Research Results in Pharmacology

Research Results in Pharmacology 11(2): 86–99
UDC: 615.45:616.12-008.331.1
DOI 10.18413/rrpharmacology.11.559

Research Article

Pharmacotherapy of arterial hypertension: assessment of knowledge levels among students and practicing physicians. Results of the PHYSTARH-II project

Roman A. Bontsevich[1,2], Nargiza Sh. Kosimova[1], Tatyana I. Chernyadyeva[1], Galina A. Batishcheva[3], Vera A. Nevzorova[4], Oksana V. Tsygankova[5,6], Galina G. Ketova[7], Galina G. Prozorova[3], Olga G. Kompanets[8], Ulankul M. Tilekeeva[9], Guzel M. Bikkinina[10], Elena V. Luchinina[11], Maxim L. Maksimov[2,13]

1 Mari State University, 1 Lenin Sq., Yoshkar-Ola 424000 Mari El Republic, Russia;
2 Kazan State Medical Academy – branch of the Russian Medical Academy of Continuous Professional Education (RMANPO), 36 Butlerova St., Kazan 420012 Russia;
3 Voronezh State Medical University named after N.N. Burdenko; 10 Studencheskaya St., Voronezh 394036 Russia;
4 Pacific State Medical University; 2 Ostryakov Ave., Vladivostok 690002 Russia;
5 Novosibirsk State Medical University; 52 Krasny Ave. Novosibirsk 630091 Russia;
6 Research Institute for Therapy and Preventive Therapy - branch of the Federal Research Center of the Institute of Cytology and Genetics of the Siberian Branch of the Russian Academy of Sciences; 175/1 Boris Bogatkov St., Novosibirsk 630089 Russia;
7 South Ural State Medical University; 64 Vorovskogo St., Chelyabinsk 454092 Russia;
8 Kuban State Medical University; 4 Sedina St., Krasnodar 4350063 Russia;
9 Kyrgyz State Medical Academy; 92 Akhunbaev St., Bishkek 720020 Kyrgyz Republic;
10 Bashkir State Medical University, 3 Lenin St., Ufa 3450000 Russia;
11 Saratov State Medical University named after V.I. Razumovsky; 112 Bolshaya Kazachya St., Saratov 410012 Russia;
12 Russian Medical Academy of Continuous Professional Education (RMANPO); 2/1 Barrikadnaya St.,Bldg 1Moscow 125993 Russia;
13 Russian National Research Medical University named after N.I. Pirogov; 1 Ostrovityanova st., Moscow 117997 Russia.

Corresponding author: Roman A. Bontsevich (dr.bontsevich@gmail.com)

Academic editor: Tatyana Pokrovskaya ♦ **Received** 5 January 2025 ♦ **Accepted** 25 March 2025 ♦ **Published** 29 June 2025

Citation: Bontsevich RA, Kosimova NSh, Chernyadyeva TI, Batishcheva GA, Nevzorova VA, Tsygankova OV, Ketova GG, Prozorova GG, Kompanets OG, Tilekeeva UM, Bikkinina GM, Luchinina EV, Maksimov ML (2025) Pharmacotherapy of arterial hypertension: assessment of knowledge levels among students and practicing physicians. Results of the PHYSTARH-II project. Research Results in Pharmacology 11(2): 86–99. https://doi.org/10.18413/rrpharmacology.11.559

Abstract

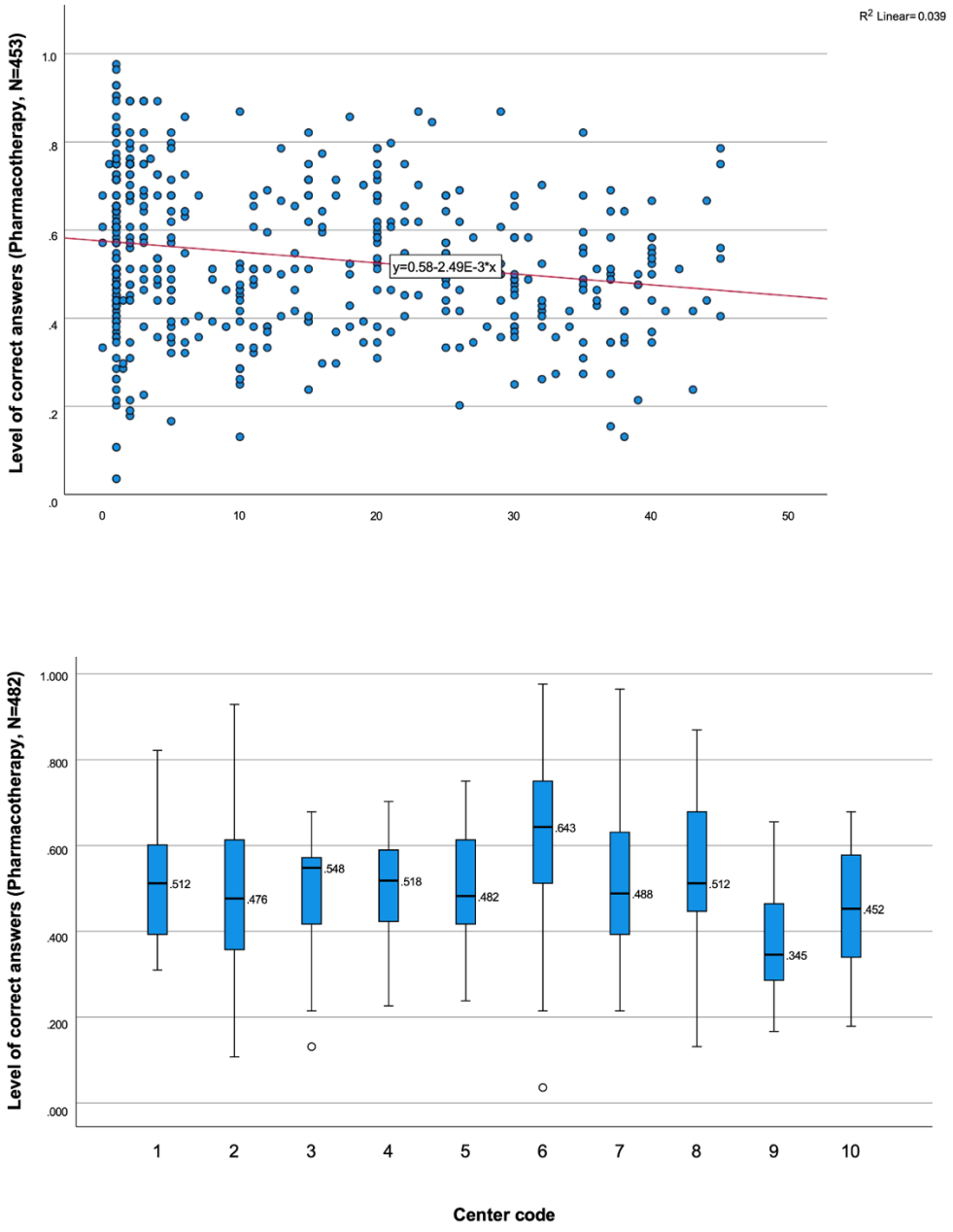
Introduction: Arterial hypertension (AH) is a significant risk factor for cardiovascular diseases and premature mortality. **The aim of the study:** To assess the level of knowledge and cognizance of physicians and medical students in a field of pharmacotherapy of AH.

Materials and Methods: This article analyzes the second phase (2019-2023) of the PHYSTARH project, a multicenter anonymous survey involving 494 therapeutic physicians from 10 Russian cities/regions and 426 students from 10 Russian and Kyrgyz universities. Comparisons were made with the previous phase (2017-2019) of student and physician research. Statistical methods included descriptive statistics, Kolmogorov-Smirnov, U-Mann-Whitney, Kruskal-Wallis, Pearson correlation, median test, ANOVA, and regression analysis ($p<0.05$).
Results: The study revealed that the knowledge levels among both students and physicians is not sufficiently high. Moreover, some questions showed a fatally low level of knowledge. The

average level of correct answers in the second part of the survey (LCA) was 44.9% for students and 53.5% for physicians. The LCA for students in the previous phase was 57.7%, while the LCA for physicians (2017-2019) in the second part of the survey was 60%.

Conclusion: The common level of knowledge base among students and physicians regarding key aspects of AH is insufficient. It is essential to implement additional educational programs to fill the recognized knowledge gaps. The results of studies highlight the necessity of improving educational programs for medical specialists in the field of arterial hypertension. The lowest correct answers rates were found in questions regarding the use of acetylsalicylic acid in patients with AH. The highest correct response rate was recorded for a question about selecting the optimal drug for managing uncomplicated hypertensive crises.

Graphical abstract



Keywords educational pharmacoepidemiology, multicenter study, pharmacoepidemiological cross-section of specialists' knowledge, knowledge assessment, real-world knowledge, surveying, medication errors, safety of pharmacotherapy

Introduction

According to the definition provided in the clinical guidelines for 2024, arterial hypertension (AH) is defined as a syndrome characterized by elevated systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg. In most cases, blood pressure increases asymptomatically, and AH is detected during the objective examination of the patient. In some cases, patients may present complaints; however, these are generally nonspecific (such as headache, palpitations, dizziness, etc.). In cases of symptomatic AH, complaints are usually associated with underlying conditions (e.g., obstructive sleep apnea syndrome, primary hyperaldosteronism, pheochromocytoma, hypercortisolism, thyroid disease, or coarctation of the aorta) (Kobaleva et al. 2024).

According to the World Health Organization (WHO) report for 2023, AH remains a "silent killer", representing a significant risk factor for premature mortality and is ineffectively controlled in most countries worldwide (Rotar et al. 2024).

In the Russian Federation, AH is classified as a socially significant disease, imposing a substantial burden on the healthcare system and resulting in considerable socioeconomic damage, which amounts up to 1% of the gross domestic product per year (Balanova et al. 2020). The findings of population-based multicenter studies conducted in Russia with the participation of the National Medical Research Center for Therapy and Preventive Medicine of the Ministry of Health of Russia demonstrate an increase in the prevalence of AH in the country over the past decade (Balanova et al. 2019). Studying the epidemiological characteristics of AH, its associated factors, and its insufficient control at the population level is an important step in combating this disease (Balanova et al. 2023).

Given the high prevalence of AH, which contributes to the development of complications such as stroke, myocardial infarction, and chronic heart failure, this condition poses a serious problem in medicine. Despite significant advances in the diagnosis and therapy of hypertension, there remains a substantial number of patients, whose conditions are undervalued, leading not only to suboptimal treatment, but also to inadequate medical care. This underscores the need for the present study, aimed at identifying existing barriers and factors contributing to the insufficient diagnosis and treatment of this disease.

Objective of the study: To assess the level of knowledge and awareness of students and physicians in medical universities regarding the pharmacotherapy of hypertension.

Materials and Methods

This study presents the results of Stage 2 of the multicenter project "PHYSTARH" (full title: "Physicians' and Undergraduates' Knowledge in Arterial Hypertension Treatment", a proprietary project name, not registered in research registries) focused on assessing the knowledge levels of physicians (P.) and students (S.) regarding the treatment methods for AH. The project has been ongoing since 2017, with results from Stage 1 published in relevant journals (Bontsevich et al. 2021, 2022).

Research methodology

The study employed a voluntary anonymous questionnaire developed specifically for this research, based on key recommendations from the clinical guidelines of the European and Russian society of Cardiology (Williams et al. 2018; Chazova and Zhernakova 2019; Kobalava et al. 2024).

Content of the questionnaire

The questionnaire consisted of 22 questions , with sub-items included in question 3, resulting in a total of 25 tasks. The surveys included questions on the etiopathogenesis, diagnosis, and pharmacotherapy of AH, featuring simulated typical clinical situations that dictate specific pharmacotherapy strategies.

Evaluation of responses

Each correct answer was awarded 1 point. If both correct and incorrect answers were selected simultaneously, the response was considered partially correct and scored between 0.25 and 0.75 points. If an incorrect answer was chosen, the respondent received 0 points. The Average Correctness Level of Answers (LCA) was defined as the mean score across all responses, incorporating correct, partially correct, and incorrect answers. A similar concept is the 'Average Accuracy Level of Answers.'

Analysis of results

This study includes an analysis of the results from the second part of the questionnaire on pharmacotherapy. The questions are presented below without answer options. For convenience, questions originally numbered 9–22 are renumbered as 1–14 in this article. This section provides a comprehensive comparison of knowledge levels between S. and P. across all questionnaire items in Phase 2 of the PHYSTARH project, along with a focused analysis of identical questions shared with Phase 1 (2017-2019) (Bontsevich et al. 2021, 2022), where partial modifications were made to certain items due to clinical guideline updates (2018-2019) (Williams et al. 2018; Systemic Hypertension 2019).

Questionnaire questions

1. Select medications for long-term antihypertensive therapy.
2. Indicate in which cases monotherapy is recommended as a starting strategy.
3. Specify in which cases individuals with high normal blood pressure should consider the possibility of antihypertensive therapy.
4. Choose the optimal class of medications for initial antihypertensive therapy, without considering specific clinical situations and limitations.
5. Indicate the therapeutic intervention (action) with the proven effectiveness of blood pressure reduction being approximately 5 times higher than simply doubling the dose of the initially administered medication.
6. Give the indication for acetylsalicylic acid (ASA) use in patients with hypertension.
7. Select irrational drug combinations from the offered options.
8. Indicate which of the specified diagnoses/conditions would be rational as a starting combination therapy for hypertension.
9. Choose a rational approach for initial therapy: Patient M., 37 years old, AH stage I, Grade 2, Risk 3.
10. Choose a rational approach for initial therapy: Patient K., 53 years old, AH stage I, Grade 1, Risk 1.
11. Select the optimal medication for the management of uncomplicated hypertensive crisis.
12.-14. Indicate absolute contraindications for prescribing: angiotensin-converting enzyme inhibitors (ACEIs), beta-adrenergic blockers, and thiazide diuretics.

Statistical methods

All questionnaire data were entered into an electronic database and processed using Microsoft Excel and Microsoft Access. Statistical analyses were performed using IBM SPSS Statistics version 27. Statistical significance was set at $p < 0.05$ with corresponding 95% confidence intervals (CI). Normality was assessed using the Kolmogorov-Smirnov test (D K-S). Group comparisons were performed using Mann-Whitney U and Kruskal-Wallis tests. Additional analyses included Pearson correlation, ANOVA, regression modeling, scatter plots, and median tests for independent samples.

Results and Discussion

In the second phase of the multicenter PHYSTARH project (2019–2023), a total of 426 students (S.) from medical universities and institutes across 10 cities and regions of Russia and Kyrgyzstan participated: 28.4% from Voronezh, 18.5% from Belgorod, 17.8% from the South Ural region (Chelyabinsk), 16.4% from the Pacific region (Vladivostok), 6.3% from Saratov, 5.4% from Bashkortostan (Ufa), and 7% from the Kyrgyz Medical Academy (Bishkek). Additionally, 494 physicians (P.) specializing in therapeutic profiles from 10 cities and regions of Russia took part, representing 7 project centers: 25.1% from Novosibirsk, 17.6% from Voronezh, 13% from Belgorod, 12.1% from Primorsky Krai, 10.5% from Sakhalin Region, 7.9% from Moscow, 3.8% from Chelyabinsk, 3.6% from Lipetsk, 3.4% from Krasnodar, and 2.4% from Rostov-on-Don.

The project yielded 475 (96.2%) fully completed questionnaires from P. and 405 (95.1%) from S. Questionnaires with the “Pharmacotherapy” section (questions 9–22) fully completed numbered 482 (97.6%) for P. and 405 (95.1%) for S. The overall level of correct answers (LCA) for the entire questionnaire was 50.0% ± 14.6% (95% CI: 48.6%–51.3%) for S. and 56.9% ± 16.1% (95% CI: 55.5%–58.4%) for P. Across centers, LCA for S. ranged from 35.2% to 58.7% ($p < 0.001$), and for P. from 39.5% to 66.3% ($p < 0.001$). For the second half of the questionnaire (“Pharmacotherapy” section), LCA was 44.9% for S. and 53.5% for P.

Data distribution deviated from normality in both groups (Kolmogorov–Smirnov test: D = 0.049, p = 0.021 for S.; D = 0.057, p < 0.001 for P.), thus medians (Me) were reported: Me_S = 45.2% [30.95; 57.1], Me_P = 51.2% [41.7; 66.7]. Detailed data are presented in Table 1.

Table 1. Descriptive statistics for the PHYSTARH-II project ("Pharmacotherapy" section)

Parameter	Physicians (N=482)	Students (N=405)
Mean LCA	0.535	0.449
95% CI	0.520-0.550	0.432-0.466
Median	0.512	0.452
Variance	0.029	0.031
Standard deviation	0.170	0.175
Minimum	0.036	0.036
Maximum	0.976	0.929
Range	0.940	0.893
Interquartile range	0.250	0.262
Skewness	0.059	0.079
Kurtosis	-0.358	-0.538

In the previous project stage (2017–2019), the LCA of S. for this part of the questionnaire was 55.5%, while the LCA of P. was 60%. However, since not all questions were identical between stages, direct comparison is limited.

In question 1, respondents were asked to indicate the criteria for an optimal medication for long-term blood pressure control. For prolonged antihypertensive therapy, it is optimal to use long-acting medications that ensure 24-hour blood pressure control with a single daily dose. The percentage of correct responses among S. in the second phase was 72.3%, with an LCA of 72.1%. The main incorrect response was the use of medications with a 12-hour effect (23.2%). The LCA among S. in the first phase was similar at 69.3% (p = 0.17 for S. between phases 1 and 2). Notably, P. in the second phase provided a higher percentage of correct answers (81.7%) compared to S. (p = 0.005). In the first phase, 85% of P. answered correctly (p = 0.159 for P. between phases 1 and 2).

Monotherapy is recommended as the initial treatment strategy for hypertension in frail elderly patients, patients with high normal blood pressure, very high cardiovascular risk, and patients with mildly elevated blood pressure (stage 1) and low risk.

Regarding question 2 on the possibility of selecting monotherapy as the initial treatment strategy, the LCA was 23.7% for S. and 31.2% for P. in the second phase (p = 0.014 for P. vs. S. in phase 2). The majority of respondents selected the indication “Patients with mildly elevated blood pressure (stage 1) and low risk” (57.8%) (Fig. 1).

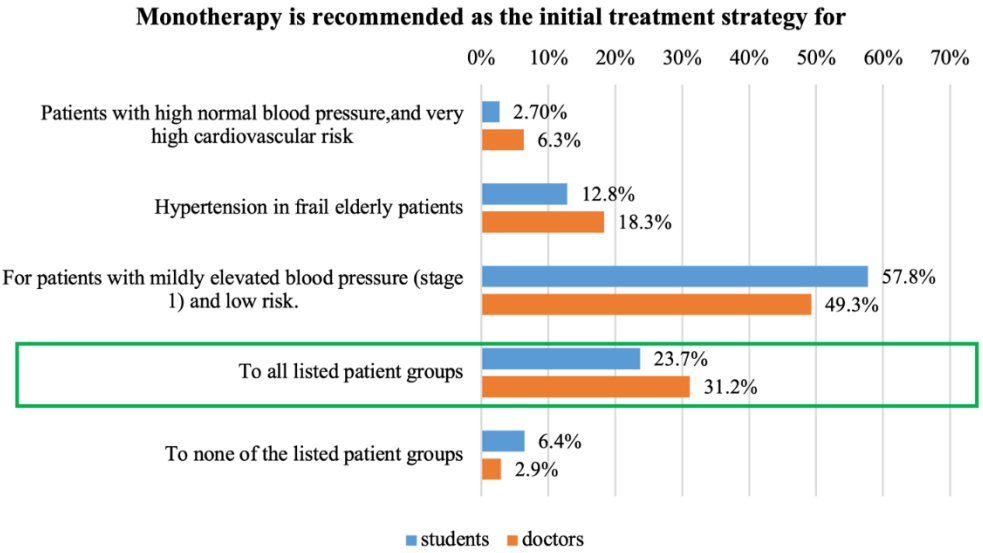


Figure 1. Frequency of choosing indications for monotherapy of hypertension as a starting strategy (The correct option is marked with a green solid border).

In the next question, respondents were asked to indicate in which cases individuals with high normal blood pressure should be considered for antihypertensive therapy. The LCA was 42.5% for S. and 57.7% for P. (p = 0.004 for P. vs. S. in phase 2). According to the 2020 Russian

Clinical Guidelines, pharmacological treatment of high normal blood pressure is recommended for patients with very high cardiovascular risk and established cardiovascular disease (especially ischemic heart disease) (Russian Society of Cardiology, 2020). The observed difference may be attributed to P.'s greater practical experience, which enhances their knowledge and ability to apply theoretical concepts in clinical practice. The data are presented in Figure 2.

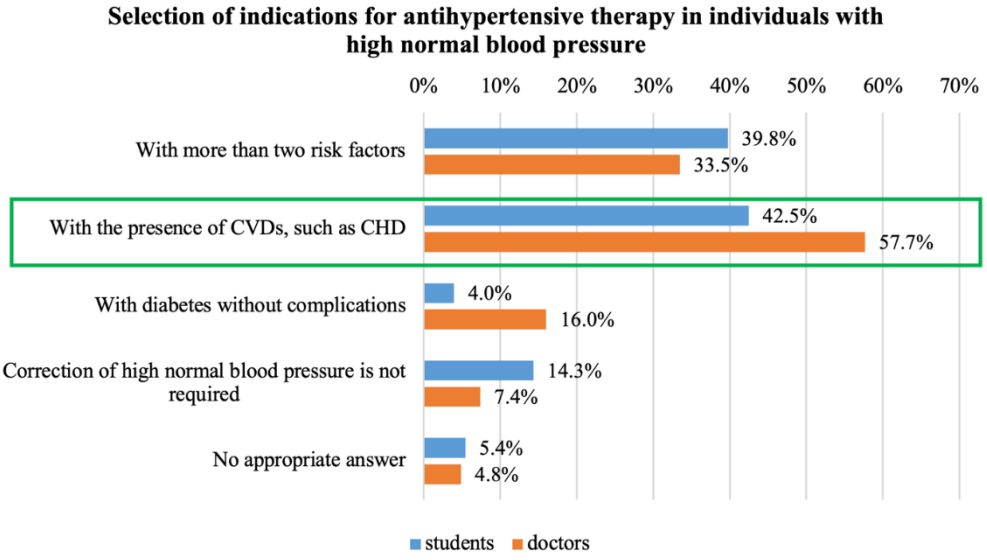


Figure 2. Frequency of choosing indications for antihypertensive therapy in individuals with high normal blood pressure (The correct option is marked with a green solid border).

In question 4, respondents were asked to indicate the optimal class of medications for initial hypertension therapy, without considering specific clinical situations or limitations (any medication class was acceptable). Only 12.8% of S. answered correctly. Considering partial answers, the LCA among S. was 22.6%, which remains very low. For P., the LCA was 35.6% ($p < 0.001$, 2nd phase, P. vs. S.). In the first phase, the LCA among S. was 12.3% ($p = 0.905$ for S. between phases 1 and 2). Correct responses were given by 26% of P. ($p = 0.002$ for P. between phases 1 and 2). The main incorrect response was the selection of angiotensin-converting enzyme inhibitors (ACEIs) as the "preferred" group. In the second phase, 39.8% of S. chose this incorrect answer. In the first phase, the percentage of incorrect answers was even higher: 61.2% of S. and 64.8% of P. selected ACEIs as "preferred" group.

The five main classes of antihypertensive medications (AHMs) recommended are ACEIs, angiotensin II receptor blockers (ARBs), calcium channel blockers (CCBs), diuretics, and beta-adrenergic blockers (BABs). All these classes can be used for both initial and maintenance therapy. Numerous studies have demonstrated their efficacy in preventing cardiovascular complications, controlling hypertension, and providing organ protection. Meta-analyses show similar impacts on cardiovascular outcomes and mortality across all five classes, making them foundational for antihypertensive therapy (Chazova et al. 2023).

ACEIs and ARBs are among the most frequently used AHMs, showing comparable efficacy regarding cardiovascular complications and mortality, both relative to each other and other classes. ARBs have a lower discontinuation rate due to side effects, comparable to placebo (Systemic Hypertension, 2019). ACEIs are generally considered first-line over ARBs for reducing myocardial infarction risk, primary prevention of heart failure, and secondary prevention of stroke. Both classes have equivalent efficacy for primary stroke prevention. Evidence supports preferential use of ACEIs in patients with type 2 diabetes for blood pressure control, primary prevention of diabetic kidney disease, and reduction of major cardiovascular and renal outcomes (Sobhy et al. 2024). The incorrect preference for ACEIs as "preferred" may be influenced by their superior protective effects compared to other groups.

In question 5, regarding the effectiveness of combination therapy compared to other blood pressure optimization methods, approximately 28.4% of S. answered correctly (LCA = 28%), while P. had an LCA of 37.7% ($p = 0.03$, 2nd phase, P. vs. S.). Most respondents believed that "cessation of smoking and weight loss >10% in obesity" was the most effective measure (52.8%), while "salt-free diet and physical activity" was selected by 14.6% of senior S. (Fig. 3).

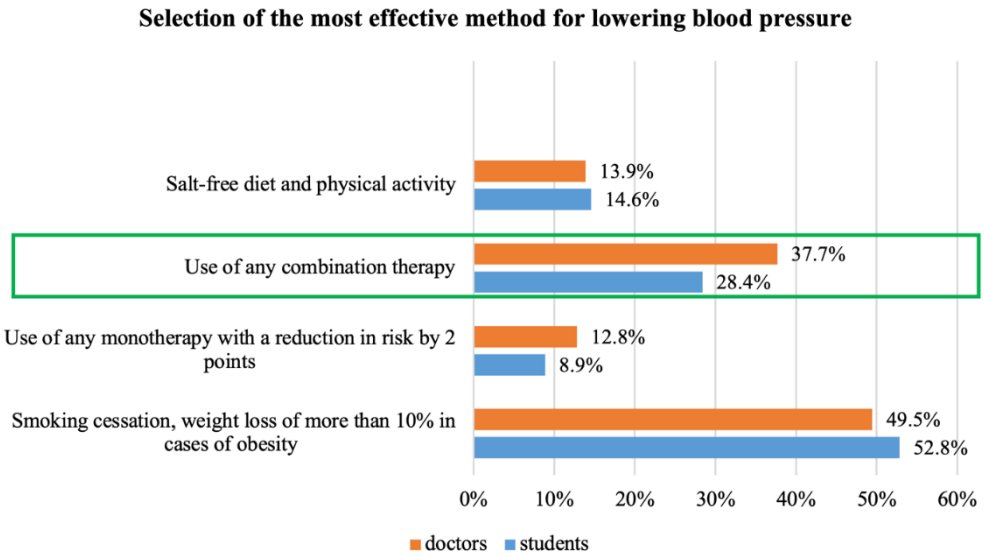


Figure 3. Selection of the most effective method for lowering blood pressure (The correct option is marked with a green solid border).

At phase 1, students' LCA was significantly lower, with a correct response rate of 17.3% ($p = 0.001$ for S. between phases 1 and 2). Physicians answered correctly at a higher rate of 33.7% ($p = 0.001$ for P. between phases 1 and 2) [95% CI: 29.1–38.5%]. In clinical practice, about 70% of physicians prefer combination antihypertensive therapy. Free combinations are prescribed most frequently (69%), while fixed combinations are less common. Preferred combinations include ACEIs + diuretics (82%), ARBs + diuretics (49%), and β-blockers + diuretics (39%). CCBs combined with other medications account for 35%. Approximately 50% of physicians use other modern combinations without diuretics, such as CCBs with ACEIs or β-blockers (Leonova et al. 2010). Large studies confirm combination therapy's effectiveness in achieving target blood pressure in most hypertensive patients (Soboleva and Slobodenyuk, 2011). Despite this, most respondents favored lifestyle modifications.

In question 6, respondents were asked to select optimal indications for aspirin (ASA) use in complex AH therapy. The correct answer involved prescribing ASA to patients with controlled hypertension who had prior cardiovascular events (myocardial infarction, ischemic stroke, transient ischemic attack). This was correctly identified by 42.3% of S. (LCA = 41.4%) and 55.5% of P. ($p < 0.001$, 2nd phase, P. vs. S.). The main error was the belief that ASA should be prescribed at any blood pressure level if indicated, which is incorrect and unsafe at high BP.

Hypertension remains the most prevalent cardiovascular disease and a major risk factor for severe complications (Melekhov and Ryazantseva 2013). Antithrombotic agents, including ASA, are essential in cardiovascular therapy. ASA's efficacy and safety are confirmed by numerous controlled studies and it is considered the "gold standard" of antithrombotic therapy (Laguta and Karpov 2007). However, ASA use should be limited to patients with stable and not excessively high BP, due to risks such as gastrointestinal bleeding, which may be exacerbated by hypertension.

One key question concerned knowledge of irrational antihypertensive medication combinations. Respondents were asked to identify irrational pairs: "ACEIs and ARBs" and "beta-blocker and non-dihydropyridine calcium channel blocker". Both ACEIs and ARBs target the renin-angiotensin-aldosterone system (RAAS) via different mechanisms, but combined use can cause excessive RAAS blockade, increasing risks of hypotension, hyperkalemia, and renal impairment. The combination of beta-blockers with non-dihydropyridine CCBs (e.g., verapamil, diltiazem) is also irrational due to additive effects on heart rate and conduction, risking arrhythmias or cardiac arrest (Kobaleva et al. 2024).

In this question, participants were presented with the following response options: a. Spironolactone and ACE inhibitors; b. Thiazide diuretics and calcium channel blockers; c. Angiotensin receptor blockers and ACE inhibitors; d. Angiotensin receptor blockers and calcium channel blockers; e. Beta-blocker and non-dihydropyridine calcium channel blocker.

Option "c" was correctly identified by 66.9% of S., and option "e" by 46.9%. Both were chosen by 31.9% of S. Incorrect options "a", "b", and "d" were selected by 22.8%, 15.3%, and 11.7% of S., respectively. Considering incomplete and incorrect answers, the LCA for S. was 41.7% (42.6% for fully completed questionnaires), while LCA for P. was 55.2% ($p < 0.001$, 2nd phase, P. vs. S.). In phase 1, LCA for S. was 42% ($p = 0.003$ for S. between phases 1 and 2), and 56% of P. answered correctly [95% CI: 50.8–60.7%] ($p = 0.456$ for P. between phases 1 and 2).

The results from P. and S., compared with data from the PHYSTARH-I project, are presented in Figure 4.

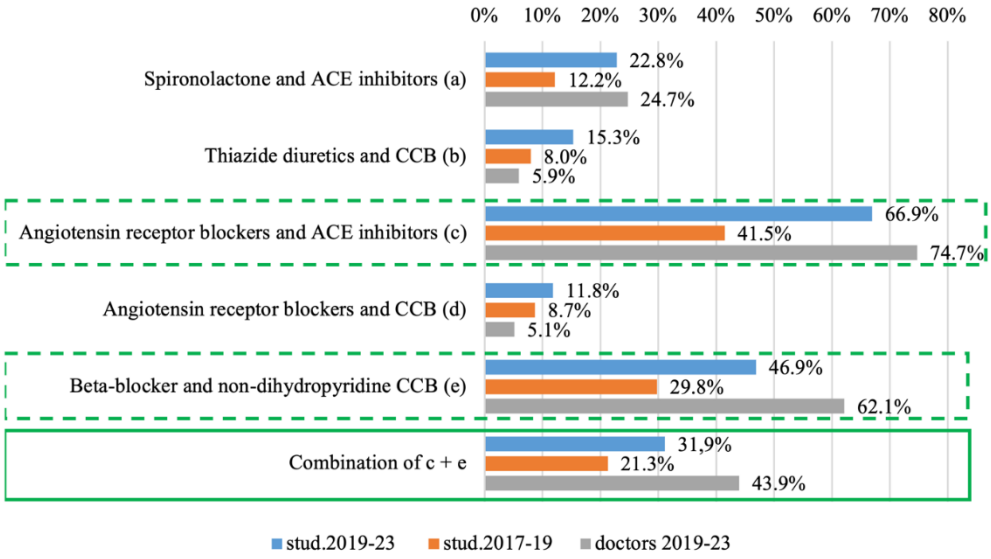


Figure 4. The issue of selecting irrational combinations of antihypertensive medications. (The correct option is marked with a green solid border, and the partial option is marked with a dashed line).

The highest number of correct answers was given by physicians. It should also be emphasized that the level of knowledge among students significantly increased compared to the previous testing phase, which may indicate an improvement in their educational training.

In question №8, respondents were asked to indicate in which proposed situations initiating combination therapy for hypertension would be rational. The correct option was stage I AH, grade 1 (BP = 145/90), risk 3. This option was selected by 48.4% of students; considering partially correct (combined) answers, the LCA decreased slightly to 47.5%. The LCA for P. was 45.3% (p = 0.673, 2nd phase, P. vs. S.). Incorrect answers were mainly options “b” (chosen by 106 students) and “d” (65 responses). Option “c” represents a justified indication for initiating combination therapy due to the high risk of cardiovascular complications (CVC), warranting a more aggressive therapeutic approach to reduce adverse cardiovascular events and improve prognosis. Option “b,” chosen by 106 students, typically involves non-pharmacological treatment methods. A comprehensive approach is recommended for these patients, including lifestyle and dietary modifications, limiting salt intake to less than 5 g/day, increasing physical activity, reducing alcohol consumption, and smoking cessation (Williams et al. 2018; Chazova and Zhernakova 2019). If these measures prove ineffective, transitioning to monotherapy is justified, considering the moderate BP level and CVC risk.

Questions №9 and №10 presented clinical scenarios requiring respondents to select the correct management strategy, considering hypertension stage, degree, and CVC risk. The percentage of correct answers among students was 45.1% and 40.4%, respectively (LCA 45.1% and 40.4%). The LCA for P. was 43.3% (p = 0.592, 2nd phase, P. vs. S.) and 41.5% (p = 0.737, 2nd phase, P. vs. S.), respectively.

For question №9, the LCA for students in phase 1 was 18.5% (p = 0.004, S. phase 1 vs. 2). The main error was underestimating the waiting period for BP stabilization and treatment effectiveness assessment; 33.6% of respondents indicated 3–5 days instead of the recommended 2 weeks. In question №10, 34.4% of respondents immediately suggested starting monotherapy, although non-pharmacological methods were appropriate initially. Among first-stage physicians, the correct response rate for question №9 was 16.3% (p = 0.089, P. phase 1 vs. 2). For question №10, it was 37.3%. The high rate of incorrect answers (>50%) indicates challenges in managing hypertension patients, particularly regarding treatment assessment timeframes and underestimation of non-pharmacological interventions.

In question №11, respondents were asked to identify the drug of choice for alleviating hypertensive crisis (HC). HC is characterized by a significant BP increase with acute target organ damage, often life-threatening, requiring immediate qualified intervention, typically via intravenous therapy. The drug of choice is captopril; alternatives include nifedipine, moxonidine, clonidine, and propranolol. Captopril was correctly selected by 75.8% of respondents; overall LCA was 75.2%. Physicians performed significantly better, with an LCA of 88.6% (p < 0.001, 2nd phase, P. vs. S.). At the previous stage, students’ LCA was 23.5% (p = 0.558, S. phase 1 vs. 2). The most common incorrect response was “nifedipine” (15.7%), which is considered a

second-line drug. Among first-stage physicians, 26.3% correctly chose captopril for uncomplicated HC (p = 0.026, P. phase 1 vs. 2).

The last three questions (№12–14) addressed absolute contraindications for ACEIs, beta-blockers, and thiazide diuretics, respectively. Answer options included: a) bronchial asthma, b) bradycardia, c) pregnancy, d) hyperkalemia >5.5 mmol/L, e) gout, f) significant sinoatrial (SA) or atrioventricular (AV) block. Comparison with the first stage was not appropriate due to question specificity.

Absolute contraindications for ACEIs are pregnancy and hyperkalemia >5.5 mmol/L. ACEIs increase blood potassium by reducing aldosterone secretion, which normally promotes potassium excretion via the kidneys. Elevated potassium levels risk severe cardiovascular complications such as arrhythmias or cardiac arrest. Pregnancy is contraindicated due to teratogenic risks. Enalapril and torasemide are absolutely contraindicated during pregnancy (Bontsevich et al. 2022).

The correct answer to question №12 was given by 33.1% of students; separately, pregnancy and hyperkalemia were indicated by 74.8% and 51.6%, respectively. Among physicians, 43.1% gave the complete correct answer; 82.6% and 51% selected pregnancy and hyperkalemia, respectively. Considering incomplete and partially incorrect answers, overall LCA was 50.1% for students and 60.4% for physicians (p < 0.001, 2nd phase, P. vs. S.). Common incorrect answers among students and physicians included bronchial asthma (18.8% of students) and intracardiac blockages (15.7% of students).

Absolute contraindications for beta-blockers include significant SA or AV block (grade 2–3), bronchial asthma, and bradycardia (Kobaleva et al. 2024). Complete correct answers were given by 35.7% of students (LCA P. – 36.6%), consisting of options “a,” “b,” and “f,” which were selected separately by 74.2%, 55.2%, and 67.8% of students, respectively. Corresponding LCA for physicians was 65.4%, 67%, and 70.9%. Considering incomplete and partially incorrect answers, students’ LCA was 56.5%, physicians’ LCA 61.4% (p = 0.077, 2nd phase, P. vs. S.).

Gout is a complex, painful disease characterized by acute inflammatory attacks caused by uric acid crystal deposition in joints and soft tissues. Thiazide diuretics can increase blood uric acid levels by reducing its renal excretion, competitively inhibiting uric acid transport proteins. Therefore, thiazides are absolutely contraindicated in gout (Bontsevich et al. 2022).

In the final question on contraindications for thiazide diuretics, 71.4% of students correctly identified gout (“e”), with LCA for physicians at 83.4%. However, “pregnancy” and “hyperkalemia” were incorrectly selected as contraindications in 21.0% and 36.8% of cases, respectively; these are relative contraindications. Students’ LCA for this question was 52.6%, physicians’ LCA 63.8% (p < 0.001, 2nd phase, P. vs. S.). Detailed data on responses regarding absolute contraindications are summarized in Table 2.

Table 2. Assessment of knowledge of absolute contraindications for prescribing a number of medications

Parameter	Absolute contraindications for*:*					
	ACEIs		beta-blockers		thiazide diuretics	
	students	**doctors**	***students***	**doctors**	***students***	**doctors**
LCA, %	*50.1*	60.4	*58.1*	61.4	*52.6*	63.8
ΔLCA among centers, *%*	*10.4 – 61*	35.7-69.4	*22.8 – 81*	36.8-76.9	*20.8 – 63.6*	14.3 – 76.3
Differences between the centers, *p*	*<0.001*	*<0.01*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Response options received (%):						
a. bronchial asthma	*18.8*	*13.4*	*74.2*#*	*65.4*#*	*1.9*	*2.2*
b. bradycardia	*7.5*	*2.8*	*55.2**	*67.0**	*7.3*	*3.0*
c. pregnancy	*72.5**	*82.6**	*19.2*	*12.3*	*20.4*	*30.6*
d. hyperkalemia >5.5 mmol/L	*49.3**	*51.0**	*6.1*	*2.2*	*36.4*	*19.8*
e. Gout	*7.0*	*3.4*	*4.9*	*2.0*	*71.4**	*83.4**
f. significant SA or AV block	*15.7*	*6.5*	*67.8**	*70.9**	*9.2*	*5.5*

Note: * – the correct options are marked; # – Current guidelines allow the use of selective beta-blockers in mild forms of asthma.

In the statistical comparison of results across different centers, several significant differences were identified. When comparing the entire sample for the “Pharmacotherapy” section (N = 482), the Kruskal-Wallis test yielded a value of 63.444 with p < 0.001, indicating statistically significant differences between centers (Fig. 5).

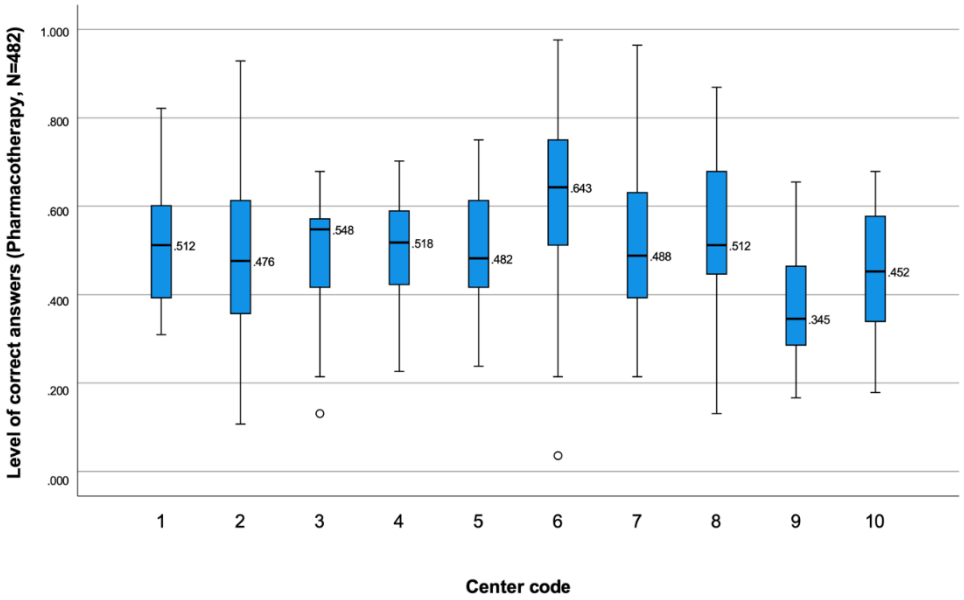


Figure 5. LCA in the section "Pharmacotherapy" in research centers (0-1, 0-100%; median values are displayed).

A correlation-regression analysis revealed a statistically significant, albeit weak, inverse correlation between specialists' knowledge level (LCA) and their years of experience (Pearson's $r = –0.198$, $p < 0.001$). This relationship can be described by the equation:

$$Y_{LCA} = 0.575 – 0.002 * X_{experience},$$

where: Y_{LCA} – the level of knowledge (LCA) of the specialist, and $X_{experience}$ – the years of work experience.

The scatter plot with graphs is presented in Figure 6.

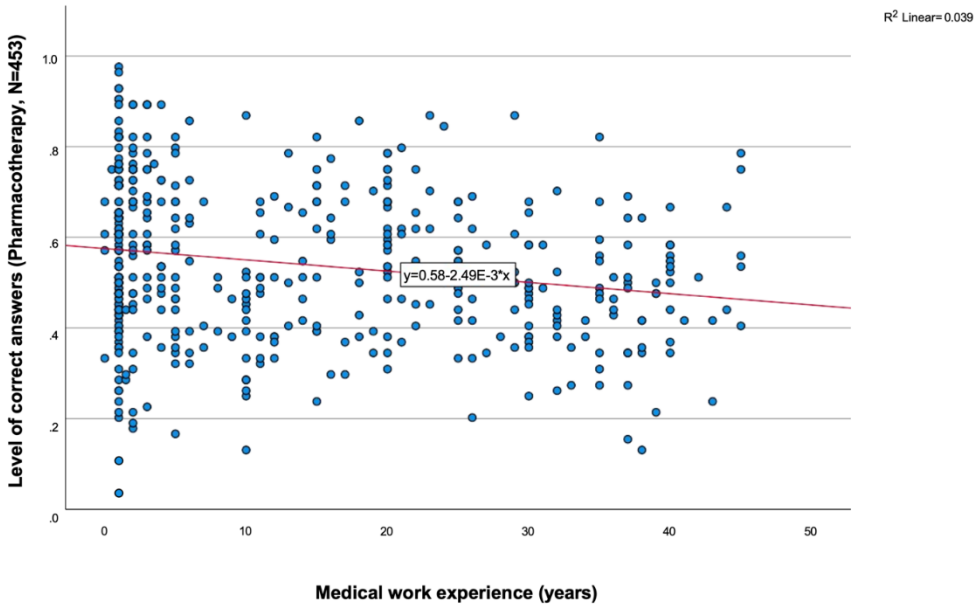


Figure 6. A graph of the regression function showing the dependence of the LCA level (section "Pharmacotherapy") on medical experience.

In addition to analyzing LCA by experience, and following previous projects in "Educational Pharmacoepidemiology" assessing specialists' knowledge in real-world practice (Real-World Knowledge) (Bontsevich 2024), knowledge levels were compared according to medical category. Responses from 220 specialists participating in the PHYSTARH-II project who indicated their category were analyzed; only fully completed questionnaires were included. Differences between categories were statistically insignificant ($p = 0.126$) (see Table 3 and Figure 7).

Table 3. The dependence of LCA on the category of the physician

Parameter	*Category*	*N*	*M*	*95%CI*
LCA (M), section "Pharmacotherapy"	*No*	*128*	*0.503*	*0.476-0.531*
	2	*12*	*0.529*	*0.435-0.622*
	1	*31*	*0.528*	*0.465-0.59*
	Highest	*49*	*0.564*	*0.521-0.608*

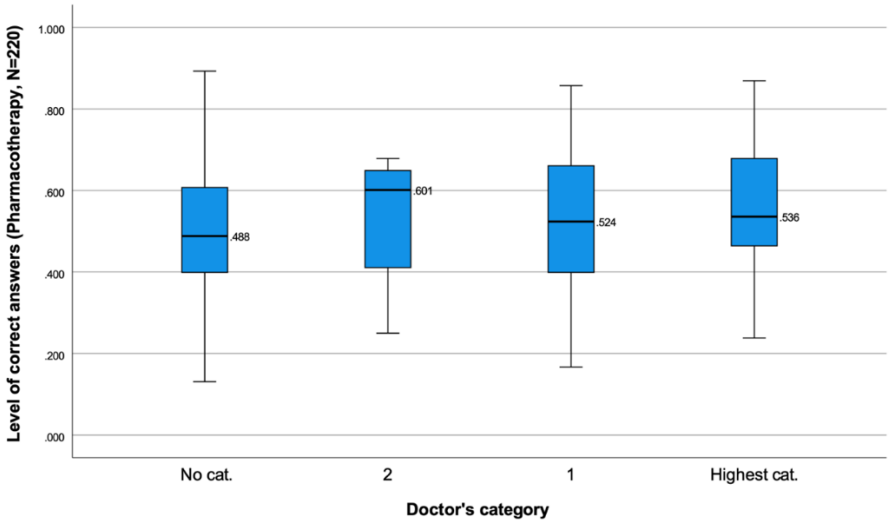


Figure 7. The level of responses from specialists (final LCA based on the questionnaire, section “Pharmacotherapy”) taking into account their medical category.

A two-factor linear regression analysis was performed to assess the combined impact of years of experience and medical category on LCA among 217 physicians. The model was statistically significant (ANOVA, $p < 0.001$). Holding category constant, experience had a significant negative effect on LCA ($p = 0.002$), with LCA decreasing by 0.003 per additional year of experience. Holding experience constant, category had a significant positive effect on LCA ($p = 0.002$), with LCA increasing by 0.027 for each one-level increase in category.

Conclusion

As a result of two research phases (2017–2023) assessing knowledge and preferences of physicians and senior students regarding AH, several problems and patterns were identified. The overall knowledge level among physician-specialists and students on AH pharmacotherapy was found to be insufficient and, in some areas, critically low, potentially negatively impacting clinical practice.

The most problematic topics included: treatment approaches for high normal blood pressure, optimal initial medication classes, advantages of combination therapy, selection of optimal therapy in typical clinical scenarios, use of acetylsalicylic acid in AH patients, and knowledge of absolute contraindications for specific antihypertensive drugs.

Unexpectedly, students demonstrated significantly higher knowledge levels than physicians on several issues (e.g., monotherapy prescribing strategy and correction of high normal blood pressure), likely reflecting effective educational processes and guideline updates. This finding highlights the need for in-depth analysis and corrective measures targeting physicians.

Significant heterogeneity in knowledge and preferences was observed among respondents from different centers, indicating regional disparities among practicing specialists. Additionally, a weak but significant negative correlation was found between physicians’ knowledge level and years of experience.

Additional information

Conflict of interest

The authors declare the absence of a conflict of interests.

Funding

The authors have no funding to report.

Data availability

All of the data that support the findings of this study are available in the main text.

References

- Balanova Yu, Drapkina O, Kutsenko V, Imaeva A, Kontsevaya A, Maksimov S, Muromtseva G, Kotova M, Karamnova N, Evstifeeva S, Kapustina A, Litinskaya O, Pokrovskaya M, Filichkina E, Ivlev O, Gomanova L, Doludin Yu, Efimova I, Borisova A, Nazarov B, Yarovaya E, Repkina T, Gonoshilova T, Kudryavtsev A, Belova N, Shagrov L, Samotrueva M, Yasenyavskaya A, Chernysheva E, Glukhovskaya S, Levina I, Shirshova E, Dorzhieva E, Urbanova E, Borovkova N, Kurashin V, Tokareva A, Ragino Yu, Simonova G, Khudyakova A, Nikulin V, Aslyamov O, Khokhlova G, Solovyova A, Rodionov A., Kryachkova O, Shamurova Yu, Tantsyreva I, Baryshnikova I, Ataev M, Radjabov M, Isakhanova M, Umetov M, Elgarova L, Khakuasheva I, Yamashkina E, Esina M, Kunyaeva T, Nikitina A, Savvina N, Spiridonova Yu, Naumova E, Keskinov A, Kashtanova D, Yudin V, Yudin S, Shalnova S (2023) Hypertension in the Russian population during the COVID-19 pandemic: sex differences in prevalence, treatment and its effectiveness. Data from the ESSE-RF3 study. Cardiovascular Therapy and Prevention [Kardiovaskulyarnaya Terapiya i Profilaktika] 22(8S): 3785 https://doi.org/10.15829/1728-8800-2023-3785 [in Russian]
- Balanova Yu, Kontsevaya A, Myrzamatova A, Mukaneeva D, Khudyakov M, Drapkina O (2020) Economic burden of arterial hypertension in the Russian Federation. Rational Pharmacotherapy in Cardiology 16(3): 415–423. https://doi.org/10.20996/1819-6446-2020-05-03 [in Russian]
- Balanova Yu, Shalnova S, Imaeva A, Kapustina A, Muromtseva G, Evstifeeva S, Tarasov V, Redko A, Viktorova I, Prishchepa N, Yakushin S, Boytsov S, Drapkina O (2019) Prevalence, awareness, treatment, and control of arterial hypertension in the Russian Federation (data from the ESSERF-2 observational study). Rational Pharmacotherapy in Cardiology 15(4): 450–466 https://doi.org/10.20996/1819-644 [in Russian]
- Bontsevich R, Vovk Ya, Gavrilova A, Kirichenko A, Krotkova I, Kosmacheva E, Kompaniets O, Prozorova G, Nevzorova V, Martynenko I, Ketova G, Barysheva V, Maksimov M, Osipova O (2021) Drug therapy of arterial hypertension: assessment of the physicians' basic knowledge. Final results of the PHYSTARH project. Systemic Hypertension 18(2): 80–87 https://doi.org/10.26442/2075082X.2021.2.200884 [in Russian]
- Bontsevich R, Vovk YaR, Kotlyarova V, Batishcheva G, Goncharova N, Cherenkova O, Ketova G, Barysheva V, Bikkinina G (2022) Drug therapy of arterial hypertension: assessment of the senior students' basic knowledge. Final results of the PHYSTARH project. Systemic Hypertension 19(2): 5–10. https://doi.org/10.38109/2075-082X-2022-2-5-10 [in Russian]
- Bontsevich RA (2024) Educational pharmacoepidemiology and "Real-World Knowledge". Real-World Data & Evidence [Real'naya Klinicheskaya Praktika: Dannye i Dokazatel'stva] 4(4): 44–52 https://doi.org/10.37489/2782–3784myrwd-062 [in Russian]
- Chazova I, Chikhladze N, Blinova N, Belaya Zh, Danilov N, Elfimova E, Litvin A, Rozhinskaya L, Sviridenko N, Shvetsov M, Azizov V, Grigorenko E, Mit'kovskaja N, Mustafaev I, Polupanov A, Sarybaev A, Hamidullaeva G (2023) Eurasian clinical guidelines for the diagnosis and treatment of secondary (symptomatic) forms of arterial hypertension. Eurasian Heart Journal [Evraziiskij Kardiologicheskii Zhurnal] (1): 6–65. https://doi.org/10.38109/2225-1685-2023-1-6-65 [in Russian]
- Chazova I.E, Zhernakova YuV (2019) Diagnosis and treatment of arterial hypertension [Guidelines]. Systemic Hypertension [Sistemnye Ghipertenzii] 16(1): 6–31. https://doi.org/10.26442/2075082X.2019.1.190179 [in Russian]
- Russian Society of Cardiology (2020). Arterial hypertension in adults. Clinical guidelines 2020. Russian Journal of Cardiology. 2020;25(3):3786. (In Russ.):2618-7620 https://scardio.ru/content/Guidelines/Clinic_rek_AG_2020.pdf [in Russian]
- Kobalava J, Konradi A, Nedogoda S, Shlyakhto E, Arutyunov G, Baranova E, Barbarash O, Boytsov S, Vavilova T, Villevalde S, Galyavich A, Glezer M, Grineva E, Grinshtein Y, Drapkina O, Zhernakova Y, Zvardau N, Irtyuga O, Kislyak O, Koziolova N, Kosmacheva E, Kotovskaya Y, Bobkova N, Libis R, Lopatyn Y, Nebiridze D, Nedoshivin A, Nikulina S, Ostroymova O, Oshchepkova E, Ratova L, Salasyuk A, Skibitsky V, Tkacheva O, Troitskaya E, Chazova I, Chesnikov A, Chumakova G, Shalnova S, Shestakova M, Yakushin S, Yanishevsky S (2024) Arterial hypertension in adults. Clinical recommendations. Russian Journal of Cardiology 29(9): 6117 https://doi.org/10.15829/1560-4071-2024-6117 [in Russian]
- Kobaleva Z, Konradi A, Nedogoda S, Shlyakhto E, Arutyunov G, Baranova E, Barbaraash O, Boytsov S, Vavilova T, Villevalde S, Galyavich A, Glezer M, Grineva E, Grinshtain Yu, Drapkina O, Zhernakova Yu, Zvartau N, Irtyuga O, Kislyak O, Koziolova N, Kosmacheva E, Kotovskaya Yu, Bobkova N, Libis R, Lopatkin Yu, Nebiridze D, Nadoshivin A, Nikulina S, Ostrova O, Oshchepkova E, Ratova L, Salasyuk A, Skibitsky V, Tkacheva O, Troitskaya E, Chazova I, Chesnikova A, Chumakova G, Shalnova S, Shestakova M, Yakushin S, Yanishevsky S (2024) Arterial hypertension in adults. Clinical guidelines. Russian Journal of Cardiology [Rossijskij Kardiologicheskij Zhurnal] 29(9): 6117 https://doi.org/10.15829/1560-4071-2024-6117 [in Russian]
- Laguta P, Karpov Yu (2007) Application of acetylsalicylic acid in patients with arterial hypertension. Russian Journal of Cardiology [Rossiiskii Kardiologicheskii Zhurnal] 20: 1489. [in Russian]
- Leonova M, Belousov D, Shteinberg L, Galitskiy A, Belousov Yu (2010) First results of the pharmacoepidemiological study of arterial hypertension, PIFAGOR III. Quality Clinical Practice [Kachestvennaya Klinicheskaya Praktika] (1): 54–60. [in Russian]
- Melekhov A, Ryazantseva E (2013) Acetylsalicylic acid in primary prevention among patients with arterial hypertension. Russian Journal of Cardiology [Rossiiskii Kardiologicheskii Zhurnal] (5): 81-87 https://doi.org/10.15829/1560-4071-2013-5-81-87 [in Russian]
- Rotar O, Ilyanova I, Boyarinova M, Moguchaya E, Tolkunova K, Dyachkov V, Rubanenko O, Rubanenko A, Gaberman O, Gubareva E, Pomogaibo B, Dolya E, Kaliberdenko V, Avdeeva I, Tomashevskaya Yu, Falkovskaya A, Manukyan M, Solonskaya E, Vtorushina A, Khunkhinova S, Tsareva V, Molokoedova L, Petrova M, Kaskaeva D, Romanova I, Danilova L, Evsyukov A, Tutyrina O, Tepnadze L, Yakunchenko T, Mevsha O, Sharapova Yu, Chernykh T, Syomkina E, Tsygankova O, Protasov K, Fedorishina O, Makeeva E, Smolkina Y, Nikishina D, Verushkina A, Smirnova E, Belenikina Ya, Bikushova I, Derevyanchenko M, Fedotov V, Shaposhnikova M, Sereda

D, Kartashova E, Zheleznyak E, Rakhmatullina D, Kiseleva L, Evsevieva M, Sergeeva O, Kudryavtseva V, Zavyalova A, Slezova V, Kitalaeva K, Artemov N, Tanicheva A, Konradi A, Shlyakhto E (2024) All-Russian screening for hypertension: results. Russian Journal of Cardiology [Rossiiskii Kardiologicheskii Zhurnal] 29(5): 5931. https://doi.org/10.15829/1560-4071-2024-5931 [in Russian]

- Sobhy M, Eletriby A, Ragy H (2024) ACE inhibitors and angiotensin receptor blockers for the primary and secondary prevention of cardiovascular outcomes: Recommendations from the 2024 Egyptian Cardiology Expert Consensus in Collaboration with the CVREP Foundation. Cardiology and Therapy 13: 707–736. https://doi.org/10.1007/s40119-024-00381-6
- Soboleva M, Slobodenyuk E (2011) Advantages of combined therapy for arterial hypertension based on modern research. Far Eastern Medical Journal [Dal'nevostochnyy Meditsinskii Zhurnal] 3: 81–84. [in Russian]
- Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M, Clement D, Coca A, De Simone G, Dominiczak A, Kahan T, Mahfoud F, Redon J, Ruilope L, Zanchetti A, Kerins M, Kjeldsen S, Kreutz R, Laurent S, Lip GYH, McManus R, Narkiewicz K, Ruschitzka F, Schmieder R, Shlyakhto E, Tsioufis K, Aboyans V, Desormais I (2018) Practice guidelines for the management of arterial hypertension of the European Society of Cardiology and the European Society of Hypertension. Blood Press 27(6): 314–340 https://doi.org/10.1080/08037051.2018.1527177
- Williams B, Mancia G, Spiering W, Rosei EA, Azizi M, Burnier M, Clement DL, Coca A, de Simone G, Dominiczak A, Kahan T, Mahfoud F, Redon J, Ruilope L, Zanchetti A, Kerins M, Kjeldsen SE, Kreutz R, Laurent S, Lip GYH, McManus R, Narkiewicz K, Ruschitzka F, Schmieder RE, Shlyakhto E, Tsioufis C, Aboyans V, Desormais I; Authors/Task Force Members (2018) 2018 ESC/ESH Guidelines for the management of arterial hypertension: The Task Force for the management of arterial hypertension of the European Society of Cardiology and the European Society of Hypertension. Journal of Hypertension 36(10): 1953–2041. https://doi.org/10.1097/HJH.0000000000001940 [PubMed]

Author Contribution

- **Roman A. Bontsevich,** MD, PhD, physician, pulmonologist, clinical pharmacologist, Associate Professor of the Department of Internal Diseases No. 2 of Mari State University, Yoshkar-Ola, Russia; Associate Professor of the Department of Clinical Pharmacology and Pharmacotherapy of Kazan State Medical Academy – branch of the Russian Medical Academy of Continuous Professional Education, Kazan, Russia; e-mail: dr.bontsevich@gmail.com; **ORCID ID:** https://orcid.org/0000-0002-9328-3905. Conceving the idea and being the project coordinator, the author analyzed the general results and provided the final conclusions, finalizing the article.
- **Nargiza Sh. Kosimova**, 4th year student of Mari State University; Yoshkar-Ola, Russia; e-mail: nargizakasymova288@gmail.com; **ORCID ID:** https://orcid.org/0009-0007-7138-2113. The author took part in the development and writing of the article, description and presentation of the results of the conducted research and statistics, was responsible for the translation of the article in English.
- **Tatyana I. Chernyadyeva**, 5th year student of Mari State University; Yoshkar-Ola, Russia; e-mail: tchernyadjeva.t@yandex.ru; **ORCID ID:** https://orcid.org/0009-0004-4275-9645. The author took part in the development and writing of the article, description and presentation of the results of the conducted research and statistics.
- **Galina A. Batisheva**, MD, PhD, Associated Professor of Voronezh State Medical University named after N.N. Burdenko, Voronezh, Russia; e-mail: bat13@mail.ru; **ORCID ID:** https://orcid.org/0000-0003-4771-7466. The author was responsible for conducting the regional study in Voronezh.
- **Vera A. Nevzorova**, Dr. Sci. (Med.), Professor, Head of the Institute of Therapy and Instrumental Diagnostic, Pacific State Medical University; Vladivostok, Russia; e-mail: nevzorova@inbox.ru; **ORCID ID:** https://orcid.org/0000-0002-0117-0349. The author was responsible for conducting the regional study in Vladivostok and Primorsky Krai.
- **Oksana V. Tsygankova**, Dr. Sci. (Med.), Professor, Professor of the Department of Emergency Medicine with Endocrinology and Occupational Pathology of the Faculty of Continuing Education and Professional Retraining of Doctors, Novosibirsk State Medical University, Novosibirsk, Russia; Senior Researcher, Research Institute of Internal and Preventive Medicine, Branch of the Institute of Cytology and Genetics, Siberian Branch of Russian Academy of Sciences, Novosibirsk, Russia; e-mail: oksana_c.nsk@mail.ru; **ORCID ID:** https://orcid.org/0000-0003-0207-7063. The author was responsible for conducting the regional study in Novosibirsk.
- **Galina G. Ketova**, Dr. Sci. (Med.), Professor, Professor of the Department of Outpatient Therapy and Clinical Pharmacology, South Ural State Medical University, Chelyabinsk, Russia; e-mail: galina_ketova@mail.ru; **ORCID ID**: https://orcid.org/0000-0002-4678-6841. The author was responsible for conducting the regional study in Chelyabinsk.
- **Galina G. Prozorova**, MD, PhD, Doctor of Medical Sciences, Professor of the Department of Therapeutic Disciplines of the Institute of Additional Education of Voronezh State Medical University named after N.N. Burdenko, Voronezh, Russia; e-mail: prozorovagg@gmail.com; **ORCID ID:** https://orcid.org/0000-0001-8675-1590. The author was responsible for conducting the regional study among doctors in Voronezh, Lipetsk and Tambov regions.

- **Olga G. Kompaniets,** Cand. Sci. (Med.), Chief Clinical Pharmacologist of Krasnodar City, Associated Professor of the Department of Therapy No. 1, Kuban State Medical University, Krasnodar, Russia; e-mail: olga-kompaniets1@yandex.ru; **ORCID ID:** https://orcid.org/0000-0001-9449-9241. The author was responsible for conducting the regional study in Krasnodar, Adygea, and Rostov regions.
- **Ulankul M. Tilekeeva**, Dr. Sci. (Med.), Professor Head of the Department of Basic and Clinical Pharmacology, Kyrgyz State Medical Academy, Bishkek, Kyrgyz Republic; e-mail: ulangul@mail.ru; **ORCID ID:** https://orcid.org/0000-0002-8407-8248. The author was responsible for conducting the regional study in Kyrgyzstan (Bishkek).
- **Guzel M. Bikkinina**, Dr. Sci. (Med.), Professor, The Department of Pharmacology with the Course of Clinical Pharmacology, Bashkir State Medical University, Ufa, Russia; e-mail: bikkinina.ru@mail.ru; **ORCID ID:** https://orcid.org/0000-0002-0116-5128. The author was responsible for conducting the regional study in Ufa.
- **Elena V. Luchinina**, Cand. Sci. (Med.), Associated Professor of the Department of Clinical Pharmacology, Saratov State Medical University named after V.I.Razumovsky, Saratov, Russia; e-mail: ELuchinina@gmail.com; **ORCID ID:** https://orcid.org/0000-0002-3120-8491. The author was responsible for conducting the regional study in Saratov.
- **Maxim L. Maximov**, Dr. Sci. (Med.), Professor, Head of the Department of Clinical Pharmacology and Pharmacotherapy, Kazan State Medical Academy – branch of the Russian Medical Academy of Continuing Professional Education, Kazan, Russia; Professor of the Department of Pharmacology of the Institute of Pharmacy and Medical Chemistry, Pirogov Russian National Research Medical University, Moscow, Russia; Dean of the Faculty of Preventive Medicine and Health Care Organization, Russian Medical Academy of Continuous Professional Education, Moscow, Russia; e-amil: maksim_maksimov@mail.ru; **ORCID ID:** https://orcid.org/0000-0002-8979-8084. The author was responsible for discussing the concept of the article and editing it.