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Input of Medical Interventions, Medical Technologies, and Accessibility Factors in Lung Cancer Treatment Outcomes

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Abstract: Expert analysis reveals that outcomes in lung cancer treatment involving novel drugs depend less on the drugs themselves and more on systemic changes in disease management. These outcomes are tied to key acceptability factors: patient awareness and perceptions regarding early diagnosis and adherence, awareness and qualifications of healthcare providers (HCPs), and overall affordability and availability. Consequently, a rational model for disease control must consider medical technology as a multi-agent integrated system. This complex must include both the medical intervention (the drug) and the critical accessibility factors that ensure treatment success, ultimately transforming the underlying healthcare infrastructure, financing, and specialist expertise.

Keywords: Accessibility, affordability, acceptability, availability, multiagent active system model, medical technology, intervention, efficacy, safety

1. INTRODUCTION

Access to medical care is an integral part of healthcare quality and implemented within national health systems. This access is a key global determinant, influencing both population's health and a nation's broader progress—including its economic, scientific, and technological advancement, social stability, and national security.

The availability of medical care is declared in the constitutions of various countries, is ensured by national regulatory legal acts and is determined by a number of objective factors: the balance of the necessary volumes of medical care to the population with financial opportunities, the availability and level of qualification of medical personnel, the availability of necessary medical technologies in specific territories, the patient's free choice of the attending physician and medical organization, available transport facilities ensuring timely receipt of medical care, the level of public education on the issues of maintaining and promoting health and disease prevention [1].

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Integrating a medical technology into healthcare system requires more than just its state registration; it also demands conditions that ensure high-quality medical care. While Health Technology Assessment (HTA) has been the primary tool for ensuring the accessibility of medical interventions — gradually evolving and supplementing beyond clinical and economic analysis to include social and environmental impacts— HTA's perceived shortcomings in Western Europe often stem from insufficient attention to real-world implementation and accessibility conditions [2 - 5].

Contemporary management and control approaches require a comprehensive evaluation of existing system elements and their impact on achieving objectives. Public health management is largely related to the use of medicines as well as the increasing their effectiveness and safety. However, both the accessibility and effective drugs application depend on numerous factors, including affordability (budgeting and economic autcomes), acceptability barriers (perception, technological, etc.), and the availability of qualified specialists [6 - 8].

The continued increase in the prevalence of certain types of oncological diseases and the high unmet need for medicines stimulate the largest research centers and pharmaceutical companies to further search for new solutions in the treatment of oncological diseases, as well as the introduction of innovative products to the market. The development of innovative medicines has the most significant impact on the medical technology market. Oncology remains the largest area of this work, second only to diabetes and infectious diseases in terms of the number of studies. Over the past years, a significant number of new drugs have been introduced into international oncology practice. As a result of oncology diseases control has been followed by the increase number of new drugs and the increase of patients' survival [9]. There is a strong negative correlation between the number of molecules (new drugs) for the treatment of the oncology conditions and mortality rates, i.e. an increase in the number and diversity of drugs increases the efficacy of treatment at the population level. The assessment of the Pearson correlation for lung cancer (ICD-10 C33, C34) revealed a strong inverse relationship. The availability of a greater number of new original drugs (21 novel molecules) in the market correlated significantly with both a lower first -year mortality rate after diagnosis and a reduced likelihood of cancer-specific death [10]. Traditionally, research into the factors influencing medicine accessibility and use has focused on developing methods to overcome barriers related to availability, acceptability, and affordability. However, there remains insufficient data on the interactions between these factors and a limited understanding of their collective contribution to improving population health [11].

2. OBJECTIVE

Assessment the contribution of new original drugs value (efficacy and safety) integrated with the input of accessibility factors and barriers in achieving indicators of population improvement at the example of lung cancer (C33, 34).

3. MATERIALS AND METHODS.

The assessment of availability factors and their relationship with lung cancer (C33, 34) treatment outcomes was performed using survey of 64 specialized in oncology healthcare practitioners (HCPs) (all available in the country). The inclusion/exclusion criteria were: to have experience in international multicenter clinical trials and to be familiar with the best international treatment standards in oncology as well as the healthcare system financing and management for 10 years, corresponding to the period of data collection in the study

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assessing the correlation between number of new original drugs and treatment outcomes in oncology [10].

The survey contained 33 questions assessing the experts' opinion regarding the impact on accessibility (availability, affordability, acceptability). factors on overall clinical outcomes in lung cancer treatment (C33, 34) during the 10-years period of the study [10].

The following scale was used for the study: 1 – significant negative impact; 2 – negative; 3 – did not impact; 4 -improved; 5 – significantly improved. The survey results are represented by the median.

Wilcoxon signed-rank test was used the assess the reliability in pairs "was – become" and the presented results have the statistical reliability of $P < 0,05$.

4. RESULTS

All respondents assessed the positive changes in treatment outcomes, which coincided with the statistical data (fig. 1). Acceptability indicators have improved and affordability indicators have significantly improved while availability of drugs in oncology units did not change (the points are connected by a continuous line) comparing to the state 10 years ago, which is shown by a gray area outlined with a dotted line.

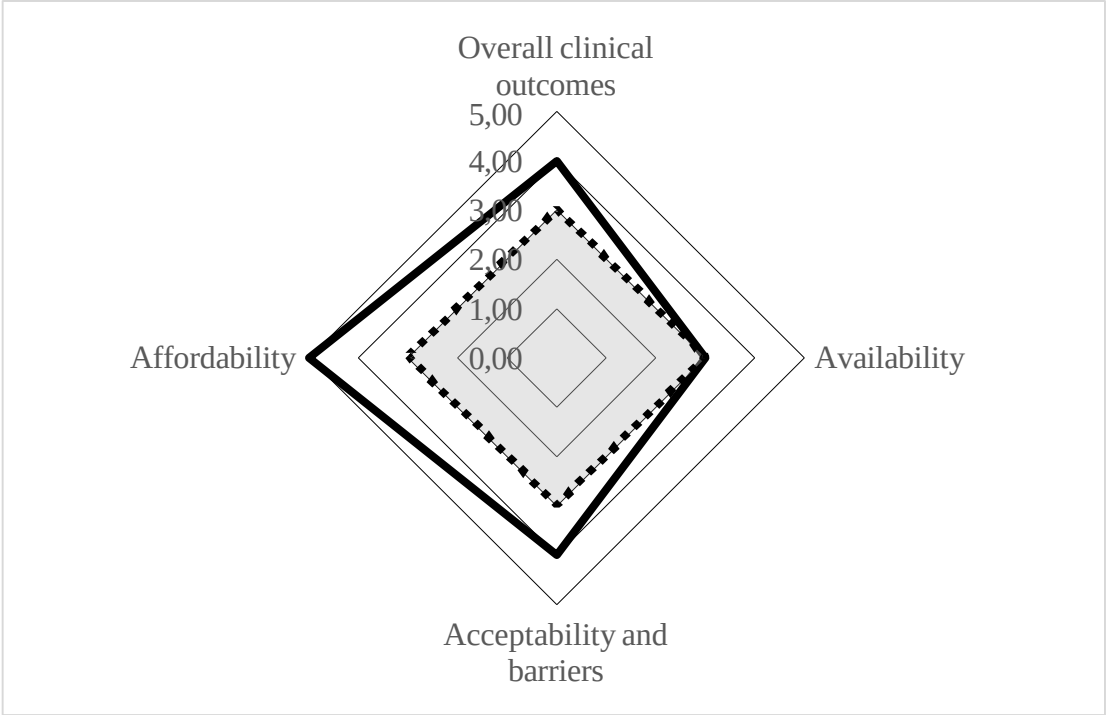

Fig. 1. Experts (HCPs) opinion on accessibility factors influencing overall clinical outcomes improvement of lung cancer treatment (C33 – C34 according to ICD 10). Rating: 1 – significant negative impact; 2 – negative; 3 – did not impact; 4 -improved; 5 – significantly improved

The most interesting and unexpected results are shown in fig. 2 indicating that features such as the safety of new drugs and their effectiveness, as well as the results of new methods of non-drug therapy (surgery, radiation therapy) had no effect on the overall improvement in outcomes. According to experts, the most important were the possibility of early diagnosis and detection of diseases at early stages, as well as the opportunity of choosing the most effective therapy depending on the diagnosis and stage of the disease. On the other hand, such result corresponds to the trend of increasing the number of non-inferiority studies studies [12–14].

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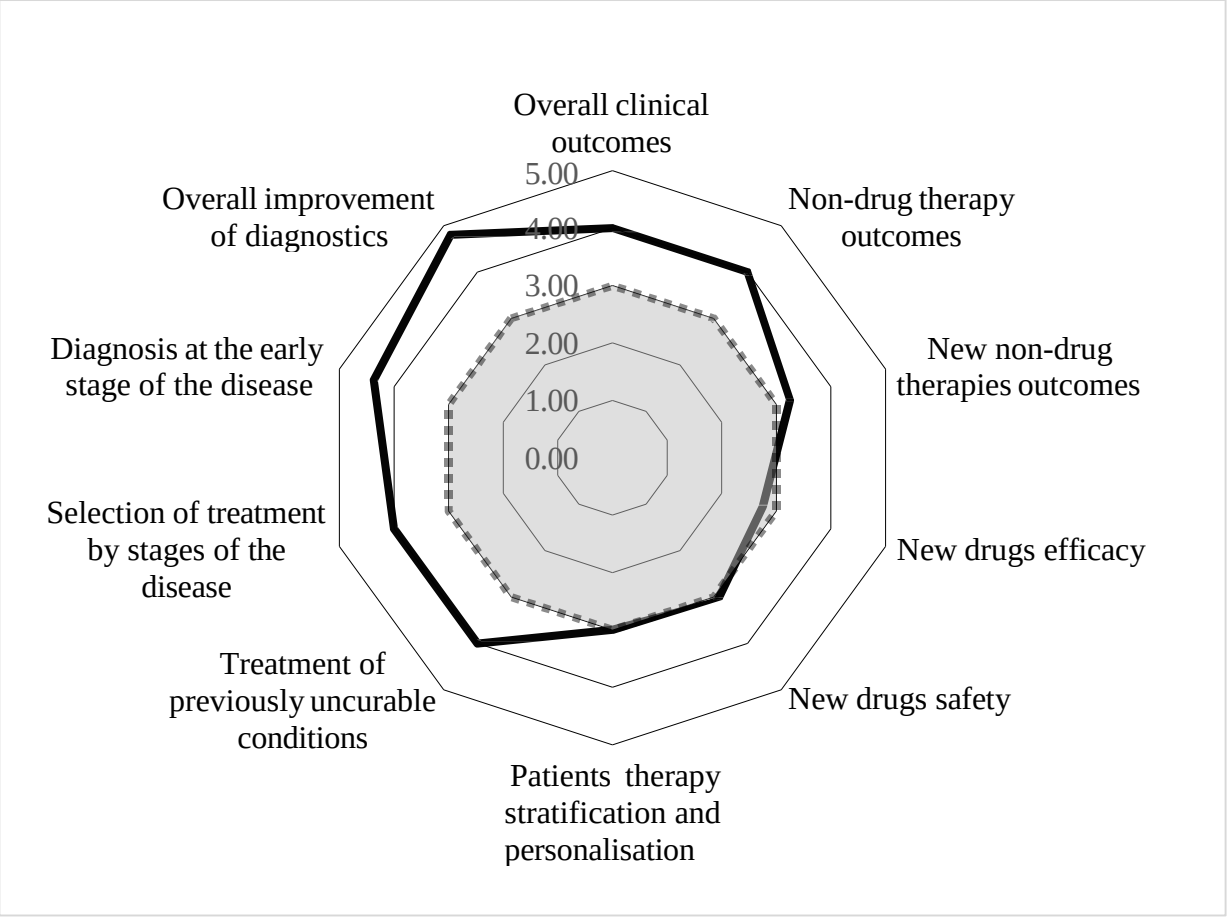

Fig. 2. Experts (HCPs) opinion on clinical factors influencing overall clinical outcomes improvement of lung cancer treatment (C33 – C34 according to ICD 10). Rating: 1 – significant negative impact; 2 – negative; 3 – did not impact; 4 -improved; 5 – significantly improved.

Fig. 3 demonstrates an increase in overall clinical outcomes linked to the acceptability barriers. Technological area is represented by the laboratory diagnostics necessary both for routine clinical monitoring during chemotherapy and for the cancer markers assessment necessary for target therapy and also by medical devices increasing the acceptability and quality of drug administration (infusomats, etc.) [15 - 17]. The possibility of using drugs that are not included in local regulatory documents increased with the number of clinical trials. Awareness both of HCPs and overall population including diagnosed patients promotes the early detection of oncological diseases and increases patient compliance, significantly facilitatating the interaction between medical personnel and patients helping improving treatment outcomes [18].

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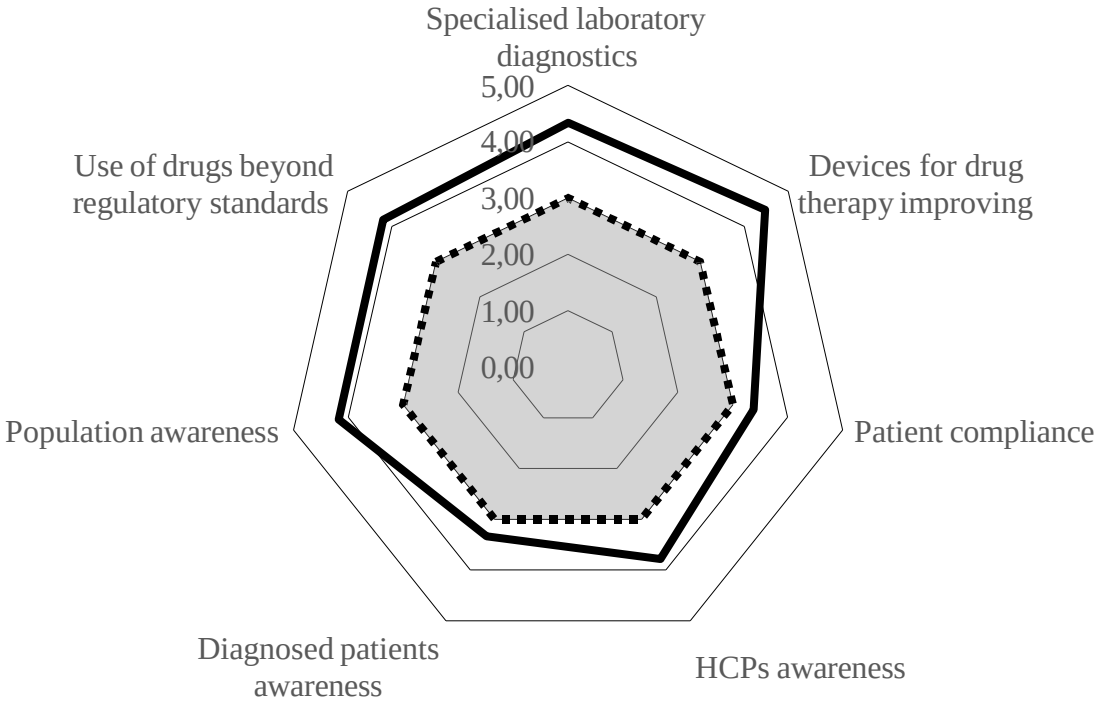

Fig. 3. Experts (HCPs) opinion on acceptability factors and barriers influencing overall clinical outcomes improvement of lung cancer treatment (C33 – C34 according to ICD 10). Rating: 1 – significant negative impact; 2 – negative; 3 – did not impact; 4 -improved; 5 – significantly improved

Drugs affordability (fig. 4) and its relationship with overall amount of funding together with price optimization (reliable price policies and use of generics) and flexibility of budgeting (capability to use different sources and to switch financial flows) has been already discussed in literature and successfully implemented into practice [19].

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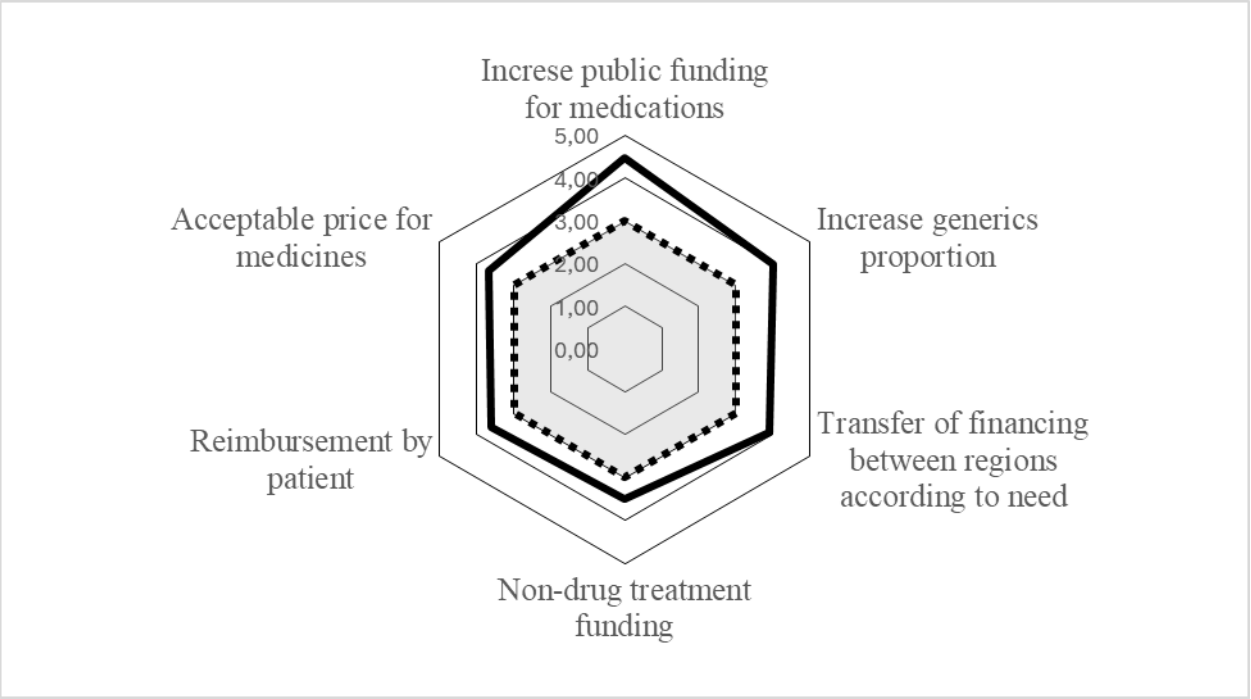

Fig. 4. Experts (HCPs) opinion on affordability factors influencing overall clinical outcomes improvement of lung cancer treatment (C33 – C34 according to ICD 10). Rating: 1 – significant negative impact; 2 – negative; 3 – did not impact; 4 -improved; 5 – significantly improved

4. DISCUSSION

The results enabled the structuring and systematization of information regarding the importance of drug availability factors for improving treatment outcomes.

The most interesting result is the absence of breakthrough drug technologies in lung cancer treatment. Despite a significant increase in the number of new original drugs (21 novel molecules), none were identified by specialists as providing a definitive increase in efficacy or safety. Nevertheless, drug therapy was directly and indirectly linked to improved clinical outcomes. The increase in the number of drugs allowed to choose the most suitable ones, based on disease characteristics and stage. At the same time, increased awareness among both potential and diagnosed patients and healthcare practitioners (HCPs) enhanced treatment compliance and results. Almost every one of the mentioned accessibility factors had an impact on the success of treatment of patients with lung cancer. The presence of at least one impassable barrier or a misalignment with an accessibility factor closes access to the drug for patients. The appearance of a new drug in a treatment protocol of a certain nosology or its absence not only alters the range of possible interventions, but also the factors and barriers to accessibility, thereby affecting the availability of other drugs this way.

In this regard, the fact of the appearance of a new drug should be considered not only in connection with its efficacy and safety characteristics, but also as a control action in a multi-agent active system.

The share and result of the use of medicines in ensuring public health is constantly expanding, and the early access of target patient populations to new developments is considered an important factor in ensuring national health in different countries. At the same time, barriers to drug access are complex, emerging across multiple levels of the healthcare system. Current early-access mechanisms often fail to account for this complexity and the interrelated nature of these barriers [20 - 24].

Managing accessibility factors is inherently complex due to presence of human factor within the control loop. Unlike any even the most complex technical system, humans display unpredictable activity —they pursue their own goals and are able to distort information

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relayed to the governing body (deception) or choose not to execute assigned tasks. This creates an "active" system of interacting agents. This can create an illusion of proper functioning and general well-being for the Center, while the actual outcome may not only deviate from predictions but become entirely opposite. Effectively managing such a system therefore requires the optimization of a variety of plans that are optimal for the individual agents themselves [25 - 27].

As systems grow larger and involve more diverse factors, achieving a shared, coherent understanding of basic concepts and knowledge becomes a fundamental management task. This semantic framework is essential for ensuring that all participants interpret goals, data, and instructions consistently used to manage the system. However, the understanding of terms varies depending on the field of application or over time, which can lead to misunderstandings between different participants and inefficiency of the management process, including the process of ensuring the accessibility of drug therapy [28 - 30].

Terms “medical technology”, “intervention”, “medicine”, and “drug” are often used in various combinations, often as synonyms. At the same time the term "technology" is defined as the application of scientific knowledge to achieve the practical goals of human life [31] or the use of scientific knowledge or processes in business, industry, production [32]. Thus, medical technology implies the achievement of medical goals while drug therapy (as a medical technology) implies a change in health indicators when using it. Medical intervention (medication itself) determined as "a treatment, procedure, or other action taken to prevent or treat disease, or improve health in other ways" [33] can be considered as an integral part of medical technology including also accessibility factor and interacting with other medical technologies in multiagent system capable controlling and managing population health.

5. CONCLUSIONS

1. Overall outcomes of lung cancer treatment depend mostly on integrated changes in accessibility factors (acceptability, affordability and availability) while safety and efficacy of new original drugs provide less impact on disease control.
2. Rational and effective disease control based on multiagent active systems model requires considering medical technology as an integrated complex including the drug itself (medical intervention) and accessibility factors that determine whether treatment goals can be achieved/
3. Ensuring the accessibility of an intervention within one medical technology ensures changes in similar accessibility factors for other interventions, thereby increasing the effectiveness of the healthcare system as a whole.

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