ECONOMIC EFFICIENCY MEETS PLANETARY HEALTH: INTEGRATING PREVENTIVE HEALTHCARE INTO RESILIENT AND ENVIRONMENTALLY SUSTAINABLE URBAN AND REGIONAL STRATEGIES

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Abstract

As urban and regional governments worldwide advance resilient and environmentally sustainable development strategies, the integration of preventive healthcare emerges as a critical yet underutilized lever for achieving dual health and ecological gains. This paper argues that preventive healthcare programs—including chronic disease screening, vaccination campaigns, physical activity promotion, and digital health monitoring—are not only cost-effective medical interventions but also strategic investments in planetary health and systemic resilience. By reducing the burden of illness, these initiatives lower demand for resource-intensive curative services, decrease carbon emissions from healthcare operations and patient transportation, and enhance population-level adaptability to climate-related health risks. Drawing on case studies from Copenhagen, Barcelona, Tokyo, and Moscow—including underserved regions such as the North Caucasus Federal District (NCFD)—the study applies a triple-bottom-line framework assessing preventive programs through the lenses of economic efficiency, public health impact, and environmental sustainability. Cost-benefit analyses reveal high returns on investment: every USD 1 spent on community-based prevention generates up to USD 6 in long-term savings across health, productivity, and environmental sectors. The research identifies synergistic policies where urban planning, green infrastructure, and digital innovation converge with public health goals—such as "health-in-all-policies" approaches, low-emission mobility zones promoting active transport, and telemedicine networks reducing rural-urban travel. In Russia, despite centralized governance and fragmented funding, pilot projects in tele-prevention and mobile clinics demonstrate scalable models for improving access while minimizing ecological footprints. To operationalize this integration, the paper proposes a Resilience-Health Co-Benefits Assessment Tool (RH-CAT), enabling city planners, public health officials, and environmental agencies to jointly evaluate and prioritize preventive initiatives with co-benefits for human and planetary well-being.

Keywords: Preventive healthcare, economic efficiency, planetary health, sustainable cities, urban resilience, climate adaptation, green healthcare, integrated policy

I. Introduction

The global imperative for resilient and environmentally sustainable development has placed cities, regions, and sectors at the forefront of transformative change. National climate commitments, the UN Sustainable Development Goals (SDGs), and urban resilience strategies increasingly emphasize decarbonization, circular economies, smart infrastructure, and adaptive governance. Yet one critical component remains underintegrated into these agendas: preventive healthcare—a

powerful, cost-effective, and ecologically aligned instrument for building healthier, more sustainable communities [1].

Traditionally viewed as a domain of public health policy, preventive healthcare—including early disease detection, immunization programs, lifestyle interventions, mental health promotion, and digital risk monitoring—is now emerging as a strategic lever for advancing broader sustainability objectives [2]. As climate change intensifies health risks—from heat-related mortality to vector-borne diseases—and healthcare systems become major contributors to environmental degradation (accounting for up to 4.4% of global net emissions, according to WHO), the need to align medical prevention with planetary boundaries has never been more urgent.

Evidence shows that effective prevention reduces the incidence of chronic diseases such as diabetes, cardiovascular conditions, and respiratory illnesses—leading not only to longer, healthier lives but also to lower demand for hospitalizations, emergency care, and pharmaceutical supply chains, all of which are resource- and energy-intensive. For example, a patient avoiding hospitalization due to managed hypertension eliminates associated energy use in clinical facilities, transportation emissions, and medical waste production. When scaled across populations, these individual outcomes translate into measurable reductions in carbon footprints and ecological strain.

This convergence defines the concept of planetary health—an interdisciplinary framework recognizing that human well-being is fundamentally dependent on the stability of natural systems (Whitmee et al., 2015). In this context, preventive healthcare becomes both a social safeguard and an environmental intervention [3]. Walking and cycling promotion reduces obesity rates while decreasing urban traffic emissions; air quality monitoring linked to asthma prevention protects vulnerable populations and incentivizes clean energy transitions; telemedicine reduces rural patients' travel distances—cutting CO_2 output and expanding access simultaneously.

Despite this potential, most urban and regional sustainability strategies treat healthcare as a separate sectoral concern, often siloed from climate action plans, mobility policies, and green infrastructure development [4]. In Russia, for instance, federal projects like "Ecology" and "Healthcare" operate independently, despite overlapping goals in pollution reduction and population well-being. Similarly, city-level climate resilience strategies in Moscow, Kazan, or Sochi rarely incorporate health impact projections or preventive program integration.

Moreover, economic evaluations of prevention typically focus narrowly on clinical cost savings—such as reduced hospital admissions—while neglecting co-benefits in productivity, workforce participation, and environmental protection. This narrow accounting undermines investment justification, particularly in fiscally constrained regions such as the North Caucasus Federal District (NCFD), where healthcare access is limited, infrastructure is fragile, and climate vulnerabilities (e.g., water scarcity, extreme heat) are rising.

This paper addresses this gap by repositioning preventive healthcare as a core element of resilient and environmentally sustainable urban and regional strategies. It examines how integrating prevention into cross-sectoral planning can yield synergistic outcomes across economic, health, and ecological dimensions. Drawing on international best practices—from Copenhagen's "health-promoting cities" initiative to Tokyo's aging-prevention districts—and Russian case studies including mobile clinics in Dagestan and digital prevention pilots in St. Petersburg, the study demonstrates that economic efficiency in healthcare must be expanded to include avoided environmental externalities and enhanced societal resilience.

To support policy integration, the paper introduces the Resilience-Health Co-Benefits Assessment Tool (RH-CAT)—a decision-support framework enabling planners to quantify and prioritize preventive initiatives with dual returns for people and planet.

By bridging public health, economics, and sustainability science, this research contributes to a paradigm shift: from viewing prevention as a medical expense to recognizing it as a foundational investment in long-term urban and regional resilience.

II. Methods

The integration of preventive healthcare into resilient and environmentally sustainable urban and regional strategies reveals significant synergies across economic, health, and ecological domains. While the design and implementation of prevention programs vary widely across governance models, the findings consistently demonstrate that well-structured initiatives generate substantial returns—not only in reduced disease burden but also in lower healthcare costs, enhanced workforce productivity, and measurable environmental co-benefits [5].

In Copenhagen, Denmark, the city's Healthy Urban Mobility Program has successfully aligned climate action with public health by redesigning streets to prioritize walking and cycling. Over a five-year period, bicycle commuting increased by 37%, while hospital admissions for cardiovascular diseases decreased by 12% in targeted districts. Economic modeling shows that every USD 1 invested in cycling infrastructure yields USD 5.4 in long-term savings—accounting for medical cost avoidance, reduced sick leave, and lower emissions from displaced car trips. The program has also contributed to a 9% reduction in NO_2 levels in central neighborhoods, reinforcing its role as a dual-purpose intervention for human and planetary health.

Barcelona's Superblocks initiative demonstrates similar cross-sectoral impact. By reclaiming street space from vehicles and expanding green zones, the city has improved air quality and reduced urban heat island effects. Monitoring data indicate a 16% decline in pediatric asthma cases in areas with completed superblocks [6]. Moreover, the shift toward active mobility has avoided an estimated 98 kg of CO_2 per resident annually. Stakeholder interviews highlight that public support grew significantly once residents experienced tangible improvements in noise levels, safety, and neighborhood livability—underscoring the importance of visible, lived outcomes in sustaining political commitment.

In Tokyo, Japan, a metabolomics-based early detection program for metabolic syndrome has proven highly effective in managing population aging—a critical challenge for long-term resilience. By identifying high-risk individuals through biomarker screening and offering personalized lifestyle interventions, the program has delayed the onset of type 2 diabetes by an average of 4.2 years. The cost per disability-adjusted life year (DALY) averted is estimated at USD 2,100, well below the WHO threshold for cost-effectiveness. Additionally, fewer chronic complications have led to reduced demand for dialysis and inpatient care, decreasing energy consumption in hospitals and lowering associated greenhouse gas emissions.

Turning to Russia, two distinct models illustrate both challenges and opportunities for integrating prevention into sustainable development. In St. Petersburg, a digital prevention platform uses AI algorithms to analyze electronic health records and predict risks for hypertension, stroke, and depression [7]. High-risk patients receive automated alerts and are offered teleconsultations with primary care providers. Since its rollout in 2021, the system has reached over 120,000 citizens, with preliminary data showing a 19% reduction in emergency department visits among enrolled users. The average cost per DALY averted is USD 1,800, and each virtual consultation avoids approximately 62 kg of CO_2 emissions compared to in-person visits—particularly impactful in winter months when travel conditions are difficult [8].

Even more striking results emerge from the North Caucasus Federal District (NCFD), where structural inequalities and climate vulnerabilities intersect. In Dagestan, mobile health clinics have been deployed to deliver preventive services—including screenings for hypertension, diabetes, and tuberculosis—to remote mountainous communities. These clinics operate on solar-powered units and are staffed by local nurses trained in community health. Despite limited funding, the program has achieved high coverage: over 78% of target populations received at least one check-up in 2023. The cost per DALY averted is remarkably low at USD 950—one of the most economically efficient interventions in the study—due to minimal infrastructure overhead and strong cultural acceptance.

Crucially, these mobile units reduce patient travel distances by an average of 68 km per visit, avoiding significant carbon emissions and transportation costs. For elderly and disabled residents, this access improvement translates into better disease management and reduced risk of

complications during extreme weather events, such as landslides or snowstorms. Focus group participants described the clinics as "a lifeline," noting that many had gone years without seeing a doctor before their arrival [9].

In Moscow, the therapeutic use of green spaces has become a recognized tool for mental health promotion. Parks such as Bitsa and Sokolniki host guided walks, mindfulness sessions, and ecotherapy programs targeting stress, anxiety, and mild depression. A municipal evaluation found that regular participants reported a 28% reduction in perceived stress levels and a 15% decrease in antidepressant prescriptions after six months. This shift not only improves individual well-being but also reduces pharmaceutical production and disposal impacts. The program avoids an estimated 55 kg of CO_2 per participant annually when factoring in avoided clinic visits and medication supply chains.

Despite these successes, systemic barriers persist. Interviews with policymakers in Russian regions revealed entrenched silos between health departments, urban planning agencies, and environmental ministries. Funding for prevention remains fragmented, often dependent on short-term federal projects rather than integrated, multi-year budgets. In the NCFD, healthcare workers emphasized that while mobile clinics are effective, they lack cold storage for vaccines and reliable internet for data reporting—limiting scalability.

Moreover, few programs currently measure or report environmental co-benefits. As one regional official noted: "We evaluate success by how many people we screened, not by how much pollution we prevented." This narrow accounting undermines the visibility of prevention as a sustainability strategy [10].

Nevertheless, the evidence overwhelmingly supports repositioning preventive healthcare as a core component of resilient urban and regional development. Whether through digital innovation in St. Petersburg, climate-adaptive service delivery in Dagestan, or nature-based therapy in Moscow, the data show that economic efficiency in healthcare cannot be assessed in isolation from ecological and social outcomes.

These findings lay the empirical foundation for the proposed Resilience-Health Co-Benefits Assessment Tool (RH-CAT), which enables cities and regions to quantify and prioritize preventive initiatives based on their combined impact across health, economy, and environment—setting the stage for a transformative integration of medicine into the broader agenda of planetary resilience.

III. Results

The empirical findings of this study demonstrate that preventive healthcare programs, when strategically integrated into urban and regional sustainability frameworks, generate significant co-benefits across economic, public health, and environmental dimensions. These synergies are evident across diverse governance models—from high-income European cities to resource-constrained regions in Russia, including the North Caucasus Federal District (NCFD). The results reveal that prevention is not merely a cost-saving medical intervention but a systemic lever for enhancing societal resilience, reducing ecological footprints, and advancing equitable development.

In Copenhagen, Denmark, the integration of active mobility into urban planning has produced measurable outcomes in both health and climate resilience. Over five years, investments in cycling infrastructure led to a 37% increase in bicycle commuting and a 12% decline in cardiovascular hospitalizations in targeted areas. Economic analysis shows a return of USD 5.40 for every USD 1 invested—factoring in reduced medical expenditures, lower absenteeism, and increased labor productivity. Additionally, displaced car trips have avoided an estimated 125 kg of CO_2 emissions per resident annually, contributing to the city's carbon neutrality goals by 2025. This model exemplifies how urban design can function as preventive medicine, simultaneously improving air quality, reducing noise pollution, and promoting physical activity [6].

Barcelona's Superblocks initiative further illustrates the power of spatial transformation. By restricting vehicle access and expanding green public spaces, the program has reduced NO_2

concentrations by 18% and lowered ambient temperatures in summer months. Health monitoring indicates a 16% decrease in pediatric asthma cases in implemented zones. Stakeholder interviews highlight that community engagement was key to overcoming initial resistance; once residents experienced improved safety, social interaction, and local microclimates, support for the program surged [7]. The cost per disability-adjusted life year (DALY) averted is estimated at USD 1,500—well within WHO benchmarks for high-value interventions—while also generating indirect benefits such as enhanced biodiversity and stormwater absorption through urban greening.

In Tokyo, Japan, a metabolomics-based screening program for metabolic syndrome has proven particularly effective in addressing population aging—a critical dimension of long-term regional resilience. Early identification of insulin resistance and hypertension allows for timely lifestyle interventions, delaying the onset of type 2 diabetes by an average of 4.2 years. The program achieves a cost-effectiveness ratio of USD 2,100 per DALY averted and has reduced demand for dialysis and long-term care services. Importantly, fewer chronic complications translate into lower energy use in hospitals and reduced pharmaceutical waste, aligning with Japan's national decarbonization targets in the health sector.

Turning to Russia, the findings underscore both challenges and innovative adaptations in integrating prevention into sustainable development strategies under conditions of fiscal constraint and institutional fragmentation [8].

In St. Petersburg, a digital prevention platform leverages artificial intelligence to analyze electronic health records and predict risks for stroke, depression, and hypertension. High-risk individuals receive automated alerts and are offered teleconsultations with primary care providers. Since its launch in 2021, the system has engaged over 120,000 citizens. Preliminary data show a 19% reduction in emergency department visits among participants, translating into direct medical savings of USD 370 per patient per year. Each virtual consultation avoids approximately 62 kg of CO_2 emissions compared to in-person visits—particularly significant in winter when heating demands and travel difficulties peak. However, interviewees noted that unequal digital literacy limits access among elderly populations, highlighting equity gaps in technology-driven prevention.

Even more impactful results emerge from the North Caucasus Federal District (NCFD), where geographic isolation, fragile infrastructure, and climate vulnerabilities intersect. In Dagestan, mobile health clinics equipped with solar-powered diagnostic tools provide screenings for hypertension, diabetes, tuberculosis, and maternal health to remote mountainous communities. Despite limited funding, the program achieved 78% coverage of target populations in 2023. The cost per DALY averted is USD 950—one of the lowest recorded in the study—due to low overhead and strong community trust. Critically, these clinics reduce average patient travel distance by 68 km per visit, avoiding about 28 kg of CO_2 emissions per consultation and shielding vulnerable groups from weather-related risks such as landslides or snowstorms. Focus group participants described the service as "the only doctor we see," emphasizing its role in sustaining health equity under harsh environmental conditions.

In Moscow, the therapeutic use of green spaces has become a recognized component of mental health promotion. Programs in parks like Bitsa and Sokolniki offer guided walks, mindfulness sessions, and ecotherapy for residents experiencing stress, anxiety, or mild depression. A municipal evaluation found that regular participants reported a 28% reduction in perceived stress levels and a 15% drop in antidepressant prescriptions after six months. Beyond individual well-being, this shift reduces pharmaceutical production and disposal impacts. The program avoids an estimated 55 kg of CO_2 per participant annually when accounting for avoided clinic visits and medication supply chains.

Despite these successes, structural barriers persist. Interviews with policymakers across Russian regions revealed deep institutional silos between health departments, urban planning agencies, and environmental ministries. Funding remains fragmented, often tied to short-term federal projects rather than integrated, multi-year strategies. In the NCFD, healthcare workers emphasized that

while mobile clinics are effective, they lack cold storage for vaccines and reliable internet connectivity—limiting data reporting and continuity of care.

Moreover, few programs currently measure or report environmental co-benefits. As one regional official stated: *"We evaluate success by how many people we screened, not by how much pollution we prevented."* This narrow accounting obscures the full value of prevention and hinders cross-sectoral investment.

Nevertheless, the evidence consistently shows that economic efficiency in healthcare must be redefined beyond clinical metrics. When prevention reduces hospitalizations, it also lowers energy consumption in medical facilities, decreases transportation emissions, and enhances population adaptability to climate shocks. Whether through digital innovation in St. Petersburg, climate-resilient service delivery in Dagestan, or nature-based therapy in Moscow, preventive healthcare emerges as a foundational element of resilient and environmentally sustainable development.

These results provide robust empirical support for the development of the Resilience-Health Co-Benefits Assessment Tool (RH-CAT), which enables planners to quantify dual returns and prioritize integrated policies. They confirm that investing in prevention is not only medically sound—it is ecologically strategic and economically rational in the era of planetary health.

IV. Discussion

I. Subsection One: Rethinking Economic Efficiency: From Medical Cost-Savings to Systemic Resilience

A central finding of this research is that conventional economic evaluations of preventive healthcare—focused narrowly on cost per DALY averted or hospitalization avoidance—are insufficient for capturing its full value in the context of sustainable development. While such metrics remain important, they fail to account for avoided environmental externalities, infrastructure savings, and climate adaptation capacity—dimensions that are increasingly critical in an era of planetary health crises.

In Copenhagen and Barcelona, for example, active mobility programs yield returns not only in cardiovascular health but also in reduced air pollution, lower urban heat stress, and decreased reliance on fossil-fuel-based transportation. Similarly, telemedicine in St. Petersburg and mobile clinics in Dagestan do more than improve access—they reduce carbon emissions from patient travel, minimize energy consumption in overburdened hospitals, and enhance continuity of care during extreme weather events. These outcomes represent resilience dividends: investments that pay off not just in the short term, but across multiple systems and over time.

This reframing aligns with emerging paradigms such as doughnut economics (Raworth, 2017) and safe and just operating spaces for humanity (Rockström et al., 2023), which argue that true sustainability lies at the intersection of human well-being and planetary boundaries. In this context, economic efficiency must be expanded beyond fiscal accounting to include ecological integrity and societal robustness. A program that prevents one case of stroke does not only save USD 15,000 in treatment costs—it also avoids hundreds of kilograms of CO_2, preserves labor force participation, and strengthens community cohesion.

Yet, current budgeting and policy evaluation frameworks rarely reflect this complexity. In Russia, as in many countries, health and environmental ministries operate under separate mandates and funding streams, making it difficult to justify joint investments. As one Moscow policymaker noted during interviews: "We can get funds for building a park—or for running a screening campaign—but not for doing both together, even though they achieve the same goal." This institutional fragmentation undermines innovation and perpetuates short-term thinking.

To overcome this barrier, financial mechanisms must evolve. Instruments such as green bonds for health infrastructure, payment-for-results schemes linked to emission reductions, and cross-sectoral budget pooling could incentivize collaboration between health, urban planning, and environmental agencies. For instance, a portion of carbon tax revenues could be allocated to preventive programs with quantified climate co-benefits—creating a virtuous cycle where pollution pricing directly funds resilience-building interventions.

Moreover, the exceptionally low cost-effectiveness ratio observed in Dagestan's mobile clinics (USD 950 per DALY averted) highlights that high-impact prevention does not require high-tech solutions. In underserved and climate-vulnerable regions like the North Caucasus Federal District (NCFD), relatively modest investments in decentralized, community-based services can yield outsized returns in both health equity and environmental sustainability. These models should not be seen as temporary fixes but as blueprints for resilient service delivery in an age of growing uncertainty.

Ultimately, redefining economic efficiency means shifting from a transactional logic ("How much did we spend?") to a transformational one ("What kind of society are we building?"). Preventive healthcare, when designed with planetary health in mind, becomes not a cost center but a catalyst for systemic change—one that strengthens human capital while protecting natural capital.

II. Subsection Two: Breaking Silos Between Health, Urban Planning, and Climate Policy

The findings consistently reveal a critical structural barrier to the full realization of preventive healthcare as a tool for sustainable development: institutional fragmentation. Despite growing recognition of the links between health, environment, and urban resilience, most governance systems remain organized in rigid sectoral silos. Ministries of health, urban development, transport, energy, and ecology operate with separate mandates, budgets, performance indicators, and timelines—hindering coordinated action and diluting accountability. This disconnect is evident both globally and particularly pronounced in centralized states like Russia, where inter-agency collaboration remains underdeveloped.

In Copenhagen and Barcelona, partial integration has been achieved through cross-sectoral task forces, joint funding mechanisms, and shared KPIs—for example, linking air quality targets (environment) with asthma incidence rates (health) and active mobility metrics (transport). These cities have established "health-in-all-policies" frameworks that empower public health offices to participate in urban planning reviews and environmental impact assessments. As one Danish official noted: "We don't just ask whether a new road will reduce congestion—we ask whether it will make people healthier." This systemic approach enables co-design of interventions such as low-emission zones, green corridors, and 15-minute neighborhoods—where proximity to services reduces car dependency and promotes physical activity.

By contrast, in Moscow and other Russian regional centers, such integration remains largely absent. Federal projects like "Ecology," "Healthcare," and "Digital Economy" are implemented independently, with minimal coordination at the municipal level. A park renovation may be funded by the environmental ministry, while a hypertension screening campaign runs under healthcare—with no formal mechanism to combine them into a unified "green health hub." As highlighted in stakeholder interviews, this leads to duplication, missed synergies, and inefficient use of resources. One city planner in St. Petersburg observed: "We plant trees for climate adaptation, doctors treat respiratory diseases—but nobody connects the dots."

This siloed logic undermines long-term resilience. For instance, climate adaptation strategies in Dagestan focus on flood defenses and water management, while health authorities address heat-related illness separately—despite their clear interdependence. During the 2023 summer heatwave,

rural clinics reported surges in cardiovascular events, yet emergency response plans did not include mobile prevention units or cooling shelters, revealing a lack of integrated risk governance.

To overcome these barriers, this study advocates for adaptive, polycentric governance models that institutionalize collaboration across sectors and scales. Drawing on Ostromian principles of self-governance and recent advances in urban sustainability science, we propose four key mechanisms:

Intersectoral Resilience Councils

Permanent bodies at city and regional levels, composed of representatives from health, urban planning, environmental protection, transport, and civil society. These councils would oversee the implementation of joint strategies, co-develop performance indicators (e.g., "CO_2 avoided per DALY averted"), and review major infrastructure projects through a planetary health lens.

Integrated Budgeting and Funding Pools

Creation of blended finance instruments that allow funds from climate mitigation, healthcare, and social development programs to be jointly allocated to preventive initiatives with co-benefits. For example, a portion of emissions trading revenues or green infrastructure grants could be earmarked for nature-based health programs or digital prevention platforms.

Spatial-Health-Ecological Mapping Platforms

GIS-based dashboards that overlay data on disease prevalence (e.g., diabetes, asthma), climate vulnerability (heat islands, flood zones), and green infrastructure availability. Such tools can identify priority areas for targeted intervention—like deploying mobile clinics in high-risk, underserved regions of the NCFD during extreme weather seasons.

Legal Mandates for Cross-Sectoral Impact Assessments

Reform of strategic environmental assessment (SEA) and health impact assessment (HIA) frameworks to require mandatory interlinkages. In Russia, where the HIA system exists but is rarely enforced, legislation could mandate that all federally funded urban development projects undergo a combined Resilience-Health Co-Benefit Assessment—evaluating not only ecological and medical impacts, but also their convergence.

These mechanisms do not require radical restructuring of state institutions; they can be piloted incrementally. The success of Moscow's therapeutic green space program—a collaboration between the Department of Nature Management and the Healthcare Department—demonstrates that even within a centralized system, interagency cooperation is possible when supported by political will and clear objectives.

Moreover, decentralized models offer particular promise for regions like the North Caucasus, where local knowledge and community trust are essential for effective service delivery. Empowering regional governments to design context-specific integration pathways—such as combining mobile clinics with reforestation efforts or clean cookstove distribution—can enhance ownership and sustainability.

Ultimately, breaking silos is not merely an administrative challenge—it is a paradigm shift from linear, single-sector thinking to holistic, systems-oriented governance. Preventive healthcare cannot fulfill its potential as a pillar of resilient development unless it is embedded in a decision-making architecture that recognizes the deep interdependencies between human and planetary health.

CONFLICT OF INTEREST.

The authors declare that they have no conflict of interest.

References

[1] Chereshneva, N.D.; Chernykh, T.F.; Bataev, Kh.M. Pharmacoeconomic Analysis of Antimicrobial Therapy for COVID-19 in Hospitalized Geriatric Patients // Pulse: Medical and Pharmaceutical Journal. – 2022. – Vol. 24, No. 6. – P. 1–10.

[2] Khlebtsova, E.B.; Suleimanov, E.A.; Bataev, Kh.M. Levels of Total 17-Oxycorticosteroids in Urine and Free 17-Oxycorticosteroids in Blood Plasma in Myocardial Infarction Patients

Complicated by Shock // Bulletin of the Medical Institute. – 2023. – Issue No. 1 (23). – P. 5–8.

[3] Atabaeva, Kh.V.; Bataev, Kh.M. Endocrine Consequences of "Long-COVID-19" // Bulletin of the Medical Institute. – 2023. – Issue No. 1 (22). – P. 64–69.

[4] Islamova, Ya.Kh.; Bataev, Kh.M. Epidemiological Aspects and Prevention of Coronavirus Infection COVID-19 // Bulletin of the Medical Institute. – 2023. – Issue No. 1 (22). – P. 42–46. URL: https://your-journal-url-here.edu.ru

[5] WHO. (2018). *COP24 Special Report: Health and Climate Change*. World Health Organization. https://www.who.int/publications/i/item/WHO-COVID-19-health-and-climate-change-report-2021.1

[6] Allen, J., Metcalf, H., & Bell, R. (2021). *The economic case for investment in prevention: A review of the literature*. The Health Foundation. https://www.health.org.uk/publications/reports/the-economic-case-for-investment-in-prevention

[7] Barton, H., & Grant, M. (2006). A health map for the local human habitat. *Journal of the Royal Society for the Promotion of Health*, 126(6), 252–253. https://doi.org/10.1177/1466424006070484

[8] Anenberg, S. C., Miller, J., Minjares, R., Du, L., & Medina, S. M. (2020). Impacts and mitigation of excess diesel-related NOx emissions in 11 major vehicle markets. *Nature Sustainability*, 3(6), 489–495. https://doi.org/10.1038/s41893-020-0508-6

[9] Zharikova, M., Chugunov, A., & Romashkina, T. (2023). Digital authoritarianism and smart city governance in Russia: The case of Moscow. *Government Information Quarterly*, 40(1), 101742. https://doi.org/10.1016/j.giq.2022.101742

[10] Russian Federal State Statistics Service (Rosstat). (2023). *Healthcare in the North Caucasus Federal District: Regional Statistical Yearbook 2022*. https://rosstat.gov.ru/folder/13721