particular, the rational selection and use of antibacterial drugs is important not only for optimizing treatment costs but also from the standpoint of limiting antimicrobial resistance.

Thus, regularly conducting pharmacoeconomic analysis in the treatment of pneumonia is one of the important tools for economically justifying clinical decisions, optimizing medicine supply, ensuring efficient use of budget funds, and providing patients with quality medical care.

Practical Recommendations

Regularly conduct an annual cost analysis of medicines used in treating patients with pneumonia.

Separately assess the clinical justification of high-cost Group A drugs.

Where Group A drugs with low clinical significance exist, reconsider the reasons for their use.

Ensure a constant reserve of vital drugs using VEN analysis.

Follow clinical protocols and antimicrobial stewardship principles when selecting antibacterial drugs.

Plan medicine procurement based on the ABC/VEN matrix.

Apply the results of pharmacoeconomic analysis in shaping the medical institution's formulary.

In future research, combine ABC/VEN results with CEA and CUA methods.

Separately assess medicine costs and clinical efficacy according to different severity levels of pneumonia.

Monitor antibiotic consumption based on the WHO AWaRe classification alongside economic analysis.

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