

Value-Based Healthcare Model of Medical and Pharmaceutical Care for Patients With Coronary Artery Disease with Comorbid Conditions: Cost-Benefit Analysis in the Healthcare Setting of Ukraine

Natalia Bilousova

arinalata@gmail.com

Shupyk National Healthcare University of Ukraine

Tamara Mahanova

Zaporizhia State Medical University

Natalia Tkachenko

Zaporizhia State Medical University

Vasyl Mykhalchuk

Shupyk National Healthcare University of Ukraine

Nataliia Kozhuharyova

Shupyk National Healthcare University of Ukraine

Maryna Dolzhenko

Shupyk National Healthcare University of Ukraine

Research Article

Keywords: Coronary Artery Disease (CAD), Adherence to Treatment, Fixed-Dose Combinations (FDC), Cost–Benefit Analysis (CBA), eHealth

Posted Date: July 7th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-9927500/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Pharmacotherapy of Coronary Artery Disease (CAD) with comorbid conditions is accompanied by severe polypharmacy and reduced patient adherence to treatment, which leads to a high incidence of cardiovascular Major Adverse Cardiovascular Events (MACE). Factors of the war in Ukraine (staff shortage, data fragmentation in eHealth of Ukraine) require the implementation of new Value-Based Healthcare models of medical and pharmaceutical care.

Purpose: To develop a conceptual model of an integrated three-level model of pharmaceutical care and conduct its comprehensive clinical and economic assessment using the Cost–Benefit Analysis method to substantiate management decisions at the macro level of the Ukrainian Healthcare system under martial law.

Methods: Based on the theory of A. Donabedian, a Conceptual Model of Pharmaceutical Care was formed, which integrates pharmacists into the clinical routes of patients and optimizes pharmacotherapy through the prescription of original Fixed-Dose Combinations (FDC), which were not included in the reimbursement program. Cost–Benefit Analysis (CBA) modeling was performed for a cohort of 100 individuals with a one-year time horizon. The existing Healthcare model (Comparator) provided for the use of generic medicines from the Affordable Medicines program (reimbursement) without pharmaceutical support. The new Healthcare model (Intervention) was based on original FDCs that were not included in the reimbursement program and outpatient monitoring using combined portable test systems. Clinical probabilities were integrated from the EUROASPIRE V, CLARIFY, and Stimul studies. Costs were calculated using the National Health Service of Ukraine (NHSU) tariffs and external price referencing mechanisms.

Results: The intervention provides an absolute reduction in the risk of MACE by 19.3% (8.6% vs. 27.9% in the comparator; OR=22.67). In Scenario №1 (Ministry of Health of Ukraine (MoH)/NHSU payer perspective), the New Technology generated a net benefit of UAH 1.56 million with a Benefit-Cost Ratio (B/C Ratio) of 2.24 versus 1.84 for the comparator. In Scenario №2 (out-of-pocket expenses of citizens are 58.6%), the New Model dominates, saving UAH 149.60 thousand (BCR=2.24 versus 1.69). In the social extinction (Scenario №3), taking into account the saved contribution to Gross Domestic Product (GDP), the net benefit increased to UAH 2.39 million, and the BCR reached 2.78. Sensitivity analysis confirmed the stability of the results (BCR>1).

Conclusion: The Conceptual model is a self-paying and highly effective investment. The results justify the need to introduce clinical pharmacist and community pharmacists rates in Healthcare Facility (HCF), develop service standards, and expand the reimbursement program through original FDCs.

Introduction

Global Economic Trends and Payer Burden in Healthcare

According to the World Health Organization (WHO), Healthcare costs are growing annually and currently account for 10.3% of the World's Gross Domestic Product (GDP). At the same time, there is a significant imbalance in their distribution between the public and private sectors, as well as a high dependence of Healthcare systems in low-income countries on external financing. The largest share of total costs (65–84%) is formed directly by HCF, in particular in the areas of preventive care and drug provision [1].

In the context of the progressive growth of the financial burden on the Healthcare system during the long-term war in Ukraine, the search and scientific substantiation of new effective models of organizing medical and pharmaceutical care, capable of ensuring the rational use of limited budgetary resources and preserving human capital, is becoming increasingly relevant.

In high-income countries, integrated models of pharmaceutical care are being actively implemented into the general structure of medical services, which contributes to the systematic optimization of costs and increasing the accessibility of treatment [1]. At the same time, Value-Based Healthcare (VBHC) is widespread in the countries of the European Union, within which the main criterion for effectiveness is clinical outcomes that are of key importance to patients, in clear proportion to the costs of achieving them.

The application of such a value-based approach allows to simultaneously improve the quality and duration of life of patients and significantly reduce the economic pressure on the budget, especially in the management of chronic non-communicable diseases, in particular CAD with comorbid conditions [2].

National Healthcare Reforms and Interprofessional Collaboration in Ukraine

In Ukraine, the strategic transformation of the Healthcare system is clearly defined by the Development Strategy until 2030 [3] and the Healthcare Sector Recovery Plan [4]. These state documents provide for the mandatory implementation of a patient-centric approach, the formation and development of multidisciplinary clinical teams, and the expansion of the professional role of pharmacists community / clinical pharmacists in the provision of medical and pharmaceutical care to the population [5]. The first successful examples of the integration of pharmacists into multidisciplinary teams in domestic HCFs, in particular in the areas of infection control and prevention of antibiotic resistance, have demonstrated a sustainable positive experience of interprofessional interaction and improvement of the final treatment outcomes [6].

Global evidence-based experience convincingly confirms that the proactive participation of pharmacists in Medication Therapy Management programs contributes to reducing the total cost of Healthcare, optimizing drug costs, and reducing the frequency of hospitalizations.

Thus, in the USA, the integration of clinical and outpatient pharmacists into multidisciplinary teams in primary and secondary care provided a reliably confirmed reduction in the median total cost of care (by

\$1427.84; $p < 0.001$), direct costs for prescription drugs (by \$222.82; $p < 0.001$), and total Healthcare system costs for medical care (by \$462.26; $p < 0.001$) [7].

Clinical and Economic Burden of CAD and Medication Adherence Challenges

Despite reforms in the Ukrainian Healthcare system, CAD remains a critical clinical and economic burden for the Ukrainian Healthcare system. Despite the successful implementation of the government reimbursement program “Affordable Medicines”, its focus mainly on generic single-component drugs is often accompanied by low patient adherence to long-term treatment. This situation is due to the absence in the current reimbursement list of a number of modern highly effective drugs proposed by the current national Unified Clinical Protocol “Stable Coronary Artery Disease” [8] and current clinical recommendations of the European Society of Cardiology (ESC) [9]. These innovative drugs are original and expensive, which causes a high financial burden on patients’ personal budgets and subsequently provokes complete or partial treatment dropout in the conditions of a decline in the socio-economic status of citizens during the war in Ukraine [10–12]. The outlined negative situation leads to suboptimal clinical outcomes and an increased incidence of MACE.

Modern pharmacoeconomic assessment and Health Technology Assessment (HTA) allow for a comprehensive comparison of alternative treatment models while simultaneously taking into account clinical outcomes and total system costs. The results of our previous studies showed that patients who did not use the “Affordable Medicines” program had higher adherence to treatment ($\chi^2 = 0.234$; $p = 0.025$) due to the targeted use of medicines that were not included in the state reimbursement list. Higher adherence to treatment was observed when using effective (expensive, original) medicines that are recommended by international and national clinical guidelines [13].

Pharmacists, doctors and patients ($n = 999$) when choosing therapy consistently preferred medicines with proven clinical efficacy and safety, the overwhelming share of which belonged to original medicines that were not included in the “Affordable Medicines” program – 79.1% [79.1 ± 0.02], 87.4% [87.4 ± 0.004] and 91.1% [91.1 ± 0.007] of the total number of respondents surveyed, respectively ($\chi^2 = 5.653$; $p = 0.017$). In addition, the established odds ratio ($OR = 22.67$) indicates that joint medical-pharmaceutical care increases the chances of improving adherence to treatment by 22 times compared to the provision of medical care by only one doctor to patients with CAD with comorbid conditions [13, 14].

Therefore, the intervention of clinical and community pharmacists in the treatment process in accordance with modern Good Pharmacy Practice (GPP) approaches can become a powerful and effective tool in the secondary prevention of cardiovascular diseases.

Study Aim and Purpose

In this regard, there is an objective need to develop and assess the economic feasibility of the transition from the existing model of medical care, focused only on monocomponent generic drugs, to an improved Value-Based Healthcare medical and pharmaceutical care. Such a model combines the strategic use of multicomponent FDCs of original drugs that are not included in the reimbursement program and proactive pharmaceutical care in the conditions of the Ukrainian Healthcare system in accordance with the international GPP standard [15].

Purpose. To develop a conceptual model of an integrated three-level model of pharmaceutical care and to conduct its comprehensive clinical and economic assessment using the Cost–Benefit Analysis method to substantiate management decisions at the macro level of the Ukrainian Healthcare system under martial law.

Methods

Study Design and Data Sources

The study was based on a comprehensive analysis of international clinical guidelines, scientific publications, the current regulatory framework of Ukraine, data from real clinical practice, and the results of observational studies (in particular, local data from the Ukrainian EUROASPIRE V cohort). When developing the study design, the specific features of the functioning of the national Healthcare system under martial law, current mechanisms for pricing and reimbursement of medicines, current Program of Medical Guarantees (PMG) tariffs, as well as existing restrictions on access of clinical pharmacists / pharmacists community to eHealth when conducting expert analysis of pharmacotherapy were taken into account. To verify expert assessments, the high consistency of opinions of participants in the treatment process was taken into account ($n = 586$, Kendall coefficient $W = 0.85$; $p < 0.001$) [16]. Based on the obtained data, pharmacoeconomic modeling using the CBA method was performed to compare the improved model of medical and pharmaceutical care with the existing medical practice of treating patients with CAD with comorbid conditions. The modeling was performed on a hypothetical cohort of 100 people with a time horizon of 1 year. The model architecture and reporting were formed in strict accordance with the international requirements of the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) [17].

Rationale for Using Cost-Benefit Analysis (CBA)

In this pharmacoeconomic study, the CBA method was chosen due to its ability to integrate all types of costs and results of medical and organizational interventions exclusively in monetary terms, which is important when assessing complex systemic changes in Healthcare [18]. The use of CBA allows for a direct comparison of total financial costs with economic benefits (savings), which is fully consistent with the approaches recommended for making macro-level managerial and strategic decisions in Healthcare [18].

The intervention evaluated in the study includes a pharmacotherapeutic component and new organizational elements: the systematic involvement of clinical pharmacists / pharmacists community and optimization of pharmacotherapy monitoring. Such interventions have a complex impact on resource use, the frequency of hospitalizations and the occurrence of premature MACE. This approach fully justifies the use of the CBA method as the only tool capable of correctly monetizing and comparing the outlined clinical and organizational consequences [19].

From the perspective of the public payer (MoH of Ukraine / NHSU), the main task is to determine the net economic effect of implementing the new model. The CBA method allows for a clear assessment of the level of compensation for additional intervention costs by proportionally reducing the costs of purchasing complications, expensive inpatient care and subsequent rehabilitation, which is fully consistent with the internal logic of budget planning within the PMG [20, 21]. An additional methodological argument in favor of choosing CBA is the availability of convincing evidence-based clinical data on the difference in the frequency of MACE between patients who are compliant with treatment and those who are not. According to real clinical studies, the frequency of MACE in patients who are compliant with treatment is 8.6%, while in patients who are not compliant it is 27.9%, which corresponds to an absolute risk reduction of 19.3% [22–24]. Such results can be directly translated into monetary benefits associated with prevented myocardial infarction, stroke, premature hospitalization, and cardiovascular death.

In addition, the use of CBA is most appropriate in conditions of limited and fragmented national evidence on specific indicators of patient Quality of life (for example, QALY or DALY), which could significantly limit the accuracy of Cost-Utility Analysis, CUA. In contrast, CBA is based on universal financial indicators, which significantly increases the interpretability and validity of the results for managers and policymakers in Healthcare [18].

Study Perspective and Alternative Scenarios

The main pharmacoeconomic analysis was carried out from the position of the public payer (MoH of Ukraine / NHSU), since it is this perspective that is decisive for making decisions on financing and reimbursement of Health Technology within the PMG. In Ukraine, the MoH of Ukraine acts as the main institutional customer and regulator of medical services and medical supplies, forming the Lists of medicines subject to reimbursement, determining marginal tariffs and distributing budgetary resources through NHSU. Accordingly, it is from the position of the payer that a correct assessment of the long-term financial consequences of implementing an improved model at the macro level of the Healthcare system is possible [18, 25]. International methodological recommendations for conducting pharmacoeconomic studies and HTA indicate that when analyzing interventions that can potentially be integrated into public funding programs, the perspective of the public payer is a priority. It allows assessing the direct impact of the Budget Impact intervention, the efficiency of using limited public resources and the overall feasibility of scaling the intervention at the national level [19, 26]. Since the intervention under study involves expanding public funding through the use of original FDCs and

financial support for the role of clinical pharmacists / pharmacists community, the analysis from the perspective of the MoH of Ukraine is methodologically sound.

However, limiting the analysis exclusively to the payer's perspective does not allow for a full reflection of the real structure of costs for the treatment of CAD in Ukraine. Despite the functioning of the "Affordable Medicines" reimbursement program, a significant part of medicines used for cardiovascular diseases (in particular, original medicines and multi-component FDCs) is financed by patients independently outside the state budget [10, 27]. In this regard, the study additionally calculated alternative scenarios that take into account the costs of medicines paid directly by patients out-of-pocket. Such a multi-perspective approach is recommended by WHO and the World Bank for countries with transition economies and mixed Healthcare financing [18, 28].

Patient Population and Cohort Characteristics

The pharmacoeconomic modeling included adult patients with stable CAD combined with comorbidities such as hypertension, dyslipidemia, atrial fibrillation, heart failure, type 2 diabetes, and/or chronic kidney disease. The demographic structure of the study cohort, integrated from national databases, was 25.0% female (mean age 65.15 ± 9.6 years) and 75.0% male (mean age 61.2 ± 9.6 years) [29].

Interventions and Comparators

The Intervention (Model 2 / New Model)

It involves the transition to improved, VBHC medical and pharmaceutical care. It is based on the use of original FDCs, which are currently not included in the "Affordable Medicines" reimbursement program, and the involvement of clinical pharmacists / community pharmacists on a permanent long-term basis in the treatment monitoring system. The appointment of FDCs simplifies the pharmacotherapy regimen and reduces the number of tablets, which significantly improves adherence to treatment. According to evidence, patient adherence to treatment when using FDCs is 81% compared to 46% in the usual use of monocomponent pharmacotherapy after 12 months ($p < 0.001$) [30].

The use of FDC angiotensin II receptor blockers with calcium channel blockers is associated with better MACE-free survival and lower hospitalization rates [31], and the use of FDC statins with ezetimibe significantly increases the chances of maintaining high adherence to treatment ($OR \approx 3.00$; 95% CI 2.70–3.30) [32]. The organizational component includes monitoring of treatment by clinical and community pharmacists using combined portable test systems (combined glucometers, test strips for glucose, albumin/creatinine, hemoglobin), which reduces the burden on the primary Healthcare system and rationalizes its resource consumption [33].

The Comparator (Model 1 / Standard Care)

Represents the existing model of medical care in Ukraine, which is based on outpatient use of mainly monocomponent generic drugs within the framework of the state reimbursement program "Affordable Medicines" without systematic involvement of pharmaceutical support for patients [8, 14]. This model reflects standard practice, focused on minimizing direct primary costs of the Healthcare system budget.

Modeling Assumptions and Time Horizon

The time horizon of the analysis and modeling was 1 year. To simplify the mathematical calculation of the model, the following basic assumptions and limitations were adopted [36, 37]:

Treatment stability

during the one-year horizon, patients in both groups did not change their pharmacotherapy regimens or adjust the doses of drugs prescribed at the beginning of the year.

Treatment adherence

the division into "adherents" and "nonadherents" was carried out on the basis of the form of drug release and pharmacist participation (odds ratio OR = 22.67 in favor of the joint work of the doctor and pharmacist [14, 38, 39]).

Index events (MACE)

complications occurred once during the modeling period.

Discounting and adverse reactions

due to the short horizon (1 year), discounting was not applied. The costs of purchasing Adverse Drug Reactions (ADRs) were not taken into account, since the use of low doses of drugs in FDCs minimizes the risk of their development [40], and official data on the occurrence of ADRs during hospitalizations or observation in the model cohort were not available.

The cost of a pharmacist's service

assumed to be 50% of the cost of a similar outpatient service by a general practitioners (GP's).

Exchange rate

All financial indicators are calculated in hryvnias (UAH). The official exchange rate of the National Bank of Ukraine for the euro to the hryvnia as of 01.06.2026 is UAH 51.55 [41].

Cost Estimation Framework

Direct medical costs for medicines in the model were determined according to the Defined Daily Dose (DDD) principle in accordance with the WHO methodological recommendations (2020), which ensures

the unification and comparability of pharmacotherapy regimens [34].

The calculation of the cost of medicines fully took into account the current mechanisms of pricing and state regulation in Ukraine. For this purpose, the provisions of the Resolution of the Cabinet of Ministers of Ukraine (CMU) №854 dated September 29, 2021 “On Approval of the List of Maximum Wholesale and Retail Prices for Medicines” and the Resolution of the CMU №955 dated June 30, 2008 “On Approval of the Procedure for Determining Mark-ups and Value Added Tax (VAT) when Selling Medicines” were applied [21, 35]. For medicines not included in the reimbursement list registers [42], the declared prices of the National Price Catalog [43, 44] were used at the median. At the consumer retail price stage, the marginal retail prices were determined to distinguish between the budget and patient (out-of-pocket) cost shares.

The cost of medical services and diagnostic procedures was calculated according to the PMG packages based on the CMU Resolution №1503 “Some issues of implementing the PMG of medical services for the population” [20]. The frequency of procedures and visits for the Comparator (Table 1) and the New Technology (Table 2) was agreed upon based on the results of the focus groups.

Table 1

Determining the number of preventive/diagnostic procedures and consultations of doctors of various specialties for comparator technology

Prevention/diagnosis / Service	Number of consultations per year	Cost, UAH	Annual expenses, UAH (Ukraine)
General urine analysis	4	98,9365	395,746
Complete blood count	4	98,9365	395,746
Fasting glucose	4	77,996	311,984
Total cholesterol	3	77,996	233,988
HbA1c	2	77,996	155,992
Creatinine	2	77,996	155,992
Liver tests	2	77,996	155,992
Potassium (electrolytes)	2	77,996	155,992
ECG	4	310	1240
Cardiologist	4	199,95	799,8
Family doctor	6	199,95	1199,7
Nephrologist	3	199,95	599,85
Pulmonologist	1	199,95	199,95
Endocrinologist	4	199,95	799,8
Psychotherapist	2	199,95	399,9

Table 2

Determining the number of preventive/diagnostic procedures and consultations of doctors of various specialties for the new technology

Prevention/diagnosis / Service	Number of consultations per year	Cost, UAH	Annual expenses, UAH (Ukraine)
General urine analysis	4	98,9365	395,746
Complete blood count	4	98,9365	395,746
Fasting glucose	2	77,996	155,992
Total cholesterol	2	77,996	155,992
HbA1c	2	77,996	155,992
Creatinine	2	77,996	155,992
Liver tests	2	77,996	155,992
Potassium (electrolytes)	2	77,996	155,992
ECG	4	310	1240
Pharmacist consultation	4	99,975	399,9
Cardiologist	3	199,95	599,85
Family doctor	3	199,95	599,85
Nephrologist	3	199,95	599,85
Pulmonologist	1	199,95	199,95
Endocrinologist	4	199,95	799,8
Psychotherapist	2	199,95	399,9

(Note: Protocol requirements for the appointment of laboratory and instrumental methods of control of individual medicines and the frequency of specialist consultations are given in accordance with the clinical guidelines for CAD with comorbid conditions and the regulations of the PMG of the NHSU [20]).

Valuation of Economic Benefits

The economic benefits in the study were estimated in terms of the amount of Healthcare savings from preventing MACE in patients with stable CAD with comorbid conditions. The baseline absolute risk reduction for complications with improved adherence was 19.3% (event rate 8.6% in the Intervention versus 27.9% in the Comparator) [22–24].

The cost of MACE treatment was calculated based on the official inpatient and Rehabilitation Diagnosis-Related Groups (DRG)-based tariffs of the NHSU in accordance with the CMU Resolution №1503 [20]:

- – acute myocardial infarction with stenting (global rate: 43,573 UAH; specific weight in the structure of complications: 56%);
- – myocardial infarction without stenting (25,261 UAH; 43%);
- – cardiovascular death (0 UAH; 2%);
- – premature emergency hospitalization (11,897.07 UAH; 39%);
- – acute cerebral stroke without endovascular interventions (15,643 UAH; 5%);
- – comprehensive inpatient rehabilitation (41,514.9 UAH; 98%).

Modeling Scenarios

Mathematical modeling and calculation of the net economic benefit (Net Benefit) and BCR coefficients were performed under three consecutive scenarios:

- – *Scenario №1* (State payer perspective): Takes into account exclusively the funds of the state budget PMG and the “Affordable Medicines” program (MoH of Ukraine / NHSU).
- – *Scenario №2* (Combined medical perspective): To the costs of Scenario 1, personal out-of-pocket expenses of patients for medicines used for cardiovascular diseases and purchased independently outside the “Affordable Medicines” program are added.
- – *Scenario №3* (Socio-social perspective): Additionally integrates indirect economic benefits in the form of saved human capital (prevention of losses of the country’s GDP due to temporary or permanent disability of citizens). The calculation was made based on the nominal GDP per capita of Ukraine of UAH 217,997.09 (equivalent to \$5,181.40 USA according to the World Bank [48]) and the official share of the working population over 60 years of age, which is 8.9% [49].

Results

Healthcare Context and Limitations of the Traditional Model

In Ukraine, the traditional practice of medical and pharmaceutical care for patients with CAD with comorbid conditions is regulated by current regulatory documents [8] and focuses on the existing model of medical care. It is characterized by the provision of medical care exclusively by a single doctor and the provision of patients with affordable monocomponent generic drugs within the framework of the “Affordable Medicines” reimbursement program. However, this approach does not provide for the systematic involvement of clinical and community pharmacists to increase adherence to treatment, manage polypharmacy, and monitor the safety of prescribed pharmacotherapy.

In modern Ukrainian realities, global medical problems are joined by obstacles caused by direct factors of war: low physical and economic availability of medicines, risks of improper storage of medicines due

to long-term power outages and difficulties with their disposal, as well as an acute shortage of pharmaceutical personnel in pharmacy establishments due to internal and external displacement [33].

Structure and Implementation of the Conceptual Pharmaceutical Care Model

In order to overcome the mentioned obstacles and increase adherence to treatment in patients within the scope of this study, the Conceptual model of pharmaceutical care based on Value-Based Healthcare was developed and adapted to modern operating conditions [2, 50]. The goal of creating the model was to maximize clinical value at optimal costs by focusing on clinical patient outcomes with an expanded paradigm of preserving the well-being of pharmaceutical personnel and the efficiency of the Healthcare system (Quadruple Aim) [51].

The Conceptual model is based on the integration of pharmacists community and clinical pharmacists in the clinical routes of patients at the primary, secondary and tertiary levels of medical care [33] according to the system principles described in the theory of A. Donabedian [52]. In addition, the developed model takes into account the concept of "Pharmacist of 7 stars" [53], supplemented by Ukrainian scientists to "Pharmacist of 10 stars" [54]. The main idea of our model is to optimize pharmacotherapy schemes by prescribing FDC and conducting cyclical processes by pharmacists:

- – express screening of cardiovascular risks;
- – monitoring of clinical indicators using portable combined test systems;
- – an individualized review of pharmacotherapy schemes and their checking for drug compatibility;
- - deprescribing in consultation with doctors;
- – motivational interviews with patients regarding the primary prevention of CAD with comorbid conditions, improvement of adherence to treatment, and improvement of patients' medical literacy [33].

While the implementation of such interventions with the participation of pharmacists has demonstrated high clinical and economic success in EU countries [55], evidence on the financial feasibility and rationality of such models in the context of humanitarian crises, emergencies, the transitional economy of Ukraine and resource shortages remained limited. This approach necessitates the need to conduct a pharmacoeconomic analysis of the developed Conceptual Model. The constructed algorithm allowed us to reflect the conceptual nature of pharmaceutical care for patients with CAD with comorbid conditions (Fig. 1) and perform HTA in terms of clinical and pharmacoeconomic effectiveness of the developed model.

The proposed model allows us to systematically assess the quality of pharmaceutical care at all levels (primary, secondary and tertiary) of medical care for patients with CAD with comorbid conditions according to the Donabedian principles [56], which can become the basis for the development of national standards for pharmaceutical services. Based on Donabedian's theory, we have identified and

divided the components of pharmaceutical care into structure, processes, efficiency and balancing of the system, which made it possible to detail and structure the process of providing individualized pharmaceutical care according to the corresponding stages (Table 3).

Table 3

The process of providing individualized pharmaceutical care to patients with CAD with comorbid conditions [33]

Nº	Stages of providing Pharmaceutical Care to patients with CAD with comorbid conditions	Structure of the stage of providing Pharmaceutical Care to patients with CAD with comorbid conditions
1	Collecting patient information	– Age, gender, weight, medical history, drug history, patient's clinical condition, allergies to drugs or drug components; – determination of the list of OTC and prescription drugs that the patient is taking; – determination of the patient's lifestyle, beliefs, and socioeconomic status that affect access to drugs.
2	Patient screening	– Measurement of blood pressure, heart rate, weight, glucose, total cholesterol, hemoglobin, albumin/creatinine, iron; – determination of the presence of anxiety/depression.
3	Evaluation of collected patient information	– Expediency of using each drug taking into account effectiveness, safety and adherence to treatment; – determination of the patient's state of health, risk factors, medical literacy regarding the use of drugs; – determining the status of immunization and the need for prevention of infectious diseases, if necessary.
4	Development of a plan for providing Pharmaceutical Care	– Addressing medication issues and optimizing pharmacotherapy in collaboration with the team of physicians; – Defining pharmacotherapy goals to achieve clinical outcomes; – Engaging the patient in the treatment process through education; – Supporting continuity of drug delivery (scheduled reminders via chatbots or SMS messages about the need to purchase medications at the patient's request).
5	Implementation of the Pharmaceutical Care Plan	– Solving issues related to the negative impact of drugs on the patient's condition; – participating in activities aimed at disease prevention; – providing patient education on self-control of the disease (monitoring blood pressure, heart rate, weight, glucose, total cholesterol, iron, albumin/creatinine); – determining the need for medical care and referring the patient to a doctor.

Nº	Stages of providing Pharmaceutical Care to patients with CAD with comorbid conditions	Structure of the stage of providing Pharmaceutical Care to patients with CAD with comorbid conditions
6	Observation, monitoring and evaluation of the provision of Pharmaceutical Care	– The feasibility, safety and effectiveness of drug use; – assessment of adherence to pharmacotherapy of coronary heart disease with comorbid conditions; – assessment of the patient's achievement of clinical outcomes.

The indicated procedural indicators of the quality of pharmaceutical care (the percentage of patients covered by pharmacotherapy analysis, deprescription, etc.) [57–60] were not directly measured when conducting this pharmacoeconomic assessment due to the current impossibility of applying individual processes in pharmacies, the lack of clinical pharmacists' rates in specialized (cardiological) departments of HCF and insufficient integration of unified patient data in eHealth of Ukraine. The main barriers and practical ways to overcome them in Ukrainian pharmaceutical practice are given in Table 4.

Table 4
Obstacles and ways to overcome them in the implementation of the Conceptual Model of Pharmaceutical Care for Patients with CAD with Comorbid Conditions

Barriers	Ways to overcome
Low medical literacy of patients, limited access to eHealth data	Educational programs, SMS reminders, integration with the eHealth
Polypharmacy, ADR, limited access to eHealth in Multidisciplinary Teams	Standardization of Pharmaceutical Care, implementation of clinical decision support for pharmacotherapy, Pharmacovigilance, integration of pharmacists community/clinical pharmacists into patients' clinical pathways
Low adherence to treatment, stress, anxiety, depression, patient distrust	Motivational interview of the patient with a pharmacist community / clinical pharmacist, psycho-emotional screening, SMS reminder
Limited integration of pharmacists/clinical pharmacists, hierarchical model	Standardized clinical patient pathways, shared CPD within multidisciplinary teams, measurement of team effectiveness potential
Data fragmentation, limited monitoring of pharmacotherapy	Integration with eHealth, digital platforms, telepharmacy
Insufficient training of pharmacists/clinical pharmacists, lack of experience	CPD, specialization and thematic improvement programs using international experience

Clinical Efficacy and Health Outcomes Modeling

Based on the integration of clinical data from observational studies, it was found that from a clinical point of view, the New Technology provides a 19.3% reduction in the incidence of MACE compared to the

Comparator, indicating higher clinical efficacy of the developed model. In the studied cohort of patients, the incidence of MACE is 8.6% in the New Technology group versus 27.9% in the Comparator group. Such observations confirm the feasibility of using FDCs and original drugs that are not included in the "Affordable Medicines" program as an effective tool for increasing adherence to pharmacotherapy and reducing the risk of complications in patients with CAD with comorbid conditions [45–47].

In monetary terms, the prevention of MACE by 19.3% within a cohort of 100 people allowed to avoid significant direct medical costs to the Healthcare system for hospitalization and rehabilitation, which formed a gross benefit of UAH 1,563,360.57 for the medical perspective (Scenarios 1 and 2).

Economic Analysis and Scenario Modeling

Scenario 1: Healthcare Provider Perspective (MoH of Ukraine / NHSU Budget)

When analyzing pharmacoeconomic data from the perspective of financing exclusively from PMG funds and the Affordable Medicines program, it was found that the structure of expenditures on medicines and pharmaceutical services within the New Model requires larger allocations for original medicines, given that generic medicines with the same active ingredient are absent on the pharmaceutical market. The Net Cost of the New Technology compared to the Comparator remained unchanged and amounted to -1.27 million UAH, since the implementation of the model requires additional investments.

At the same time, due to the avoidance of acute conditions, the Net Benefit of the New Technology within the healthcare system amounted to 1.56 million UAH. Within the medical perspective, for Scenario 1, the Benefit-Cost Ratio (B/C Ratio) for the New Technology was 2.24, which means receiving UAH 2.24 of benefit for every UAH 1 of cost. For the Comparator, this ratio was 1.84, which proves a higher cost-effectiveness of implementing the New Model by 22% (Table 5).

Table 5
Pharmacoeconomic data for Scenario 1

Scenario 1	Explanation
Net benefit: 1563360,57	The net benefit consists of costs not incurred due to avoidance of MACE in patients who were adherence to treatment and used FCD and brand medicines.
Net costs: -127911,8418	Net costs are associated with higher costs of FCD and brand medicines.
Costs/Benefits New technology: 0,445847898	Every 1 monetary unit of benefits requires 0.44 monetary units of costs.
Cost/Benefit Comparator: 0,543292656	Every 1 monetary unit of benefits requires 0.54 monetary units of costs.
Benefits/Costs New technology: 2,242917382	For every 1 monetary unit of expenses, you receive 2.24 monetary units of benefits.
Benefits/Costs Comparator: 1,840628598	For every 1 monetary unit of expenses, you receive 1.84 monetary units of benefits.

Scenario 2: Combined Medical Perspective (MoH of Ukraine + Out-of-Pocket Expenses)

When calculating the data for Scenario 2, the Comparator's costs included the costs of all drugs that patients purchase independently during 1 year of treatment, the structure of net costs changed significantly. The net costs of the New Technology compared to the Comparator amounted to UAH 149,606.3601, which indicates a lower cost of the New Technology compared to the Comparator.

For the Comparator, the B/C Ratio in this scenario was 1.69, demonstrating its lower cost-effectiveness in the baseline scenario due to the higher direct costs of the medicines purchased by the patient. For New Technology, the BCR indicator remained stable at 2.24, deepening the economic gap in favor of the intervention (Table 6). Currently, the actual costs per cohort of 100 patients per year are 58.6% of all necessary costs for full pharmacotherapy (273,342 UAH).

Table 6
Pharmacoeconomic data for Scenario 2

Scenario 1	Explanation
Net Benefit: 1563360.57	Net benefit consists of costs not incurred due to avoidance of MACE in treatment-adherent patients using FCD and brand medicines.
Net Cost: 149606.3601	New technology turned out to be less costly than Comparator.
Cost/Benefit New Technology: 0.445847898	Every 1 monetary unit of benefits requires 0.44 monetary units of costs.
Cost/Benefit Comparator: 0.590810241	Every 1 monetary unit of benefits requires 0.59 monetary units of costs.
Benefit/Cost New Technology: 2.242917382	For every 1 monetary unit of costs we receive 2.24 monetary units of benefits.
Benefit/Cost Comparator: 1.692590835	For every 1 monetary unit of costs we receive 1.69 monetary units of benefits.

Scenario 3: Societal Perspective and Human Capital Preservation

When expanding the analysis horizon to the societal perspective, which additionally takes into account indirect economic benefits in the form of preserved working capacity of 100 patients and prevention of GDP losses of the country, the net economic benefit (Net Benefit) of the New Technology increased from 1.56 million UAH to 2.39 million UAH (the exact value of the total societal benefit: 1833051.31 UAH). The additional increase of 269.69 thousand UAH reflects the value of preserved human capital.

The economic efficiency of the New Technology in Scenario 3 increased: B/C Ratio = 2.78, which is 24% higher compared to the provision of pure medical care, while maintaining an absolute advantage in the economic dimension. For the Comparator, this indicator in the societal perspective is 2.15 (Table 7).

Table 7
Pharmacoeconomic data for Scenario 3

Scenario 1	Explanation
Net Benefit: 1833051.31	An increase of UAH 269 thousand. This difference reflects the retained productivity (GDP) of patients compared to scenario 1
Net Cost: -127911.8418	Remained unchanged, as the cost of medicines and unavoidable MACE does not change.
Cost/Benefit New Technology: 0.38025178	The indicator has improved: costs account for only 38% of the generated social benefits.
Cost/Benefit Comparator: 0.463359815	Every 1 monetary unit of benefits requires 0.46 monetary units of costs.
Benefit/Cost New Technology: 2.629836472	Increased. Every 1 UAH of costs now accounts for 2.63 UAH of benefits.
Benefit/Cost Comparator: 2.158150031	For every 1 monetary unit of costs we receive 2.15 monetary units of benefits.

Deterministic Sensitivity Analysis

The conducted one-factor sensitivity analysis demonstrated high stability of the obtained results to variations of the main parameters in the range of $\pm 10\text{--}20\%$. The most influential factors were determined as:

- – for net costs – Maximum Wholesale Price (MWP) of medicines;
- – for net benefits and Benefit-Cost ratios – percentage of avoided MACE in the Comparator group.

All sensitivity analysis scenarios remained economically advantageous, since their key indicator exceeds the critical limit of 1 (BCR > 1).

Discussion

Evidence-Based Regimens and the Burden of Polypharmacy

The scientific publications we analyzed, clinical recommendations on pharmacotherapy in patients with CAD with comorbid conditions, as well as the conducted studies allow us to state that pharmacotherapy based on the principles of evidence-based medicine includes a fairly large number of drugs. This situation can subsequently lead to a number of serious problems: polypharmacy, undesirable interactions of drugs according to clinical recommendations by pharmacological groups in the prescribed pharmacotherapy and with food, the development of potential adverse reactions and adverse reactions in the composition of FDC [61], a decrease in the affordability of drugs for the end consumer

[10], limited availability of necessary active substances in the National List of Essential Medicines [62], as well as significant inconveniences in the use of drugs and frequent violations of the dosing regimen by patients.

War-Related Disruptions and Pharmacy Retail Realities in Ukraine

In Ukraine, the global medical problems are joined by specific destructive obstacles caused by direct factors of war: low physical accessibility to medicines (especially in rural areas and in front-line areas), inadequate storage conditions of medicines due to long-term power outages, pronounced problems with their disposal, as well as an acute shortage of qualified pharmaceutical personnel in pharmacies due to internal and external displacement and their early professional burnout.

These contradictions between the updated domestic legislation, which, for example, allowed the implementation of vaccination programs directly in pharmacies [63], and their practical implementation during the war are significantly complicated by the processes of monopolization of pharmacy retail. The presence of such a situation leads to a commercial orientation of services to increase the average check and aggressive promotion of dietary supplements of domestic brands [33, 64, 65].

Current monitoring data clearly show a trend towards a rapid increase in the share of dietary supplements while simultaneously reducing the market volume of packaged medicines [66]. This trend indicates that a large number of patients with cardiovascular diseases are uncontrollably taking dietary supplements in parallel with their prescribed cardiovascular therapy, provoking unpredictable microsomal interactions and ADRs [33, 67].

Digital and Systemic Barriers in E-Health Integration

The coordination and correction of pharmacotherapy by the pharmacists community in the context of the development of telepharmacy or the use of eHealth in Ukraine is currently significantly limited. The current digital architecture of the system does not allow doctors of various specializations, clinical pharmacists and pharmacists community to promptly collect a complete, verified and integrated list of medicines that a particular patient actually takes [68, 69].

The justification of the functional content of the professional Roles of pharmacists at the primary, secondary and tertiary levels of medical care [33] allowed us to adapt the Conceptual Model of Pharmaceutical Care (Fig. 1). The developed model is based on cyclical processes aimed at continuous patient support:

- – targeted assessment of individual risk factors;
- – express screening of indicators (blood pressure, heart rate, blood glucose level, total cholesterol, albumin/creatinine, hemoglobin) [70];
- – comprehensive review of current pharmacotherapy;

- – conducting justified deprescription (deprescribing) [71];
- – mandatory recording of interventions and maintaining medical and pharmaceutical documentation in eHealth [72].

To ensure the sustainable functioning of the developed Conceptual Model, it is important to proactively develop professional competencies in clinical pharmacology and communication skills through interprofessional education during continuous professional development (CPD). This approach is already partially implemented within the educational activities of the Public Organization “Ukraine Primary Care Cardiovascular Association” [73].

On the basis of the national medical policy, the practical implementation of the pharmaceutical care model requires amendments to the Law of Ukraine “Some Issues of eHealth” [74] to officially establish the role of the clinical pharmacist, legislative introduction of appropriate rates into the staffing of specialized (cardiological) departments of HCF, as well as the operational development of industry standards and Standard Operating Procedures (SOPs) for interprofessional interaction of clinical pharmacists / pharmacists community as part of multidisciplinary teams.

Interpretation of Economic Modeling and Global Comparison

The results of our pharmacoeconomic modeling fully confirm the hypothesis put forward and demonstrate that the developed Conceptual Model of Pharmaceutical Care for Patients with CAD with Comorbid Conditions is clinically justified and highly effective in the conditions of martial law in Ukraine.

Comparison of the results with the data of the large-scale international project iSIMPATY [55] and global systematic reviews [75] confirms a stable general medical and social trend: structured interventions with the participation of pharmaceutical specialists, focused on patients with high cardiovascular risk and hyperpolypharmacy, provide a pronounced financial return for the budget. If in world studies the payback rate varies from 2.48 to 24.20 euros for every 1 euro invested [75], then our calculated BCR indicator at the level of 2.24–2.63 (with an achievement of 2.78 according to separate estimates of the social time horizon) reliably proves the full self-sufficiency of the developed model in the realities of Ukraine, even in conditions of severe resource shortage.

The main factor that ensured the economic and clinical advantage of the New Technology is a significant improvement in patient adherence to treatment due to the combination of individualized pharmaceutical care and the transition to the use of multicomponent FDCs. As evidenced by evidence-based medicine, reducing the daily pill load prevents Treatment Dropout [40, 75].

Our analysis clearly demonstrated a stable analytical pattern: in Scenario №1, the New Model requires additional costs. Another UAH 127,911.84 needs to be allocated for the purchase of original medicines that are not included in the reimbursement program. However, the model completely covers the indicated starting minus. Thanks to the prevention of emergency hospitalizations, the proposed model

generates UAH 1.56 million of net medical benefit. The difference in the frequency of MACE (8.6% in the New Model versus 27.9% in the comparator) proves that the traditional approach is an “imaginary economy” that subsequently simply shifts the financial burden to the purchase of acute stroke and heart attack conditions in inpatient departments of HCF.

Payer Settings and Societal Value Impact

The results of the simulation under Scenario №2 deserve special attention. The determination that patients are currently forced to cover 58.6% of the cost of outpatient pharmacotherapy out-of-pocket (UAH 273,342 per cohort of 100 people) clearly emphasizes the financial imperfection of the existing comparator. The introduction of the New Technology makes the model cheaper overall than traditional practice (net costs are + UAH 149,606.36), which ensures effective protection of family budgets of Ukrainian citizens.

The increase in net economic benefit to UAH 2.39 million (the total social benefit under the model is UAH 1.83 million with an additional indirect contribution to GDP of UAH 269,69 thousand) within Scenario №3 indicates the strategic state value of the model. Preservation of working capacity and continuation of professional activity of persons over 60 years of age in the conditions of demographic crisis during the war and in the post-war period is an extremely important factor for preserving the human capital of Ukraine [49].

The conducted one-factor deterministic sensitivity analysis fully confirmed the high reliability and stability of the obtained conclusions. The highest sensitivity of the model to MWP for medicines and the percentage of avoided MACE cases indicates that state price regulation using mechanisms of External Price Reference [21] and a focus on patients at the highest cardiovascular risk are the main levers for the successful implementation and scaling of this medical technology.

Since the Benefit-Cost ratio for all variations of the parameters consistently exceeds 1 ($BCR > 1$), investments in the new Conceptual Model of Pharmaceutical Care for Patients with CAD with Comorbid Conditions is a reliable investment that fully justifies its higher initial cost compared to the existing less effective Comparator.

Conclusions

Based on the principles of Value-Based Healthcare and the Quadruple Aim concept, a three-level Conceptual Model of Pharmaceutical Care for Patients with CAD with Comorbid Conditions has been developed and theoretically substantiated. The introduction of the model within the classical theory of A. Donabedian allows for a systematic combination of the structure and cyclical processes of pharmaceutical care (express screening, pharmacotherapy review, deprescription, monitoring of adherence to treatment, pharmacovigilance) and recording the final results of the quality of medical and pharmaceutical support at the primary, secondary and tertiary levels of medical care.

Within the framework of the developed model, specific barriers of the domestic pharmaceutical sector have been identified, which have significantly worsened under the influence of war factors: acute staff shortage, destruction of logistics chains, data fragmentation in eHealth and uncontrolled growth of the dietary supplements market. It was determined that effective ways to overcome them are the implementation of standardized clinical routes with the mandatory integration of pharmaceutical specialists into multidisciplinary teams, the use of digital telepharmacy platforms and conducting individual motivational interviews with patients.

From a clinical point of view, the implementation of the Conceptual Model provides a pronounced advantage, leading to a reduction in the incidence of MACE by 19.3% in absolute terms compared to traditional practice (8.6% in the intervention versus 27.9% in the comparator, respectively). It has been proven that systemic pharmaceutical support in combination with the transition of patients to FDC and original medicines is the main tool for overcoming unacceptable polypharmacy and radically increasing adherence to long-term treatment.

The conducted CBA confirmed the high financial feasibility of implementing the developed model. In all considered scenarios, its integral indicator of the Benefit-Cost Ratio (B/C Ratio) consistently exceeds the limit of 1 ($BCR > 1$), which indicates full self-sufficiency and high reliability of investments in this medical technology.

According to the base Scenario No. 1 (the perspective of the state payer - MoH of Ukraine / NHSU), the calculated B/C Ratio for the New Technology was 2.24, which proves the generation of 2.24 UAH of direct medical benefit for every 1 UAH of budget funds invested due to the avoidance of costs for purchasing emergency conditions. For the Comparator, this indicator was 1.84, which demonstrates the advantage of the New Model in the allocation of PMG resources by 22%. The model generates a net economic benefit (Net Benefit) for the healthcare system in the amount of UAH 1.56 million per cohort of 100 people/year with net medical costs (Net Cost) at the level of -127,911.84 UAH, which reflects the need for additional initial allocations for original medicines that are not included in the reimbursement program.

The analysis of the joint medical perspective (Scenario №2) revealed a significant financial imbalance in the current practice, where patients are forced to cover 58.6% of the cost of outpatient pharmacotherapy out-of-pocket (UAH 273,342 per cohort of 100 people). The integration of these data into the total costs confirmed the full economic advantage of the New Technology - it becomes less expensive than the Comparator (net costs amounted to UAH 149,606.36), reducing the BCR of the control group to 1.69 and reliably protecting the family budgets of Ukrainian citizens.

From the perspective of society (Scenario №3), taking into account indirect economic benefits from preserving human capital (labor productivity and preventing GDP losses for people over 60 years old) increases the net benefit of the New Technology to UAH 2.39 million (total social benefit according to the model: UAH 1,833,051.31). The additional contribution to the country's GDP is estimated at UAH 269.69

thousand, which increases the social efficiency coefficient of the model to B/C Ratio = 2.78 versus 2.15 for the comparator.

A single-factor deterministic sensitivity analysis demonstrated high stability of the obtained economic conclusions to fluctuations in the main parameters in the range of $\pm 10\text{--}20\%$. The most influential factors were determined to be the MWP of drugs (for net costs) and the percentage of MACE cases avoided in the control group (for benefits), while in all iterations the BCR indicator remained consistently greater than 1.

The practical implementation and further scaling of the developed Conceptual Model of Pharmaceutical Care in Healthcare in Ukraine requires the adoption of balanced political and regulatory decisions: amendments to the Law of Ukraine "Some Issues of eHealth" regarding the verification of the role of the clinical pharmacist, legislative introduction of appropriate rates into the staffing of specialized (cardiological) departments of HCF, development of industry standards and SOPs of interprofessional interaction, as well as expansion of the nomenclature of the "Affordable Medicines" program at the expense of original FDC drugs. The results obtained are a reliable basis for conducting further analysis of the impact on the budget (Budget Impact Analysis) at the national level.

Abbreviations

CAD	Coronary Artery Disease
MACE	Major Adverse Cardiovascular Events
FDC	Fixed-Dose Combinations
CBA	Cost-Benefit Analysis
NHSU	National Health Service of Ukraine
MoH	Ministry of Health of Ukraine
GDP	Gross Domestic Product
HCF	Healthcare Facility
WHO	World Health Organization
VBHC	Value-Based Healthcare
ESC	

European Society of Cardiology
HTA
Health Technology Assessment
GPP
Good Pharmacy Practice
PMG
Program of Medical Guarantees
ADR
Adverse Drug Reactions
GPs
general practitioners
DDD
Defined Daily Dose
CMU
Cabinet of Ministers of Ukraine
VAT
Value Added Tax
DRG
Diagnosis–Related Groups
MWP
Maximum Wholesale Price
SOPs
Standard Operating Procedures

Declarations

Data Availability Statement

The datasets generated and analyzed during the current study (including the pharmacoeconomic simulation models, cost-benefit analysis matrices, and statistical datasets) are not publicly available due to institutional restrictions regarding raw clinical-economic modeling data but are available from the corresponding author on reasonable request.

Ethical approval and consent to participate

The study was approved by the Ethics Committee of the Shupyk National Healthcare University of Ukraine (Kyiv, Ukraine), Protocol №9/5 dated November 17, 2024. All procedures performed in this study involving human subjects complied with the ethical standards of the institutional and national research committee, as well as the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Informed consent was obtained from all individual study participants.

Consent to publication

Not applicable.

(Note: This section is “Not applicable” because the manuscript contains aggregated clinical-economic modeling data and does not contain individual patient profiles, images, or videos that could identify specific individuals).

Data and Materials Availability

The data sets generated and analyzed during the current study (including pharmacoeconomic modeling models, cost-benefit analysis matrices, and statistical datasets) are not publicly available due to institutional restrictions on raw clinical economic modeling data, but are available from the corresponding author upon reasonable request.

Conflict of Interest

The authors declare that they have no competing interests (financial or non-financial) that could directly or indirectly influence the content of this manuscript.

Funding

This study did not receive any specific grant from any funding institution in the public, commercial, or non-profit sectors.

Author Contributions

All authors have contributed equally to

Acknowledgements

The authors would like to thank the administration and clinical staff of the participating medical institutions for their support in organizing the pharmaceutical care workflow.

References

1. World Health Organization. Global spending on health: coping with the pandemic. Geneva: World Health Organization; 2023. Available from: <https://iris.who.int/bitstream/handle/10665/375855/9789240086746-eng.pdf>. Accessed 3 Jun 2026.
2. Katz G, editor. EIT Health. Implementing value-based health care in Europe: handbook for pioneers. EIT Health; 2020. Available from: <https://eithealth.eu/wp-content/uploads/2020/06/Implementing-Value-Based-Healthcare-In-Europe.pdf>. Accessed 3 Jun 2026.
3. Ministry of Health of Ukraine. Healthcare system development strategy until 2030: Strategy. Kyiv: MoH Ukraine; 2022. Available from: <https://moz.gov.ua/uploads/ckeditor/Стратегія/UKR%20Health%20Strategy%20Feb%2024.2022.pdf>. Accessed 3 Jun 2026. [in Ukrainian].

4. National Council for the Recovery of Ukraine from the War. Draft Ukraine healthcare system recovery plan for 2022–2032. Materials of the "Healthcare" working group. Kyiv: Ministry of Health of Ukraine; 2022. Available from: https://moz.gov.ua/uploads/ckeditor/Новини/21-07-2022-Draft-Ukraine%20HC%20System%20Recovery%20Plan-2022-2032_UKR.pdf. Accessed 3 Jun 2026. [in Ukrainian].
5. WHO Regional Office for Europe. Principles for health system recovery and transformation in Ukraine. Copenhagen: WHO Regional Office for Europe; 2022. Available from: <https://iris.who.int/bitstream/handle/10665/361136/WHO-EURO-2022-5750-45515-65487-ukr.pdf>. Accessed 3 Jun 2026. [in Ukrainian].
6. Ministry of Health of Ukraine. On the organization of infection prevention and control in healthcare facilities and institutions providing social services/social protection of the population: Order of the MoH of Ukraine №1614 dated August 3, 2021: as of April 18, 2023. Available from: <https://zakon.rada.gov.ua/laws/show/z1318-21#Text>. Accessed 3 Jun 2026. [in Ukrainian].
7. Earby JA, et al. An analysis of the impact on total cost of care within a pharmacist-led comprehensive medication management program. JACCP J Am Coll Clin Pharm. 2024. <https://doi.org/10.1002/jac5.2007>.
8. Ministry of Health of Ukraine. Unified clinical protocol of primary, secondary (specialized) and tertiary (highly specialized) medical care "Stable ischemic heart disease": Unified clinical protocol №HS 2021-2857 dated December 24, 2021. Available from: <https://www.dec.gov.ua/mtd/stabilna-ishemichna-hvoroba-serczya/>. Accessed 3 Jun 2026. [in Ukrainian].
9. Vrints C, et al. 2024 ESC Guidelines for the management of chronic coronary syndromes. Eur Heart J. 2024. <https://doi.org/10.1093/eurheartj/ehae177>.
10. Bilousova N, et al. Research of affordability to essential medicines for coronary heart disease in Ukraine. J Pharm Policy Pract. 2025;18(1). <https://doi.org/10.1080/20523211.2025.2470841>.
11. Bilousova NA, et al. Adherence to treatment of patients with coronary heart disease with comorbidities: the impact of socio-economic factors during martial law in Ukraine (first report). Ukr J Mil Med. 2025;1(6):159–69. [https://doi.org/10.46847/ujmm.2025.1\(6\)-159](https://doi.org/10.46847/ujmm.2025.1(6)-159). [in Ukrainian].
12. Bilousova NA, Nesukai VA, Simahina TV, Dolzhenko MM, Shmatenko OP, Solomennyyi AM, Tarasenko VO. Adherence to treatment of patients with coronary heart disease with comorbidities: the impact of socio-economic factors during martial law in Ukraine (second report). Ukr J Mil Med. 2025;2(6):111–24. [https://doi.org/10.46847/ujmm.2025.2\(6\)-111](https://doi.org/10.46847/ujmm.2025.2(6)-111).
13. Dolzhenko MM, Bilousova NA, Nesukai VA, Simahina TV, Kozhukharova NA. Preferences in choosing original and generic drugs: pharmaceutical care for patients with coronary heart disease and comorbid conditions. Modern Med Technol. 2025;1(17):12–21. <https://doi.org/10.14739/mmt.2025.1.317003>. [in Ukrainian].
14. Dolzhenko MM, Bilousova NA, Mykhalchuk VM, Tkachenko NO, Luchinskaya YO. Study of the influence of medication properties and lifestyle of patients with coronary heart disease on adherence to treatment. Wiad Lek. 2025;4(78):860–75. <https://doi.org/10.36740/WLek/203897>.

15. World Health Organization. Good pharmacy practice: Joint FIP/WHO guidelines on GPP: Standards for quality of pharmacy services. World Health Organization; 2011. Available from: https://zakon.rada.gov.ua/laws/show/897_009#Text. Accessed 3 Jun 2026. [in Ukrainian].
16. Dolzhenko MM, Bilousova NA, Mykhalchuk VM, Tkachenko NO, Yakovenko LI. Modern paradigms of treatment of coronary heart disease: consistency of opinions of participants in the treatment process. *Wiad Lek.* 2025;6(78):1142–9. <https://doi.org/10.36740/WLek/207372>.
17. Husereau D, et al. Consolidated Health Economic Evaluation Reporting Standards 2022 (CHEERS 2022) statement: updated reporting guidance for health economic evaluations. *BMC Med.* 2022;20(1). <https://doi.org/10.1186/s12916-021-02204-0>.
18. World Health Organization. Global spending on health: weathering the storm. Geneva: WHO; 2022. Available from: <https://www.who.int/publications/i/item/9789240060835>. Accessed 3 Jun 2026.
19. Drummond ME, et al. *Methods for the economic evaluation of health care programmes*. 3rd ed. Oxford: Oxford University Press; 2005. Oxford Academic; 2023. <https://doi.org/10.1093/oso/9780198529446.001.0001>.
20. Cabinet of Ministers of Ukraine. Decree №1503-2024 dated December 29, 2024 "On approval of packages of medical services within the medical guarantees program for 2025". Available from: <https://zakon.rada.gov.ua/laws/show/1503-2024#Text>. Accessed 3 Jun 2026. [in Ukrainian].
21. Cabinet of Ministers of Ukraine. Some issues of medication reimbursement within the state program of medical guarantees: Decree of the Cabinet of Ministers of Ukraine №854 dated July 28, 2021: as of February 4, 2025. Available from: <https://zakon.rada.gov.ua/laws/show/854-2021-n#Text>. Accessed 3 Jun 2026. [in Ukrainian].
22. Jernberg T, Hasvold P, Henriksson M, et al. Cardiovascular risk in post-MI patients with poor adherence. *Glob Heart.* 2022;17(1):1273. <https://doi.org/10.5334/gh.1273>.
23. Valgimigli M, Bueno H, Byrne RA, et al. 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. *Eur Heart J.* 2020;41:3499–569. <https://doi.org/10.1093/eurheartj/ehaa177>.
24. De Filippo O, D'Ascenzo F, Angelini F, et al. Real-world evidence on adherence and outcomes in cardiovascular disease: a multicenter cohort study. *Glob Heart.* 2020;15:67. <https://doi.org/10.5334/gh.1273>.
25. Ministry of Health of Ukraine. Program of state guarantees of medical services for the population. Available from: <https://moz.gov.ua/uk/medichni-garantii>. Accessed 3 Jun 2026. [in Ukrainian].
26. International Society for Pharmacoeconomics and Outcomes Research (ISPOR). Health economic evaluation publication guidelines. Available from: <https://www.ispor.org/heor-resources/good-practices4>. Accessed 3 Jun 2026.
27. ThePharma.Media. Cardiovascular diseases in Ukraine: challenges, solutions, perspectives; 2025. Available from: <https://thepharma.media/uk/business/37129-sercevo-sudinni-zaxvoryuvannya-v-ukrayini-vikliki-risennya-perspektivi-12022025>. Accessed 3 Jun 2026. [in Ukrainian].

28. World Bank. Out-of-pocket expenditure (% of current health expenditure). World Bank Data; 2024. Available from: <https://data.worldbank.org/indicator/SH.XPD.OOPC.CH.ZS>. Accessed 3 Jun 2026.
29. Bilousova NA, et al. Influence of gender characteristics, polypragmasia, anxiety and depression on medication adherence in patients with coronary heart disease and comorbid conditions. *Hypertension*. 2025;18(1):5–13. <https://doi.org/10.22141/2224-1485.18.1.2025.374>. [in Ukrainian].
30. Bangalore S, Kamalakkannan G, Parkar S, Messerli FH. Fixed-dose combinations improve medication adherence: a systematic review and meta-analysis. *BMJ*. 2014;348:g3318. <https://doi.org/10.1136/bmj.g3318>.
31. Bangalore S, et al. Single-pill combinations of antihypertensive agents improve adherence and outcomes: Real-world evidence from cohort studies. *Am J Med*. 2017;130(10):1142–1149. <https://doi.org/10.1016/j.amjmed.2017.05.029>.
32. Arnett DK, Blumenthal RS, Albert MA, et al. 2023 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease. *Circulation*. 2023;148(12):e141–e242. <https://doi.org/10.1161/CIR.0000000000001125>.
33. Bilousova N. Conceptual model of pharmaceutical care for patients with coronary heart disease and comorbid conditions in Ukraine. *J Pharm Policy Pract*. 2025;18(1). <https://doi.org/10.1080/20523211.2025.2484577>.
34. WHO Collaborating Centre for Drug Statistics Methodology. Guidelines for ATC classification and DDD assignment. Oslo: WHO; 2020. Available from: https://www.whocc.no/atc_ddd_index/. Accessed 3 Jun 2026.
35. Cabinet of Ministers of Ukraine. On approval of the procedure for determining markups and VAT in the sale of medicinal products: Decree №955 dated June 30, 2008. Available from: <https://zakon.rada.gov.ua/laws/show/955-2008-п>. Accessed 3 Jun 2026. [in Ukrainian].
36. Sullivan SD, et al. Budget impact analysis-principles of good practice: report of the ISPOR 2012 Budget Impact Analysis Good Practice II Task Force. *Value Health*. 2014;17(1):5–14. <https://doi.org/10.1016/j.jval.2013.08.2291>.
37. Institute for Quality and Efficiency in Health Care (IQWiG). Health economic evaluation of medical interventions. Cologne: IQWiG; 2015. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK385778/>. Accessed 3 Jun 2026.
38. Cazarim MS, Pereira LRL. Cost-effectiveness analysis of pharmaceutical care for hypertensive patients from the perspective of the public health system in Brazil. *PLoS One*. 2018;13(3):e0193567. <https://doi.org/10.1371/journal.pone.0193567>.
39. Ternova S. Cardiovascular diseases in Ukraine: challenges, solutions, perspectives. *ThePharmaMedia*; 2025. Available from: <https://thepharma.media/uk/business/37129-sercevo-sudinni-zaxvoryuvannya-v-ukrayini-vikliki-risennya-perspektivi-12022025>. Accessed 3 Jun 2026. [in Ukrainian].
40. Williams B, et al. 2018 ESC/ESH Guidelines for the management of arterial hypertension. *J Hypertens*. 2018;36(10):1953–2041. <https://doi.org/10.1097/HJH.0000000000001940>.

41. National Bank of Ukraine. Official exchange rate of the Hryvnia against foreign currencies. Available from: <https://bank.gov.ua/ua/markets/exchangerates>. Accessed 3 Jun 2026. [in Ukrainian].
42. Ministry of Health of Ukraine. On approval of the Lists of medicinal products and medical devices subject to reimbursement under the state program of medical guarantees as of August 28, 2025: Order №1409 dated September 10, 2025. Available from: <https://moz.gov.ua/uk/decrees/nakaz-moz-ukrayini-vid-10-09-2025-1409>. Accessed 3 Jun 2026. [in Ukrainian].
43. Cabinet of Ministers of Ukraine. On measures to stabilize prices for medicinal products: Decree №955 dated October 17, 2008: as of March 1, 2025. Available from: <https://zakon.rada.gov.ua/laws/show/955-2008-п#Text>. Accessed 3 Jun 2026. [in Ukrainian].
44. Ministry of Health of Ukraine. National Price Catalogue. Available from: <https://moz.gov.ua/uk/nacionalnij-katalog-cin>. Accessed 3 Jun 2026. [in Ukrainian].
45. Chen C, et al. Adherence with cardiovascular medications and the outcomes in patients with coronary arterial disease: "Real-world" evidence. *Clin Cardiol*. 2022;45(7):789–798. <https://doi.org/10.1002/clc.23898>.
46. Shalaeva EV, et al. Impact of persistent medication adherence and compliance with lifestyle recommendations on major cardiovascular events and one-year mortality in patients with type 2 diabetes and advanced stages of atherosclerosis: results from a prospective cohort study. *Glob Heart*. 2023;18(1):42–51. <https://doi.org/10.5334/gh.1273>.
47. Bansilal S, et al. Assessing the impact of medication adherence on long-term cardiovascular outcomes. *J Am Coll Cardiol*. 2016;68(8):789–801. <https://doi.org/10.1016/j.jacc.2016.06.005>.
48. Ministry of Finance of Ukraine. Gross Domestic Product (2002-2025). Statistics, indexes, and tariffs. Available from: <https://index.minfin.com.ua/ua/economy/gdp/>. Accessed 3 Jun 2026. [in Ukrainian].
49. Sudakov M, Lisohor L. Labor market of Ukraine 2022–2023: state, trends, and prospects. Kyiv: State Employment Service of Ukraine, Federation of Employers of Ukraine, Solidarity Fund PL; 2023. Available from: https://solidarityfund.org.ua/wp-content/uploads/2023/04/ebrd_ukraine-lm-1.pdf. Accessed 3 Jun 2026. [in Ukrainian].
50. Saporito A, Mrad Georgis B. Value-Based Healthcare: A paradigm for efficiency and quality in healthcare services. In: *Healthcare Services Management*. Cham: Springer; 2025. p. 113–122. https://doi.org/10.1007/978-3-032-12602-3_12.
51. Saari ME, et al. Examining the influence of integrated home and community care programs on Quadruple Aim and health equity outcomes across the health care system: a scoping review. *Int J Integr Care*. 2026;26:12. <https://doi.org/10.5334/ijic.9896>.
52. De Rosis S. Performance measurement and user-centeredness in the healthcare sector: Opening the black box adapting the framework of Donabedian. *Int J Health Plann Manage*. 2023. <https://doi.org/10.1002/hpm.3732>.
53. International Pharmaceutical Federation (FIP). Pharmacy education taskforce: action plan 2008–2010. The Hague: FIP; 2008. Available from:

- <https://www.fip.org/files/fip/PharmacyEducation/Taskforce%20action%20plan.pdf>. Accessed 3 Jun 2026.
54. Kremin Y, Lesyk L, Lesyk R, Levytska O, Hromovyk B. Detailing the ten main professional roles of a pharmacist to provide the scope of professional functions. *Sci Pharm*. 2023;91(1):5. <https://doi.org/10.3390/scipharm91010005>.
 55. O'Mahony C, et al. Economic cost-benefit analysis of person-centred medicines reviews by general practice pharmacists. *Int J Clin Pharm*. 2024. <https://doi.org/10.1007/s11096-024-01732-y>.
 56. Donabedian A. The quality of care. How can it be assessed? *JAMA*. 1988;260(12):1743–8. <https://doi.org/10.1001/jama.260.12.1743>.
 57. Rupp MT. Assessing quality of care in pharmacy: remembering Donabedian. *J Manag Care Spec Pharm*. 2018;24(4):354–6. <https://doi.org/10.18553/jmcp.2018.24.4.354>.
 58. Jannah W, et al. Suitability of measures of pharmacy-based medication adherence for routine clinical use among patients with chronic diseases: a systematic review. *Patient Prefer Adherence*. 2025;19:265–78. <https://doi.org/10.2147/ppa.s492461>.
 59. Mohammed MA, Moles RJ, Chen TF. Impact of pharmaceutical care interventions on health-related quality-of-life outcomes. *Ann Pharmacother*. 2016;50(10):862–88. <https://doi.org/10.1177/1060028016656016>.
 60. Brandt J, et al. Medication review service implementation in community pharmacy settings: scoping review with focus on implementation studies. *Res Social Adm Pharm*. 2020;16(7):875–85. <https://doi.org/10.1016/j.sapharm.2019.10.005>.
 61. Dolzhenko M, Bilousova NA, Sirenko YM, Lobach L, Kozhuharyova NA. Influence of potential pharmacodynamic drug interactions in pharmacotherapy of coronary heart disease with comorbid conditions on treatment adherence: a cross-sectional study of a Ukrainian patient cohort. *Patient Prefer Adherence*. 2025;19:3615–32. <https://doi.org/10.2147/PPA.S552550>.
 62. Cabinet of Ministers of Ukraine. On amendments to the National List of Essential Medicines: Decree №18 dated January 6, 2023. Available from: <https://zakon.rada.gov.ua/laws/show/18-2023-п#Text>. Accessed 3 Jun 2026. [in Ukrainian].
 63. Ministry of Health of Ukraine. On amendments to the Order of the Ministry of Health of Ukraine dated July 18, 2024 №1254: Order of the MoH of Ukraine No. 1351 dated July 31, 2024. Available from: <https://zakon.rada.gov.ua/laws/show/z1183-24#Text>. Accessed 3 Jun 2026. [in Ukrainian].
 64. National Agency on Corruption Prevention. Corruption risks in the health technology assessment procedure (Strategic analysis of corruption risks). Kyiv: NACP; 2023. Available from: <https://nazk.gov.ua/wp-content/uploads/2023/06/doslidzhennya-OMT-2023.pdf>. Accessed 3 Jun 2026. [in Ukrainian].
 65. Tkachenko NO, Zarichna TP, Mahanova TV, Chervonenko NM. Modern approaches of pharmacy institutions to building long-term relationships with consumers of pharmaceutical products and improving pharmaceutical care. *Pharm J*. 2024;(4):73–81. <https://doi.org/10.11603/2312-0967.2024.4.14990>. [in Ukrainian].

66. Kirsanov D. Pharmacy sales based on the results of the first half of 2024. Apteka Online; 2024. Available from: <https://www.apteka.ua/article/698730>. Accessed 3 Jun 2026. [in Ukrainian].
67. Grzešk G, et al. The clinical significance of drug–food interactions of direct oral anticoagulants. *Int J Mol Sci*. 2021;22(16):8531. <https://doi.org/10.3390/ijms22168531>.
68. E-Health Ukraine. Electronic prescription for medicinal products: detailing redemption. Analytical dashboards; 2025. Available from: <https://edata.e-health.gov.ua/e-data/dashboard/reimb-manufacturer-details>. Accessed 3 Jun 2026. [in Ukrainian].
69. Cabinet of Ministers of Ukraine. Some issues of reimbursement of medicinal products and medical devices under the program of state guarantees of medical care for the population: Decree №584 dated July 28, 2021. Available from: <https://zakon.rada.gov.ua/rada/show/854-2021-п#n146>. Accessed 3 Jun 2026. [in Ukrainian].
70. Wu L, et al. Practice guidelines for the value evaluation of clinical pharmacy services (version 2). *Front Public Health*. 2025;12. <https://doi.org/10.3389/fpubh.2024.1472355>.
71. Urick BY, Urmie JM. Framework for assessing pharmacy value. *Res Social Adm Pharm*. 2019;15(11):1326–37. <https://doi.org/10.1016/j.sapharm.2018.12.008>.
72. Cabinet of Ministers of Ukraine. Some issues of the electronic health care system: Decree №411 dated April 25, 2018: as of February 4, 2025. Available from: <https://zakon.rada.gov.ua/laws/show/411-2018-п#Text>. Accessed 3 Jun 2026. [in Ukrainian].
73. Dolzhenko M, Bilousova N. Optimizing pharmacotherapy in coronary heart disease with comorbidities: impact of an online continuing professional development program in Ukraine: Pharmacology 2025. Selected Abstracts from Pharmacology 2025. *Br J Clin Pharmacol*. 2025. <https://doi.org/10.1002/bcp.70349>.
74. Simonetti L, et al. Pharmacoeconomic and clinical impact of pharmaceutical service in the intensive care unit: a systematic review. *Eur J Hosp Pharm*. 2024. <https://doi.org/10.1136/ejhpharm-2024-004208>.
75. Association of Cardiovascular Care of Family Medicine of Ukraine. A newer paradigm for the treatment and prevention of cardiovascular diseases using a polypill strategy. *Ukr Med J*. 2025. Available from: <https://doi.org/10.32471/umj.1680-3051.262834>. [in Ukrainian].

Figures

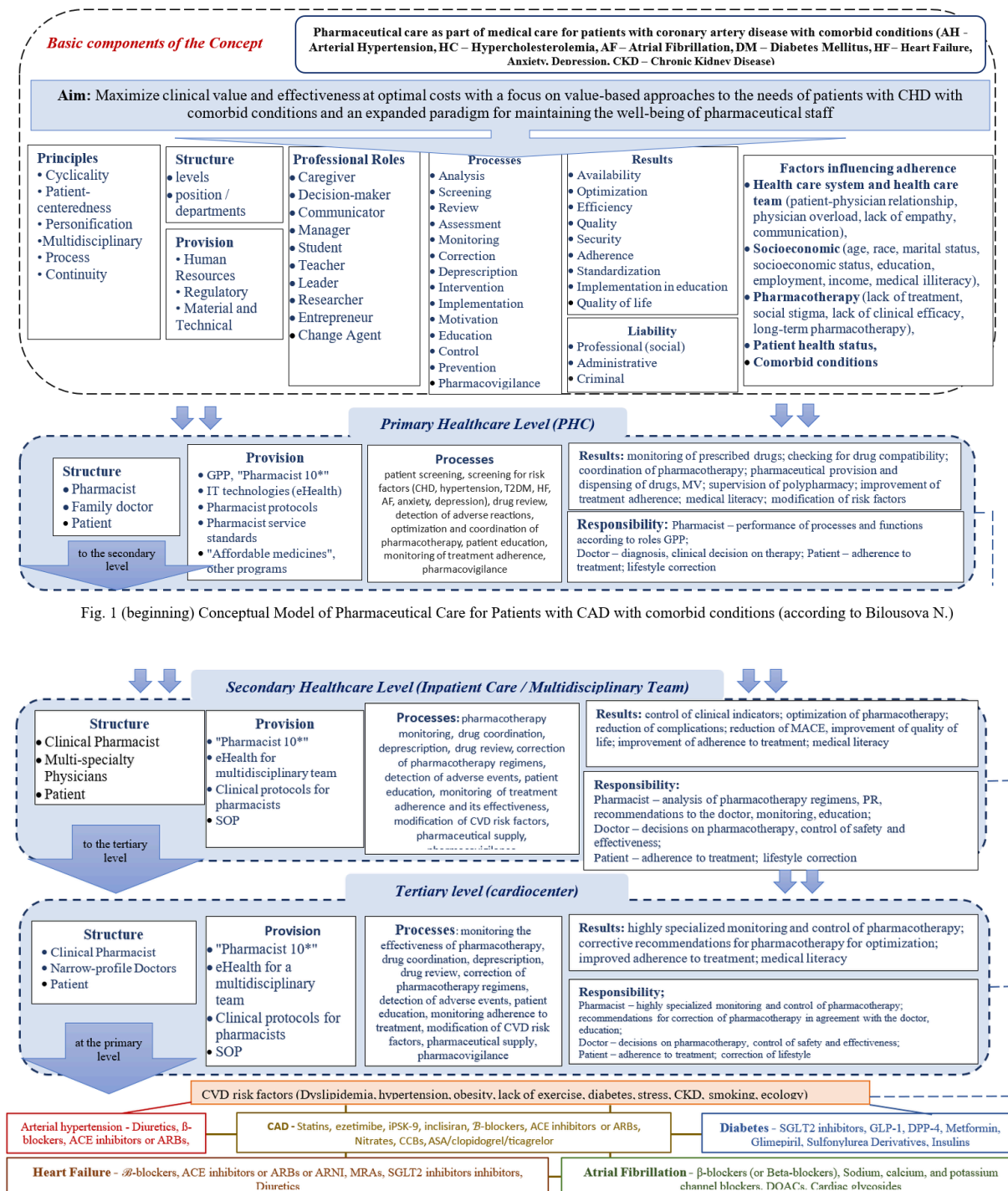


Fig. 1 (continued) Conceptual Model of Pharmaceutical Care for Patients with CAD with comorbid conditions (according to Bilousova N.)

Figure 1

See image above for figure legend.