DIGITAL ECONOMY AND TELEMEDICINE: ASSESSING ECONOMIC IMPACT AND IMPLEMENTATION BARRIERS WITHIN RESILIENT AND ENVIRONMENTALLY SUSTAINABLE URBAN AND REGIONAL STRATEGIES

Shkodinsky Sergey[1] , Kandybko Natalia[2] , Sobol Tatiana[3]

[1]Bauman Moscow State Technical University (BMSTU)
[2]Academy of Military Sciences, Moscow, Russia
[3]Moscow Polytechnic University, Moscow, Russia

sh-serg@bk.ru

Abstract

The integration of telemedicine into the digital economy is increasingly recognized as a strategic lever for building resilient and environmentally sustainable urban and regional health systems. This paper examines the economic impact and implementation barriers of telemedicine within the framework of sustainable development, emphasizing its dual role in enhancing healthcare accessibility and reducing ecological footprints. Drawing on case studies from Moscow, St. Petersburg, the North Caucasus Federal District (NCFD), Estonia, Denmark, and Singapore, the study applies a mixed-methods approach combining cost-benefit analysis, policy review, stakeholder interviews, and carbon footprint modeling. Findings reveal that telemedicine generates significant economic returns: every USD 1 invested yields between USD 2.80 and USD 4.30 in savings from avoided hospitalizations, reduced transportation costs, and improved workforce productivity. In Russia, digital consultations have expanded access to specialists in remote regions such as Dagestan and Ingushetia, decreasing average patient travel by up to 70 km per visit—translating into an estimated reduction of 60–85 kg of CO_2 per consultation. These outcomes align with planetary health goals, demonstrating that digital health can contribute to climate-resilient infrastructure and low-carbon service delivery. However, critical barriers impede scalability. Key challenges include uneven digital literacy, weak broadband coverage in rural areas, fragmented regulatory frameworks, data privacy concerns, and institutional resistance. In the NCFD, cultural mistrust of remote diagnostics and lack of multilingual platforms further limit adoption. Moreover, despite federal support through the "Digital Economy" and "Healthcare" national projects, inter-sectoral coordination between IT, health, and environmental agencies remains underdeveloped. To address these gaps, the paper proposes a Sustainable Telemedicine Integration Framework (STIF), which embeds telemedicine into urban and regional resilience strategies through four pillars: equitable access, green infrastructure alignment, regulatory harmonization, and community-centered design.

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

I. Introduction

The global transition toward a digital economy is reshaping public services, with healthcare emerging as one of the most transformative domains. Telemedicine—defined as the delivery of clinical care and health-related services through digital communication technologies—has evolved

from an emergency contingency measure into a strategic component of national and regional development agendas. Accelerated by the pandemic, advances in connectivity, artificial intelligence, and data analytics, telemedicine now stands at the intersection of digital innovation, economic efficiency, and environmental sustainability.

In urban and regional planning, resilience is no longer measured solely by infrastructure robustness or disaster preparedness—it increasingly includes the capacity of social systems to adapt under stress. Health systems, in particular, are being re-evaluated not only for their medical outcomes but also for their carbon intensity, resource efficiency, and equitable reach. In this context, telemedicine offers a unique convergence of benefits: it reduces patient travel, lowers energy consumption in overburdened clinics, minimizes medical waste, and enhances access to care—especially in remote and climate-vulnerable regions.

These co-benefits position telemedicine as a key enabler of resilient and environmentally sustainable strategies at country, regional, and city levels. The European Union's Digital Decade 2030 initiative explicitly links digital health to green transformation, while the World Health Organization (WHO) promotes telemedicine as part of its "climate-resilient health systems" framework. Similarly, the United Nations' Sustainable Development Goals (SDGs)—particularly SDG 3 (Good Health and Well-Being), SDG 9 (Industry, Innovation and Infrastructure), and SDG 11 (Sustainable Cities and Communities)—underscore the role of digital solutions in building inclusive, low-carbon societies.

Yet, despite its promise, the integration of telemedicine into broader sustainability strategies remains fragmented. Economic evaluations often focus narrowly on cost savings per consultation, neglecting systemic impacts such as avoided emissions, reduced absenteeism, and long-term adaptation capacity. Moreover, implementation faces persistent barriers: technological disparities, regulatory misalignment, data privacy concerns, and socio-cultural resistance—challenges that are particularly acute in geographically diverse and institutionally complex countries like Russia.

Nowhere is this more evident than in the North Caucasus Federal District (NCFD), where mountainous terrain, underdeveloped broadband networks, and low digital literacy hinder the rollout of even basic teleconsultations. At the same time, these regions face growing climate risks—from landslides to extreme heat—that strain already fragile healthcare systems. Paradoxically, they stand to benefit the most from decentralized, low-footprint models of care. Pilot projects in Dagestan and Kabardino-Balkaria have shown that mobile telemedicine units combined with satellite connectivity can reduce diagnostic delays by up to 60%, yet scaling remains constrained by funding gaps and inter-agency silos.

In central Russia, cities like Moscow and St. Petersburg have made significant progress through large-scale platforms such as Moscow's "Electronic Register" and the federal Gosuslugi health portal. These systems handle millions of virtual visits annually, demonstrating high user satisfaction and measurable reductions in clinic congestion. However, integration with environmental planning—such as estimating CO_2 savings or aligning with urban decarbonization targets—remains absent from official reporting.

This disconnect highlights a critical research gap: how can telemedicine be systematically embedded within resilient and environmentally sustainable urban and regional strategies—not just as a digital service, but as a cross-sectoral investment in human and planetary health?

To address this question, the study analyzes the economic impact and implementation barriers of telemedicine across diverse contexts, including high-capacity cities and underserved peripheries. It evaluates both financial returns and ecological co-benefits, using real-world data to quantify emission reductions and system efficiencies. Furthermore, it introduces the Sustainable Telemedicine Integration Framework (STIF)—a policy tool designed to align digital health with climate action, equity goals, and long-term resilience planning.

By bridging the domains of digital economy, public health, and environmental governance, this research contributes to a paradigm shift: from viewing telemedicine as a technical add-on to recognizing it as a foundational pillar of sustainable development in the 21st century.

II. Methods

This study employs a transdisciplinary, mixed-methods research design to examine the economic impact and implementation barriers of telemedicine within the framework of resilient and environmentally sustainable urban and regional development strategies. The methodology integrates quantitative, qualitative, and policy-analytical approaches, with deliberate inclusion of diverse Russian contexts—ranging from high-capacity metropolitan centers like Moscow and St. Petersburg to underserved, climate-vulnerable regions in the North Caucasus Federal District (NCFD). This multi-scalar analysis ensures that findings are both globally relevant and contextually grounded.

A systematic literature and policy review was conducted following PRISMA guidelines across major academic databases: Scopus, Web of Science, PubMed, IEEE Xplore, and eLIBRARY.ru for Russian-language sources. Search terms combined key concepts such as "telemedicine," "digital economy," "economic impact," "implementation barriers," "sustainable cities," and "climate resilience." After screening 437 records for relevance, duplication, and methodological quality, 96 peer-reviewed articles and 28 official policy documents were selected for thematic synthesis. These included national strategies such as Russia's National Projects "Digital Economy" and "Healthcare," EU Digital Decade 2030 targets, WHO guidelines on digital health and climate-resilient health systems, and OECD frameworks for measuring digital transformation in public services. Particular attention was paid to indicators linking telemedicine to broader sustainability outcomes, including carbon footprint reduction, energy efficiency, and social equity.

To capture real-world dynamics, six comparative case studies were analyzed using a qualitative case-based approach. Cases were purposively selected to represent a spectrum of governance models, technological readiness, and socioeconomic conditions. In Russia, the focus included Moscow's centralized telehealth platform—handling millions of virtual visits annually—and St. Petersburg's integrated regional network connecting primary care clinics with specialist hubs. A critical component of the analysis centered on pilot telemedicine initiatives in Dagestan and Ingushetia, where mobile units equipped with satellite internet provide remote consultations in mountainous, low-connectivity areas. These cases were contrasted with international benchmarks: Estonia's fully interoperable e-health system, Copenhagen's green digital health strategy aligned with carbon neutrality goals, and Singapore's AI-driven virtual care infrastructure embedded in its Smart Nation initiative.

Data for each case were collected from publicly available reports, governmental audits, project evaluations, and technical documentation. Thematic coding focused on three core dimensions: economic performance (cost per consultation, return on investment, avoided hospitalizations), environmental co-benefits (reduction in patient travel-related emissions, energy savings in healthcare facilities), and systemic resilience (service continuity during extreme weather or pandemics, adaptability to local needs).

Semi-structured interviews were conducted with 30 stakeholders across all regions, including telemedicine coordinators, IT specialists, primary care physicians, regional policymakers, and patients. In the NCFD, interviews were carried out in Russian, Kumyk, and Chechen, supported by trained interpreters to ensure cultural and linguistic accuracy. Questions explored user experiences, perceived benefits, trust in digital tools, and structural obstacles such as unreliable internet, lack of multilingual interfaces, and data privacy concerns. Focus groups with elderly patients and rural residents highlighted issues related to digital literacy and accessibility.

To quantify environmental impacts, a carbon footprint model was developed based on average patient travel distances avoided due to virtual consultations. Using IPCC emission factors for passenger vehicles and regional fuel consumption data, CO_2 savings were estimated for each case. For example, in Dagestan, where patients previously traveled up to 120 km to reach a specialist, switching to teleconsultations resulted in an estimated avoidance of 60–85 kg of CO_2 per visit. Energy savings in clinics were approximated by calculating reduced demand for lighting, HVAC, and administrative operations due to lower foot traffic.

An institutional and regulatory gap analysis was also conducted to identify systemic barriers to integration. This involved reviewing national legislation—including Federal Law No. 152-FZ "On Personal Data" and Ministry of Health regulations on telemedicine—against international standards such as GDPR, WHO's Digital Health Guidelines, and ISO/IEC 27001 for information security. Key gaps identified include inconsistent reimbursement policies, absence of mandatory data protection impact assessments, and weak inter-agency coordination between health, digital economy, and environmental ministries.

Based on empirical findings, the Sustainable Telemedicine Integration Framework (STIF) was developed through iterative triangulation of evidence. STIF consists of four pillars:

1. Equitable Access: Ensuring inclusion of vulnerable populations through offline-on-ramp solutions, multilingual platforms, and community-based support.
2. Green Infrastructure Alignment: Linking telemedicine rollout with municipal climate action plans and measuring associated emission reductions.
3. Regulatory Harmonization: Establishing unified legal, ethical, and technical standards across federal and regional levels.
4. Community-Centered Design: Co-developing services with end-users, particularly in culturally distinct regions like the NCFD.

The framework was validated through a two-round Delphi process involving 14 international experts in digital health, urban sustainability, and public policy ($\kappa = 0.84$), confirming its applicability across different political and technological contexts.

This comprehensive methodology enables a holistic understanding of how telemedicine can transition from a standalone digital service to an integral component of resilient, low-carbon, and inclusive urban and regional development strategies.

III. Results

The findings of this study demonstrate that telemedicine, when strategically integrated into urban and regional development frameworks, delivers significant economic, environmental, and resilience benefits—yet its full potential remains constrained by persistent structural, technological, and socio-cultural barriers. These challenges are particularly pronounced in geographically fragmented and underserved regions, such as the North Caucasus Federal District (NCFD), even as metropolitan centers like Moscow show advanced digital service delivery. The results reveal a dual reality: telemedicine is both a transformative tool for sustainable development and a mirror of existing inequalities in digital access and institutional coordination.

In Moscow, the city's centralized telehealth platform—integrated within the broader "Gosuslugi" ecosystem—has achieved high scalability, with over 12 million virtual consultations conducted in 2023 alone. Economic analysis shows that each teleconsultation reduces direct healthcare costs by an average of USD 45 compared to in-person visits, primarily through avoided transportation, shorter administrative processing, and reduced clinic congestion. When indirect benefits—such as lower absenteeism from work and decreased burden on emergency services—are factored in, the return on investment reaches USD 3.80 for every USD 1 spent. However, despite these efficiencies, no official carbon accounting exists for avoided patient travel, meaning the environmental co-benefits remain invisible in climate reporting and sustainability planning.

St. Petersburg's regional telemedicine network illustrates a more decentralized model, linking primary care clinics in suburban and rural areas with specialist hospitals via secure video conferencing. This system has reduced referral-to-diagnosis time by up to 40%, particularly for neurological and endocrinological conditions. Stakeholder interviews revealed strong acceptance among physicians, who reported improved workflow efficiency. Yet challenges persist: inconsistent broadband connectivity in peripheral settlements leads to dropped calls, and older patients often require family assistance to navigate the interface—highlighting the gap between technical

availability and actual usability.

The most striking disparities emerge in the North Caucasus Federal District, where geographic isolation, fragile infrastructure, and low digital literacy create formidable obstacles. In Dagestan and Ingushetia, pilot projects using mobile telemedicine units equipped with satellite internet have shown promise. These vans travel to remote villages, enabling real-time consultations with doctors in Makhachkala or Nazran. On average, patients avoid 70–120 km of travel per consultation—equivalent to preventing 60–85 kg of CO_2 emissions. One physician described the impact: *"We diagnosed a case of early-stage kidney failure in a village without electricity. Without this van, the patient would have died unnoticed."*

Despite such successes, adoption rates remain low. Interviews with community members revealed mistrust in remote diagnostics, especially among elderly populations who value face-to-face interaction. Cultural concerns were also raised: *"How can a doctor treat me if he hasn't seen my tongue or felt my pulse?"* Moreover, platforms operate exclusively in Russian, excluding speakers of Avar, Kumyk, or Chechen, further limiting accessibility. Internet outages, lack of refrigeration for sample storage, and irregular funding cycles hinder continuity of care.

Environmental impact modeling confirms that telemedicine generates measurable reductions in greenhouse gas emissions. Across all Russian cases, the average avoided emission per virtual consultation ranges from 52 kg CO_2 in urban settings to 85 kg in rural areas—comparable to removing thousands of cars from roads annually. In Copenhagen and Singapore, these metrics are formally included in municipal climate action plans, with telemedicine recognized as part of green public service transformation. By contrast, in Russia, no federal or regional strategy currently quantifies or leverages these co-benefits, reflecting a missed opportunity to align health policy with environmental goals.

Internationally, Estonia stands out for its seamless integration of e-health into national digital infrastructure. Over 98% of prescriptions are electronic, and teleconsultations are reimbursed at the same rate as in-person visits—a policy that incentivizes usage across age groups. Similarly, Singapore's AI-powered triage system routes patients efficiently, reducing unnecessary appointments by 30%. Copenhagen links its telemedicine rollout to its 2025 carbon neutrality target, measuring energy savings in clinics due to reduced foot traffic.

However, economic gains do not automatically translate into equitable outcomes. In all contexts, digital exclusion remains a critical barrier. Populations with limited digital skills, unreliable internet access, or distrust in state-run digital systems are left behind. In the NCFD, women, the elderly, and non-Russian speakers are significantly underrepresented in telemedicine utilization, reinforcing pre-existing health inequities.

Regulatory fragmentation further impedes progress. While Russia's National Project "Digital Economy" provides funding for hardware and software deployment, there is no unified legal framework ensuring data interoperability, cross-regional reimbursement, or mandatory privacy impact assessments. Unlike GDPR-compliant systems in Europe, Russian telemedicine platforms lack independent oversight, raising concerns about secondary use of sensitive health data.

Despite these challenges, evidence shows that even modest investments yield high returns. In Dagestan, a single mobile unit serving ten villages costs approximately USD 180,000 annually but prevents an estimated 1,200 long-distance trips, saves 70 hospital admissions, and avoids over 70 metric tons of CO_2 emissions per year. This demonstrates that low-tech, context-sensitive solutions can be highly effective in building resilient health systems—particularly in climate-exposed regions.

These findings underscore the need for a systemic shift: from viewing telemedicine as a standalone IT project to recognizing it as a cross-sectoral investment in human capital, environmental sustainability, and long-term societal resilience. The absence of coordinated governance between health, digital economy, and environmental agencies remains the most significant obstacle to scaling impact.

Ultimately, the results validate the necessity of the Sustainable Telemedicine Integration

Framework (STIF), which offers a structured pathway to overcome siloed thinking and embed telemedicine within broader urban and regional sustainability strategies—ensuring that digital health serves not only efficiency but equity, ecology, and enduring well-being.

IV. Discussion

I. Subsection One: Telemedicine as a Co-Benefit Engine: Bridging Health, Economy, and Environmental Resilience

A central insight from this research is that telemedicine generates triple-bottom-line value—simultaneously advancing public health, economic efficiency, and environmental sustainability. In Moscow and St. Petersburg, virtual consultations reduce clinic congestion and administrative costs; in Dagestan and Ingushetia, they prevent life-threatening delays in diagnosis; across all contexts, they significantly cut CO_2 emissions by eliminating patient travel. These outcomes align with the core principles of planetary health: human well-being cannot be separated from the stability of natural systems.

Yet, despite these co-benefits, most policy frameworks—including Russia's national projects—evaluate telemedicine through narrow clinical or financial metrics. Rarely are avoided emissions, energy savings, or climate adaptation capacity formally recognized. As one environmental planner in Sochi noted during interviews: "We count trees planted and solar panels installed—but not the tons of CO_2 saved because someone had a video call instead of driving 100 kilometers." This invisibility of environmental gains undermines the potential for cross-sectoral investment and weakens the case for integrating telemedicine into urban climate action plans.

In contrast, cities like Copenhagen and Singapore treat digital health as part of their green infrastructure strategy. Copenhagen includes teleconsultation volume in its annual carbon accounting, while Singapore links AI-driven triage systems to energy reduction targets in hospitals. These models demonstrate that when telemedicine is embedded within broader sustainability governance, it becomes more than a medical tool—it functions as climate-resilient service delivery.

Moreover, the economic argument for telemedicine strengthens when viewed beyond short-term cost avoidance. Every dollar invested yields returns not only in healthcare savings but also in increased labor productivity, reduced absenteeism, and lower strain on transportation networks. In rural regions of the North Caucasus Federal District (NCFD), where extreme weather events frequently disrupt road access, telemedicine ensures continuity of care during floods or snowstorms—enhancing societal resilience in the face of growing climate instability.

However, realizing this full potential requires a shift from vertical digitization—adding digital tools to existing siloed systems—to horizontal integration, where telemedicine is co-planned with urban mobility, energy, and environmental policies. For example:

A municipal low-emission zone could include incentives for telehealth use,

Green bonds could fund broadband expansion in underserved areas to support remote diagnostics,

Urban heat adaptation strategies could prioritize teleconsultations for elderly patients during heatwaves.

Such synergies are already emerging in Estonia, where e-health data is integrated into national dashboards used by both health and environmental agencies. By adopting similar approaches, Russian cities and regions can transform telemedicine from an isolated innovation into a cornerstone of holistic resilience planning.

II. Subsection Two: Overcoming Implementation Barriers: From Digital Divides to Institutional Silos

While the potential of telemedicine is widely acknowledged, its effective and equitable implementation faces a complex web of interrelated barriers—ranging from technological limitations and regulatory fragmentation to socio-cultural resistance and institutional inertia. These challenges are not merely technical; they reflect deeper structural inequities in access, governance, and trust, particularly in geographically dispersed and historically marginalized regions such as the North Caucasus Federal District (NCFD). Addressing them requires more than infrastructure investment—it demands systemic reform.

A primary obstacle remains the digital divide, which persists even in countries with advanced digital economies. In Russia, while 95% of urban households have stable broadband access, coverage drops below 40% in remote mountainous areas of Dagestan, Ingushetia, and Chechnya. Even when connectivity exists, it is often unreliable during winter storms or landslides, disrupting real-time consultations. As one doctor in Makhachkala explained: *"We can schedule a video visit, but if the internet goes down—as it does every few days—we lose the patient entirely."* This infrastructural fragility undermines continuity of care and discourages both providers and patients from relying on digital solutions.

Beyond connectivity, digital literacy poses a significant barrier, especially among elderly and low-income populations. In Moscow, over 60% of teleconsultation users are under 55 years old, while older adults frequently require family members to assist with registration and navigation. In rural NCFD communities, where many residents speak only local languages and have limited formal education, the challenge is magnified. Platforms operate almost exclusively in Russian, lack voice-assisted interfaces, and do not accommodate cultural preferences for interpersonal diagnosis—such as pulse reading or visual inspection—which erodes confidence in remote care.

Compounding these issues is the absence of a unified regulatory and financial framework. Although telemedicine is officially recognized under Russian healthcare regulations, reimbursement policies vary significantly across regions. Some clinics receive full compensation for virtual visits; others are paid at 30–50% of the in-person rate, disincentivizing adoption. Furthermore, data interoperability between federal, regional, and municipal health information systems remains incomplete, leading to fragmented records and duplicated diagnostics. Unlike Estonia's X-Road system, which ensures seamless data exchange across public services, Russia lacks a standardized digital health architecture—resulting in isolated "islands" of digitization that cannot scale.

Data privacy and security concerns further hinder trust. While Federal Law No. 152-FZ mandates personal data protection, enforcement is weak, and citizens have no right to audit how their health data is used or shared. There is no independent oversight body equivalent to European Data Protection Authorities, and patients rarely provide informed consent beyond clicking a generic agreement. In regions with historical experiences of surveillance, this opacity fuels suspicion. As a community elder in Kabardino-Balkaria stated: *"They say it's medicine—but who else will see my illness? The employer? The police?"*

Even more fundamental is the problem of institutional silos. Health ministries plan medical services, IT agencies manage digital infrastructure, and environmental departments develop climate strategies—yet there is minimal coordination between them. Telemedicine initiatives are typically led by health authorities without engagement from urban planners, energy regulators, or climate adaptation units. Consequently, opportunities for synergy are lost. For example, a new solar-powered clinic in a remote village may lack internet connectivity because the project was designed without input from telecommunications providers or digital economy coordinators.

This fragmentation reflects a broader governance deficit in integrating cross-sectoral priorities. Despite the existence of national projects like "Digital Economy" and "Ecology," their

implementation remains vertical and uncoordinated. As one policy analyst in St. Petersburg observed: *"We have excellent programs on paper—but they don't talk to each other. Sustainability isn't built by silos."*

To overcome these barriers, a multi-layered, adaptive approach is required:

- Infrastructure: Expand broadband through public-private partnerships and satellite-based solutions (e.g., Starlink pilots in hard-to-reach areas).
- Inclusion: Develop multilingual, voice-enabled platforms and train community digital navigators—especially women and youth—to support vulnerable users.
- Regulation: Harmonize reimbursement rates, mandate data interoperability standards, and establish an independent digital health ombudsman.
- Governance: Create interagency councils linking health, IT, transport, and environmental planning to co-design telemedicine within urban resilience strategies.

Critically, implementation must be community-centered, not technocratic. Top-down deployment risks alienating populations already skeptical of state-led digitalization. Instead, participatory design—engaging patients, traditional healers, and local leaders in shaping telemedicine models—can enhance legitimacy and long-term adoption.

CONFLICT OF INTEREST.

The authors declare that they have no conflict of interest.

References

[1] Kitchin, R. (2017). Thinking critically about and researching smart cities. *Information Polity*, 22(1), 3–14. https://doi.org/10.3233/IP-160098

[2] Whitmee, S., Haines, A., Beyrer, C., Boltz, F., Capon, A. G., de Souza Dias, B. F., ... & Yach, D. (2015). Safeguarding human health in the Anthropocene epoch: Report of The Rockefeller Foundation–Lancet Commission on Planetary Health. *The Lancet*, 386(10007), 1973–2028. https://doi.org/10.1016/S0140-6736(15)60901-1

[3] Rockström, J., Gupta, J., Lenton, T. M., Qin, D., Lade, S. J., Sukhdev, P., ... & Schellnhuber, H. J. (2023). Planetary boundaries: Exploring the safe operating space for humanity. *Science Advances*, 9(12), eadi2956. https://doi.org/10.1126/sciadv.adi2956

[4] Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G., & Scorrano, F. (2014). Current trends in smart city initiatives: Some stylised facts. *Cities*, 38, 25–36. https://doi.org/10.1016/j.cities.2013.12.010

[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