



Arterial hypertension in Romania: A national call for action through prevention, diagnosis, treatment and adherence

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Abstract

Arterial hypertension (HTN) represents the leading cause of cardiovascular mortality in Romania, with a rising prevalence estimated at over 45% among the adult population. Despite some progress in recent years, blood pressure control remains suboptimal, highlighting the urgent need for national intervention. This article proposes an integrated action plan, structured around four key pillars – prevention, diagnosis, treatment and adherence, to significantly improve HTN management in Romania. Drawing on recent national and international epidemiological data, as well as successful models implemented in other countries, the authors outline a set of feasible, evidence-based measures that can be progressively and sustainably implemented. These include population-wide nutritional and behavioural interventions, reorganised screening programmes, establishment of digital registries, standardised treatment protocols with fixed-dose combinations, integration of telemedicine and development of digital tools to improve long-term adherence. In addition, the proposed framework explicitly addresses several Romania-specific implementation gaps. A coordinated implementation of this framework could help achieve blood pressure control rates approaching 70% by 2030, thereby reducing the national cardiovascular burden. Consequently, HTN may become a more manageable condition on a national scale, with long-term positive impact on public health.

Keywords

hypertension, cardiovascular prevention, public health strategy, adherence, digital health tools

Introduction

Arterial hypertension (HTN) remains one of the most important determinants of premature cardiovascular morbidity and mortality in Romania and should be regarded as a major public health priority. According to the 2024 National Institute of Public Health analysis, diseases of the circulatory system accounted for 49.6% of all deaths in Romania in 2023, while the crude cardiovascular mortality rate remained as high as 600.8 per 100,000 inhabitants. This burden is unevenly distributed, being markedly higher in rural areas than in urban settings (733.9 vs 496.0 per 100,000 inhabitants) and higher in women than in men (625.8 vs 574.6 per 100,000 inhabitants). At the European level, Romania continues to rank among the countries

with the highest age-standardised prevalence of cardiovascular disease, estimated at 7140.8 per 100,000 inhabitants, exceeding both the average across ESC member countries (6962.9 per 100,000) and the European Union average (6271.1 per 100,000), thus highlighting a persistently greater cardiovascular burden than that observed in more developed European health systems [1]. Within this broader cardiovascular burden, arterial HTN remains a central and modifiable driver of stroke, ischaemic heart disease, heart failure, chronic kidney disease and premature death.

Contemporary national screening data further illustrates the scale of unmet preventive needs. The Romanian cardiovascular screening programme ‘*Totul Pentru Inima Ta/All for your Heart*’ evaluated more than 146,000 individuals, including approximately 85,000 from rural areas and contributed to early diagnosis and counselling for persons with cardiovascular risk factors. The programme showed that only 22% of screened individuals were classified as low risk according to SCORE, while 58% had moderate risk, 15% high risk and 3% very high risk. In parallel, the screened population showed a substantial clustering of modifiable cardiometabolic determinants: 17% were smokers, 40% were physically inactive, 76% were overweight or obese, including 36% with obesity, 55% had elevated total cholesterol and 15.17% had increased fasting glucose. Dietary risk indicators were also highly prevalent, including inadequate vegetable intake in 46%, inadequate fruit intake in 44%, excessive salt-related dietary patterns in 39%, and inadequate fish intake in 80% of participants [1,2].

Recent European real-world data also indicate that the challenge is not limited to detection but extends to risk recognition and long-term

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control. In the SNAPSHOT study, which included 9307 hypertensive patients from six European countries. In Romania, 91.3% of patients had at least one additional cardiovascular risk factor, 81.8% had dyslipidaemia and 33.3% had type 2 diabetes. Despite this high-risk clinical profile, physician-based cardiovascular risk assessment was accurate in only 38.0% of cases when compared with SCORE1 and only in 26.7% when compared with SCORE2/SCORE2-OP, while risk was underestimated in 54.3% and 71.8% of patients, respectively. Control of major therapeutic targets was also poor, with blood pressure control achieved in fewer than 25% of patients, LDL-cholesterol control in fewer than 12% of those with concomitant dyslipidaemia and glycated haemoglobin control in fewer than 50% of those with type 2 diabetes [3]. Taken together, these findings suggest that Romania is facing not only a high prevalence of HTN and related risk factors, but also a substantial implementation gap across screening, risk stratification, treatment intensification and long-term adherence.

Romania-specific implementation gap

Beyond epidemiological burden, Romania faces a set of implementation barriers that are specific to its healthcare structure. Cardiovascular risk is frequently underestimated not only because of patient-related factors, such as limited health literacy, asymptomatic disease perception and economic barriers, but also because global risk estimation is not yet systematically embedded into daily clinical workflows. The routine use of SCORE2/SCORE2-OP remains insufficiently standardised, particularly in settings where electronic records are fragmented, consultation time is limited and laboratory results are not automatically integrated into risk calculators. Although preventive services and basic cardiovascular risk assessment are included in the Romanian primary care package, the absence of a national audit system linking blood pressure screening, newly detected HTN, treatment intensification and achieved control rates limits the ability to monitor implementation [4]. Therefore, the national action plan should move beyond isolated screening campaigns and towards measurable indicators, reimbursed preventive pathways and digital tools that support both physicians and patients.

Given this context, the National Alliance for the Prevention, Detection and Treatment of Hypertension in Romania (RO-APDT-HTA) proposes an integrated approach based on four essential pillars: **Prevention, Diagnosis, Treatment and Adherence**.

Epidemiology of HTN in Romania

Epidemiological studies from the last decade highlight a very high prevalence of arterial HTN among the adult population in Romania. The most recent nationally representative study, SEPHAR IV (2021), reported a HTN prevalence of 46%, up from 45.1% in SEPHAR III (2016) and 40.4% in SEPHAR II (2012) [5]. This upward trend underscores the persistence and worsening of cardiovascular

risk factors in the population. Another national study, PREDATORR (2016), reported an even higher overall HTN prevalence of 47.4% among adults aged 20–79 years [6].

The prevalence of HTN increases exponentially with age: from approximately 10% in young adults (20–39 years) to over 75% among individuals over the age of 60. These figures place Romania among the countries with the highest prevalence of HTN in Europe [7–9], where the average is estimated at ~44%; by comparison, in the United States, the prevalence is approximately 29% [10].

The age-based distribution of cases reveals a very high prevalence from the sixth decade of life onward of life and beyond: practically three out of four Romanians over 60 years old suffer from HTN [6]. This age-related progression reflects the extremely high lifetime risk of developing HTN in Romania. Specialists warn that, in the absence of systematic preventive interventions, the prevalence of HTN could exceed 50% in the next decade [5,7].

Clustering of cardiometabolic risk factors, obesity and sex-specific cardiovascular risk in Romania

HTN in Romania should not be approached as an isolated condition, because it commonly clusters with obesity, dyslipidaemia, diabetes, chronic kidney disease, smoking and unhealthy dietary patterns. In the 'Totul Pentru Inima Ta/All for your Heart' screening programme, 76% of screened participants were overweight or obese, including 36% with obesity, 55% had elevated total cholesterol and 15.17% had increased fasting glucose [2]. Similarly, the PREDATORR study documented a high burden of obesity, overweight, abdominal obesity and metabolic syndrome in the Romanian adult population, reinforcing the role of excess adiposity as a major upstream driver of HTN [11]. These data support an integrated cardiometabolic prevention model in which blood pressure control is combined with weight management, lipid control, diabetes prevention, renal risk evaluation and lifestyle intervention.

A sex-specific approach is also required. Although several metabolic risk factors may be numerically more prevalent in men, their cardiovascular consequences may be disproportionately severe in women, a phenomenon recently described as the cardiometabolic paradox in women [12]. Female-specific risk factors, including hypertensive disorders of pregnancy, gestational diabetes, premature menopause, infertility-related conditions and the menopausal transition, should be systematically included in cardiovascular risk assessment, as also emphasised by the 2024 ESC guidelines on elevated blood pressure and HTN [12,13]. Postmenopausal women may also be more vulnerable to salt-sensitive blood pressure elevation, making sodium reduction, weight control and early blood pressure monitoring particularly relevant in this subgroup [14].



Action plan for HTN control – an integrated four-pillar approach

The proposed action plan for HTN control outlines an integrated intervention model structured around four fundamental pillars: **Prevention, Diagnosis, Treatment and Adherence** (Figure 1). This approach ensures systematic coverage across the entire continuum of care for hypertensive patients, from disease prevention to long-term maintenance of optimal blood pressure control. Each pillar targets specific strategic directions, including individual, community and system-level interventions, all supported by scientific evidence and international recommendations tailored to the local context.

Pillar I – prevention: interventions to reduce the incidence of arterial HTN in Romania

Arterial HTN is a multifactorial condition strongly influenced by modifiable lifestyle factors such as excessive salt intake, unhealthy diet, physical inactivity, alcohol consumption and smoking. Studies show that over 80% of cardiovascular diseases could be prevented through targeted behavioural and public health interventions [15].

Reducing Sodium Intake and Increasing Potassium Intake. Excessive salt consumption is a major contributor to the development of HTN. In Romania, the average daily salt intake is estimated at 10–12 g/day – more than twice the recommended limit [15]. The World Health Organization recommends less than 5 g of salt per day, 2 g of sodium, and a minimum potassium intake of 3510 mg/day. A high sodium intake combined with insufficient potassium increases the risk of HTN [16,17].

A large meta-analysis showed that reducing sodium intake leads to an average decrease in systolic blood pressure of ~3.4 mmHg and diastolic BP by ~1.5 mmHg in adults [18]. The effect is more pronounced in hypertensive individuals or those with very high salt intake, compared to normotensive individuals [18]. Moreover, dietary

potassium helps counterbalance the effects of sodium and promotes vasodilation. Increased potassium intake has been associated with BP reduction, with potassium supplementation lowering systolic BP by ~4 mmHg and diastolic BP by ~2–3 mmHg in clinical trials [19].

Household-based salt reduction and dietary implementation

In Romania, salt reduction strategies should target not only processed foods but also discretionary salt added during cooking or at the table. In many Central and Eastern European dietary patterns, bread and cereal products, processed meat, cheese, preserved foods and salt added during home cooking represent major contributors to sodium intake [20]. Therefore, public health campaigns should be designed for the household rather than only for the individual patient. Educational materials should involve the person responsible for cooking and should include practical recommendations such as gradual salt reduction, replacing salt with herbs and spices, choosing lower-salt bread and cheese, avoiding highly processed foods and reading nutritional labels. This is especially relevant in rural households, where traditional food preservation and home-prepared meals may contribute substantially to sodium exposure.

Population-Level Nutritional Interventions. Promoting a balanced diet rich in vegetables and fruits, with low levels of saturated fats and sugars, has proven beneficial for maintaining normal blood pressure. Healthy dietary patterns such as the Mediterranean or dietary approaches to stop hypertension (DASH) diets have demonstrated BP-lowering effects. The DASH diet – rich in vegetables, fruits, low-fat dairy and lean proteins, with reduced sodium and saturated fat – has produced significant BP reductions in clinical trials: ~11 mmHg in hypertensive individuals (when combined with a low-sodium diet), and ~7 mmHg in normotensive individuals [21]. Another target is weight control. Even modest weight loss positively impacts BP: a meta-analysis including 35 studies found that a mean BMI reduction of ~2.3 kg/m² was associated with a systolic BP decrease of ~5.8 mmHg and a diastolic decrease of ~3.4 mmHg [22]. Chronic excessive alcohol consumption raises blood pressure, with a dose-dependent effect. Studies on alcohol reduction have shown that decreasing intake results in BP reduction; for instance, reducing intake from six drinks/day to half that amount led to a ~5 mmHg drop in systolic BP [23].

Promoting Physical Activity. People with high levels of physical activity have significantly lower risk of developing HTN compared to sedentary individuals. Those with high recreational activity had ~19% lower risk, and those with moderate activity had ~11% lower risk compared to inactive individuals [24].

Regular aerobic exercise induces vasodilation and improves vascular elasticity, reducing peripheral resistance. A systematic review of 93 controlled clinical trials quantified the effects: aerobic endurance training resulted in a mean reduction of ~3.5 mmHg systolic and ~2.5 mmHg diastolic BP. Importantly, hypertensive individuals benefit the most from physical activity [25].

Table 1 - Action plan for HTN control structured across four key pillars

Pillar	Key objective	Key actions
I. Prevention	Reducing HTN incidence through education and environmental and lifestyle changes	- Reduce salt intake (<5 g/day) and increase potassium through food reformulation and culinary education - Promote healthy dietary patterns (DASH, Mediterranean) and weight control- - Limit alcohol, lower smoking rates - Encourage ≥150 min/week of physical activity; build infrastructure for walking/cycling - Health education campaigns in schools - Public policies: front-of-pack labelling, sodium reduction targets and taxation - Continuous training of healthcare professionals - Digital solutions: mHealth & telemedicine
II. Diagnosis	Early detection and systematic monitoring	- Public blood pressure screening campaigns - Establishment of a National Resistant HTN Registry - Observational studies to evaluate Guidelines implementation - Involvement of pharmacists in accurate BP measurement and patient counselling - Public campaigns (printed, audio-video) dedicated for correct blood pressure measurements at home
III. Treatment	Optimising BP control through standardised care and access	- Standardised treatment protocols; early initiation with SPC - Reducing therapeutic inertia - Integration of telemedicine - Health innovation across the care network
IV. Adherence	Sustaining treatment and lifestyle changes long-term	- Identification of the barriers (international and national surveys) - National digital system for medication and appointment reminders - Integration of adherence questionnaires with alerts for non-adherence - Support programmes (e.g., peer mentorship groups) - Empathetic communication training for physicians and pharmacists - Educational materials and guidelines adapted to literacy levels and cultural context

BP, DASH, dietary approaches to stop hypertension; HTN, hypertension; SPC, single-pill combinations

Structured exercise programmes and cardiac rehabilitation models

Physical activity recommendations should be translated into structured, prescribable interventions rather than limited to generic advice. A national prevention strategy should promote individualised exercise prescriptions based on the FITT principle: frequency, intensity, time and type of exercise. For most adults with HTN or elevated blood pressure, structured aerobic exercise such as brisk walking, cycling, swimming, or supervised group exercise should be recommended for at least 150 min/week, complemented by resistance training when clinically appropriate. In high-risk individuals, frail older adults, or patients with established cardiovascular disease, exercise initiation should be preceded by clinical assessment and adapted to functional capacity [26].

Cardiac rehabilitation provides a useful organisational model for HTN prevention and control. Although traditionally used after myocardial infarction, revascularisation, or heart failure hospitalisation, its core components – risk factor education, supervised exercise, dietary counselling, medication adherence support, smoking cessation and psychological support – can be adapted for hypertensive patients at high or very high cardiovascular risk [27]. In Romania, this model could be implemented through hybrid programmes combining hospital-based cardiovascular rehabilitation units, family medicine practices, community centres and digital follow-up. In rural areas, low-cost interventions such as walking groups, nurse-led exercise education and tele-rehabilitation may provide a feasible alternative where access to specialised centres is limited.

Health Education Campaigns and Public Policy Regulations. Lack of awareness leads to failure in lifestyle modification and treatment adherence, contributing to the low control rate [9]. Health education efforts can take many forms: national media campaigns, school-based initiatives, TV and radio broadcasts. All of these are aiming to: (1) increase public knowledge of modifiable risk factors and their link to HTN and (2) change attitudes and behaviours so individuals voluntarily adopt healthier lifestyles and monitor their blood pressure.

Legislation and public policy are powerful tools to influence dietary and behavioural environments. Reducing salt intake at the population level through public policies is a globally recognised priority. In 2013, all WHO member states committed to a 30% reduction in salt consumption by 2025 [28].

Policies and regulations that have proven effective

- Food Reformulation: Imposing maximum salt limits in staple foods. Romania has already adopted some EU-aligned measures such as nutritional labelling that indicates salt content. A further step could be implementing Nutri-Score labelling to highlight products high in salt, sugar, or fat [29].
- Policies in Public Institutions: Governments can regulate food offerings in kindergartens, schools, hospitals and public canteens, restricting or banning unhealthy foods [28].
- Food Taxation and Subsidies: Some countries have implemented taxes on unhealthy foods and/or subsidies for fruits, vegetables

and whole grains. In 2014, Hungary introduced a tax on sugary drinks and highly caloric foods, which reduced their sales and promoted the consumption of water and unsweetened beverages [28].

Educational strategies for prevention of HTN

- **Intensive Training and Accredited Courses:** Countries with strong training programmes for family doctors and all medical specialties involved in the care of hypertensive patients have achieved better BP control rates [10]. Unlike isolated sessions, this could involve structured, certified courses aimed at creating a core group of local HTN prevention experts capable of further knowledge dissemination.
- **Multidisciplinary Roundtables:** Organising meetings between specialists allows alignment with current prevention guidelines. Literature shows that interactive workshops and case discussions improve clinical performance and guideline adherence. Multidisciplinary teams have shown greater effectiveness in managing cardiovascular risk factors compared to fragmented specialist interventions [10,30].
- **Awareness Courses in Local Outpatient Clinics:** Expanding education to outpatient settings in small towns and local hospitals is a second key direction, where training access may be limited. Local awareness sessions can help reduce urban–rural disparities in HTN prevention knowledge.

Use of digital technology

Mobile apps and online platforms can offer risk assessment questionnaires or interactive educational modules accessible at any time. In Romania, developing a national digital platform for cardiovascular health could integrate risk evaluations and personalised advice. Furthermore, digital technology enables data collection and epidemiological monitoring.

Pillar II – diagnosis: strategies for early detection and systematic monitoring of arterial HTN in Romania

Recent data indicate that approximately half of adults with elevated blood pressure levels are unaware of their condition [31]. In order to meet ambitious public health targets, such as achieving HTN control rates above 70% at the population level, a substantial intensification of screening and monitoring efforts are needed.

Public Awareness Campaigns on the Importance of Blood Pressure Measurement. International guidelines advocate for regular blood pressure screening in all adults, due to the proven benefits of early detection [32]. Evidence shows that organised screening identifies a significant number of individuals with elevated blood pressure who would otherwise remain undiagnosed. In a large-scale

global BP screening campaign (May Measurement Month 2017–2019), over 10,000 Australian adults were evaluated, and 52% of those found to have HTN were previously unaware of their condition. Another national initiative ('Australia's Biggest Blood Pressure Check' 2018) conducted over 500,000 free measurements, revealing that 82% of participants with elevated BP values had not been previously diagnosed [33]. Public campaigns aimed at promoting blood pressure screening can improve both public attitudes towards preventive care and actual participation in screening. The global 'May Measurement Month' campaign successfully tested millions of people and identified tens of thousands of new HTN cases worldwide [34].

Frequency and organisation of blood pressure screening

Current European recommendations support opportunistic blood pressure screening in all adults, with measurement at least every 3 years in adults younger than 40 years and at least annually in adults aged 40 years or older [13]. In Romania, these recommendations should be operationalised through family medicine visits, occupational medicine, pharmacies, community screening campaigns and school- or workplace-based health programmes. Screening should not end with a single measurement; elevated values should trigger confirmation by repeated standardised office measurements, home blood pressure monitoring, or ambulatory blood pressure monitoring, followed by structured referral and treatment initiation when appropriate.

Organising free public HTN screenings in community settings is an effective way to reach segments of the population who rarely interact with the healthcare system. The effectiveness of community-based screenings has been demonstrated by numerous international initiatives. 'Pop-up' BP campaigns, often led by NGOs or medical societies, succeed in identifying a significant proportion of participants with elevated blood pressure. For example, in the Australian community project mentioned above (Biggest Blood Pressure Check 2018), of over half a million adults screened for free in pharmacies and public spaces, approximately 15,000 were referred for medical evaluation, many of whom were subsequently confirmed to have HTN [33].

A critical factor in the success of these actions is **multidisciplinary involvement**: physicians from various specialties, nurses, residents, medical students and pharmacists can collaborate in teams to ensure accurate BP measurement and proper counselling. The presence of medical professionals at these screenings lends credibility, and individuals identified with high readings receive on-the-spot explanations about risks, along with formal recommendations for specialist evaluation.

Establishment of a National Resistant Hypertension Registry Integrated with Electronic Health Records (EHRs). To ensure continuity of care, the elaboration of a National Resistant Hypertension Registry, ideally automatically integrated with existing electronic medical record systems, is proposed. Such a registry would serve as a unified, real-time database, containing information

on patients with elevated BP values, diagnoses and on multiple lines of treatments, accessible to both healthcare providers and patients. Studies from integrated healthcare systems have shown that the implementation of a HTN registry significantly improved BP control rates, from below 50% to over 80% within a few years [33].

The integration of a digital alert system within electronic medical records has the potential to improve HTN monitoring and follow-up when designed in a selective and clinically meaningful manner. Given the physiological variability of blood pressure as a parameter, overly frequent alerts based on isolated elevated BP values may generate unnecessary anxiety or contribute to alert fatigue among physicians. Therefore, a more appropriate strategy would be to limit alerts to situations with clear clinical significance, such as severely elevated BP values (e.g., $\geq 180/120$ mmHg), or to cases in which a hypertensive patient fails to attend a scheduled follow-up visit or does not return for prescription renewal. In this way, the system could help reduce therapeutic inertia and gaps in care while avoiding excessive, non-actionable notifications. Pharmacists' Involvement in Accurate BP Diagnosis and Patient Counselling. Training community pharmacists to correctly measure blood pressure and provide counselling to patients can yield substantial benefits, as supported by international studies and programmes. A well-trained pharmacist can identify abnormal BP values in clients purchasing medications or using pharmacy BP services, enabling early referral for medical evaluation. Pharmacists can also support already diagnosed patients in improving treatment adherence and implementing lifestyle changes. Thus, in the UK, the Pharmacy Hypertension Case-Finding Service allows pharmacists to conduct screenings in at-risk individuals and even provide ambulatory BP monitoring for diagnostic confirmation – thus integrating directly into the hypertensive patient care pathway [35]. Recent recommendations emphasise the role of team-based care in HTN management, where pharmacists, alongside nurses and health educators, complement physicians by providing community-based monitoring and support.

Pillar III – treatment: optimising HTN control in Romania through standardisation, access and therapeutic innovation

Arterial HTN is a major cardiovascular risk factor, yet control rates remain poor in contemporary European practice. In the SNAPSHOT study, only 24.5% achieved blood pressure control according to 2018 ESC/ESH targets. Moreover, physicians underestimated cardiovascular risk in 54.3% of patients relative to SCORE1 and in 71.8% relative to SCORE2/SCORE2-OP [3]. These results underline the urgent need for treatment standardisation, faster therapeutic intensification and systematic reduction of therapeutic inertia in Romania.

Standardised Therapeutic Protocol and Combination Therapy. Adopting a standardised therapeutic protocol from the time of diagnosis ensures rapid initiation of optimal treatment. The current European guidelines for the management of elevated blood pressure and HTN (ESC 2024) [13] recommend that most patients begin

antihypertensive therapy with a combination of two drug classes, preferably as a single-pill combination (SPC). Specifically, they advise combining a renin–angiotensin system inhibitor (ACE inhibitor or angiotensin receptor blocker) with a calcium channel blocker or a thiazide or thiazide-like diuretic, in a single fixed-dose combination tablet, especially in patients with marked BP elevation or high cardiovascular risk. Monotherapy is reserved for specific exceptions. The rationale of this strategy is to improve adherence by reducing the number of daily pills, while providing a faster and more effective blood pressure control [13]. Studies have demonstrated better adherence and persistence with SPCs compared to free-equivalent regimens. For instance, a real-world meta-analysis including 11 studies with at least 12 months follow-up showed that patients on SPCs were significantly more likely to achieve $\geq 80\%$ adherence than those taking equivalent separate pills. Moreover, patients on SPCs experienced fewer hospitalisations and emergency visits related to hypertensive complications compared to those on multiple-drug regimens [36].

Reducing therapeutic inertia through clinician training and practice updates

Therapeutic inertia refers to the unjustified hesitation or delay in treatment intensification by healthcare professionals when BP targets are not achieved. Educational programmes specifically targeting physicians have proven effective in countering inertia. Validated interventions include guideline dissemination, continuing medical education based on updated guidelines, workshops and practical case simulations, as well as electronic reminders. Embedding guidelines into EHRs assists clinicians in identifying when medication adjustment is needed.

In parallel, the use of cardiovascular risk calculators has become essential in Europe for tailoring therapeutic decisions. European guidelines recommend stratifying overall risk in hypertensive patients using validated models. Integrating these tools into clinical practice helps identify high- or very-high-risk individuals who require more aggressive therapy, even if their BP alone would suggest a milder approach [37]. Moreover, these calculators can be integrated into digital platforms that signal the patient's risk level and guide physicians towards combined therapy or the addition of other measures when global risk warrants it.

Embedding SCORE2/SCORE2-OP into routine clinical practice

The underestimation of cardiovascular risk observed in Romania suggests that risk calculators should be embedded directly into the clinical workflow. A practical solution would be the automatic integration of SCORE2 and SCORE2-OP into electronic medical records and e-prescription platforms, using routinely available variables such as age, sex, smoking status, blood pressure, lipid profile, diabetes status, renal function and albuminuria when

available [3,4,37]. The system should provide a simple risk category, suggested treatment intensity and follow-up interval. This should be accompanied by audit and feedback reports for family medicine practices, continuing medical education and Romanian-language pocket algorithms aligned with current ESC recommendations.

Telemedicine Digital health interventions can complement traditional strategies by facilitating both patient education and behavioural change monitoring. Home BP telemonitoring combined with remote counselling and proactive therapeutic intervention leads to significant improvements in BP control [38]. A 2023 meta-analysis of 22 randomised clinical trials conducted in low- and middle-income countries assessed the impact of digital interventions in hypertensive patients and found a mean reduction of 4.4 mmHg in systolic BP compared to usual care. Interestingly, SMS-based interventions showed among the greatest effects, with an average systolic BP reduction of ~5.8 mmHg. The likely reason is the simplicity and broad accessibility of text messaging [39].

Digital Solutions for Prescription and Delivery in Isolated Areas. Rural and remote populations often face limited access to healthcare and pharmacies. Electronic prescribing allows physicians to issue prescriptions remotely, which can then be fulfilled at the nearest pharmacy or delivered. Many European countries have already implemented national e-prescription systems, enabling patients in isolated regions to receive treatment without needing to visit a doctor physically. In parallel, telepharmacy has emerged as a model for providing pharmaceutical counselling via phone or internet. In a 2023 randomised clinical trial, hypertensive patients who received regular pharmacist counselling via phone showed significant reductions in BP after 6 months, and the HTN control rate increased from 39% to 66% compared to the control group [40]. Regarding medication delivery, options include courier or postal services and innovative solutions like drone-based delivery to hard-to-reach areas.

Rural implementation barriers in Romania

The higher cardiovascular mortality observed in rural Romania reflects not only a higher risk factor burden but also structural barriers to prevention and chronic disease management. These include shortages of healthcare personnel, lower density of family physicians in several regions, limited access to cardiologists, nephrologists and diabetes specialists, long travel distances, reduced availability of validated home blood pressure devices, lower digital literacy, variable access to pharmacies and financial barriers related to transport, investigations and medication continuity. Recent health-system analyses describe persistent rural access challenges in Romania, including concentration of hospitals and specialist clinics in urban areas and unequal access to family medicine infrastructure [41]. These barriers may lead to delayed diagnosis, inadequate follow-up, therapeutic inertia and premature treatment discontinuation.

To address these gaps, the national plan should include rural implementation mechanisms: mobile blood pressure screening units, nurse- and pharmacist-led community blood pressure hubs, teleconsultation pathways between family physicians and specialists,

reimbursed home blood pressure monitoring for high-risk patients, simplified referral pathways and community health workers trained in blood pressure measurement and patient education. Digital solutions should be designed to complement, not replace, local healthcare capacity.

Rapid-access treatment centres and BP self-monitoring training

To streamline treatment initiation and monitoring, some health systems have implemented **rapid-access antihypertensive treatment centres**, where patients receive medications immediately after diagnosis. Instead of receiving only a prescription, patients can obtain their first doses on-site along with the necessary instructions. This is particularly beneficial for newly diagnosed patients, for whom the first post-diagnosis interaction is critical. These centres can take the form of expanded hospital pharmacies or mobile units serving peripheral communities, providing prompt treatment after detection of HTN.

Simultaneously, training patients to use home BP monitors is a highly valuable complementary intervention. Guidelines recommend that hypertensive patients regularly monitor their BP at home, as home readings correlate better with true cardiovascular risk and help eliminate the 'white coat effect'. For self-monitoring to be effective, patients must be properly instructed in the correct use of BP devices [42]. Studies show that, without standardised education, many patients make measurement errors, potentially leading to inappropriate treatment adjustments [43]. Furthermore, engaging patients in self-monitoring enhances disease awareness and treatment adherence.

Organisation of home blood pressure monitoring in Romania

Home blood pressure monitoring is increasingly recommended, but in Romania its use remains largely opportunistic and dependent on patient access to validated devices and physician instruction. A national programme should standardise home monitoring by recommending validated upper-arm devices, written instructions and a simple measurement schedule, preferably two measurements in the morning and two in the evening for seven consecutive days before clinical visits or therapeutic decisions [42,43]. Results could be recorded either in a paper diary or in a digital platform linked to the national HTN registry. Pharmacies and family medicine practices could verify device accuracy, teach correct measurement technique and identify patients requiring ABPM or treatment intensification. A recent Romanian pilot study also suggests that mobile health technologies can support blood pressure reporting, although larger studies and structured implementation pathways are still needed [44].

Pillar IV – adherence in the national plan for the prevention and control of HTN

Globally, long-term persistence with antihypertensive therapy remains suboptimal, and many patients discontinue or irregularly take treatment within the first year after initiation. In Romania, available data suggest that the adherence problem is heterogeneous and should not be reduced to a single figure. Some primary-care studies have reported relatively high self-reported adherence, while national and real-world data continue to show insufficient blood pressure control among treated patients [5,45,46]. This discrepancy suggests that poor outcomes may result from several overlapping mechanisms: incomplete treatment persistence, insufficient treatment intensification, irregular prescription renewal, economic barriers, side effects, complex regimens, low health literacy, asymptomatic disease perception and reduced access to follow-up care, especially in rural areas. Therefore, the adherence pillar should combine SPCs, refill monitoring, SMS or app-based reminders, pharmacist involvement, household education and systematic follow-up of patients who miss appointments or prescription renewals.

National digital support system for adherence

Implementing a national digital adherence support system involves using technology to send automatic reminders, via SMS or mobile apps, prompting patients to take their medications at scheduled times and attend their medical appointments. The effectiveness of such reminders has been demonstrated in multiple studies. For example, a randomised controlled trial showed that hypertensive patients who received regular SMS reminders had significantly higher medication adherence scores compared to those without reminders [47]. In addition to SMS, HTN-specific smartphone apps offer medication alerts, blood pressure journaling and lifestyle advice. Pilot studies using these apps have reported improved adherence based on prescription refill rates and self-reporting, although their long-term impact on blood pressure levels still requires evaluation. One such example is the TEXTMED study, in which patients receiving daily reminders and periodic app-based counselling experienced better blood pressure control and medication adherence than those in the control group [48,49].

Periodic Digital Adherence Assessments. Routine evaluation of treatment adherence using standardised digital questionnaires can be integrated into patients' EHRs. At preset intervals or during consultations, patients complete scientifically validated adherence questionnaires. This integration enables both longitudinal monitoring of individual adherence and the automatic generation of alerts for healthcare providers when adherence falls below a critical threshold. Current guidelines emphasise that non-adherence must be proactively addressed, starting with acknowledging its scale and routinely assessing it through direct or indirect methods [50,51].

From an objective standpoint, research shows improved HTN control among patients using app-based telemonitoring, especially when these tools are part of a broader telemedicine system with clinical feedback. A representative example is the Hypertension Telemedicine Trial (2014), which found that patients who transmitted their blood pressure readings daily through a digital portal and received remote therapeutic adjustments were significantly more likely to reach target BP levels compared to those receiving standard care [52]. Moreover, data collected through apps can be linked to national HTN registries, allowing physicians to track blood pressure trends between appointments [33,53].

Peer support and patient mentorship programmes

Learning from other patients' experiences represents another valuable strategy for improving adherence. Programmes that connect patients living with the same condition – allowing them to share practical knowledge, offer mutual encouragement and overcome treatment challenges together – have proven effective. These initiatives may take the form of support groups or one-on-one mentoring, where experienced patients with good blood pressure control are paired with newly diagnosed or non-adherent individuals to provide guidance and motivation.

Household and caregiver involvement

Team-based care should also include the household. Dietary sodium reduction, weight control, alcohol reduction and regular medication intake are difficult to sustain when the patient is addressed in isolation. Family members, caregivers and the person responsible for cooking should therefore be included in educational sessions whenever possible. This household-based approach is particularly relevant in rural settings and in older patients, where food preparation, medication purchase, appointment attendance and self-monitoring may depend on family support.

Training Family Doctors and Pharmacists in Empathetic, Patient-Centred Communication. A patient-centred approach means that the doctor or pharmacist actively listens, validates the patient's challenges in following treatment, explains medical concepts in simple terms and builds trust. An ESC statement notes that communication styles and the level of interpersonal trust are crucial, especially in patients with comorbidities, for adherence management. Family doctors should be trained in motivational counselling skills and patient engagement techniques. They are uniquely positioned to understand the patient's family and social context and can therefore personalise messages and solutions [51].

Pharmacists are another underutilised pillar of adherence. They interact frequently with patients during monthly medication dispensing and can provide valuable clarification and guidance. In Canada and the U.S., there has been a strong push in recent

years to expand pharmacists' roles in managing chronic diseases. Hypertension Canada strongly supports increased pharmacist involvement in detection and control of HTN, based on evidence that their active participation is cost-effective and yields significant clinical benefits [50].

Patient Educational Guides Tailored to Health Literacy and Cultural Context. Developing patient conduct guides tailored to varying levels of medical literacy and cultural backgrounds is essential. Adjusting materials to literacy levels means using plain language, avoiding unexplained technical jargon and including illustrations or pictograms whenever possible. Numerous studies have shown that patients with limited health literacy have poorer adherence, often due to a lack of understanding about the rationale or correct administration of treatment. Cultural adaptation involves recognising values, beliefs and customs of the target population. Patient guides can take the form of brochures provided at diagnosis and reinforced at follow-up visits, or structured action plans. Digital interactive versions are also viable. In Canada, expert coalitions issued recommendations as early as the 1990s regarding the simplification of health communication and the need to address sociocultural barriers in HTN adherence. At the European Union level, the concept of 'patient-centred care' is widely promoted, which includes offering patient-friendly educational materials and co-creating the care plan with the individual [51].

Conclusion

The success of such a strategy will depend on its ability to address Romania-specific implementation barriers, including rural workforce shortages, unequal access to specialists and investigations, insufficient use of structured risk assessment, low health literacy, sex-specific cardiovascular risk and the need for household-level lifestyle interventions.

The current epidemiological data, along with projections for the next decade, underscores the need for a structured, sustainable and multisectoral intervention. The proposed integrated model, built around four essential pillars, provides a coherent national action framework that aligns with international recommendations, while being adapted to the realities of the Romanian healthcare

system. The outlined interventions are supported by robust scientific evidence and target both the individual and population levels. Achieving blood pressure control goals will require firm commitment from national authorities, as proved by the recently adopted National Strategy for Management of Cardiovascular and Cerebrovascular Diseases [54], as well as healthcare professionals, civil society and the private sector. Only through coordinated efforts can we reduce the cardiovascular burden and improve the active life expectancy of the Romanian population.

Conflicts of Interest

The authors have each completed the International Committee of Medical Journal Editors Form for uniform Disclosure of Potential Conflicts of Interest. No authors have any potential conflict of interest to disclose.

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