Multiagent AI Systems in Healthcare: A Comparative Study of Nigerian and Russian Healthcare Systems

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Abstract

Multi-Agent AI systems (MAS) have transformative healthcare potentials. However, as a result of different approaches, policies, infrastructural and socio-political challenges, varied applications of MAS have appeared across several countries. This mixed-methods comparative study of MAS application in Nigeria (Lagos) and Russia (Moscow) dives into differing issues such as infrastructural preparedness, legal policies and actual implementation. Whereas Moscow has an advanced healthcare system that employs MAS in telemedicine and preventive medicine, surgeries (such as Da Vinci systems), Lagos implements MAS in diagnosis and EHR (electronic health record system) integration, which could be referred to as foundational applications. This study highlights main adoption challenges, including funding hurdles, gaps in operability and sociocultural resistance, while presenting solutions for improvement- such as FHIR (Fast Healthcare Interoperability Resources) standards in Nigeria and federated learning pilots in Russia. The study further dives into on how government policies, digital literacy, and local innovation ecosystems shape the effectiveness of MAS adoption in both settings. Lagos and Moscow were chosen as case studies as they are national health and economic innovation hubs, and both locations have remarkable models to emulate for new e-healthcare economies. By reviewing outcomes (efficiency, reduced errors) with qualitative insights (methods), this study could prove a suitable blueprint for implementing and optimizing MAS across a plethora of healthcare systems, with a view to a broader African and Eurasian adoption.

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Introduction

A country will need capable policymakers who are ready to invest in universal health coverage and in training skilled healthcare professionals to deliver high-quality, patient-centered care within a health system built on a solid foundation of community-based primary healthcare in order to achieve universal healthcare [1]. Access to healthcare involves two essential dimensions: the quality of services provided and the affordability of those services. Ensuring high-quality care is particularly important because it demonstrates how well a health system meets the needs of its patients and translates available resources into real

health benefits.

Nigeria is the most populous country in Africa and also holds the continent's largest economy. Yet, these strengths have not translated into steady growth or a reliable healthcare system capable of serving its people effectively [2]. Around the world, Artificial Intelligence (AI) is changing how data are analyzed and used to guide decisions, but Nigeria has been slow to take advantage of these developments in its health sector. For a country of more than 200 million people, this slow pace of adoption represents a missed chance to improve healthcare planning and delivery. The contrast is clear when compared with Russia, where AI has been recognized as a national priority through the Artificial Intelligence Strategy for 2030 [3].

Nigeria is listed as a lower-middle-income country (LMIC) [4], but for many years, its people have struggled to get basic and affordable healthcare. Many doctors, nurses, and other professionals continue to leave the country, mostly because of insecurity, unstable politics, low pay, and poor working conditions. These issues have made it difficult for the health system to grow or deliver consistent care. The use of Multiagent AI Systems (MAS) could help change this trend by improving service coordination and making the work environment better for health workers [5].

At the moment, only about 3.03% of Nigeria's national budget goes into healthcare, serving a population of roughly 217 million people, much less than what Ethiopia or Ghana spend [6]. Government spending stands at around USD 15.95 per person, while Ghana spends about USD 40.24, Ethiopia USD 22.70, and Canada USD 70.17. Nearly 71% of Nigeria's total health expenditure is on private healthcare, far more than in those countries. Still, only around 3% of facilities have working computers or internet access, showing how far behind the system remains in terms of digital readiness.

Meanwhile, advanced countries such as China and the United States are leading in the field of artificial intelligence, while Russia is lagging behind, possibly due to low demand and limited funding from state medical institutions to support AI initiatives. Additionally, concerns about the reliability, safety, and clinical effectiveness of AI applications remain a significant barrier to wider adoption [8]. Scientific teams are currently conducting research in this area [7], and a domestic market for AI-based medical solutions has begun to emerge, with some products receiving certification from Roszdravnadzor (Federal Service for Surveillance in Healthcare) as medical devices.

As far as policy-making is concerned, the Decree of the President of the Russian Federation No. 4904, which authorized the National Strategy for the Development of Artificial Intelligence for the period up to 2030 [7], establishes the foundation for statutory regulation of the AI market in the Russian Federation. In the area of artificial intelligence (AI) for healthcare and medicine, Russia has been developing and approving national technical standards since 2019. Enhancing the quality of solutions and services and making them more competitive are the main goals of this activity, along with promoting Russia's social and economic development and integrating it into the global economy and international standardization systems.

With this dedication to healthcare improvement, Russia's health expenditure per capita % GDP: over 8, having a government Expenditure per capita: 267 USD. This figure is projected to rise steadily between 2024 and 2029, with a total increase of approximately 559.5 USD (+45.68%) [9]. Additionally, in Russia more than 40% of IT solutions in medicine contain AI. They account for about half of all investments in digital developments [10].

However, difficulties still exist in spite of tremendous advancements. The lack of demand for e-health product development has been caused by poor patient trust and limited digital literacy, preventing these technologies from serving as additional drivers of IT advancement in healthcare [11]. Furthermore, there are also issues with the current legal framework controlling IT in medicine. The adoption of remote healthcare technologies has been somewhat limited by the regulatory act established by the Russian Federation's Ministry of Health (Order No. 965n, dated November 30, 2017, "On Approval of the Procedure for Organizing and Providing Medical Care Using Telemedicine Technologies"). Medical personnel frequently face implementation difficulties when integrating telemedicine into clinical and hospital settings [12], as regulation provides limited guidance and ignores a number of real-world problems [13].

This does not mean that MAS are not in vogue in the world's largest country by land mass, as notable examples of MAS applications can be seen in Moscow, Voronezh, Kaluga, Saint-Petersburg, Novgorod and a host of other cities;

1. AI-powered breast cancer screening at the Federal Medical Center of the FMBA enhances early detection and diagnostic precision in women's health.
2. Drug discovery and molecular design are being advanced through a Skoltech and Helmholtz Center that visualizes pharmaceutically relevant chemical compounds using AI.
3. Neurodiagnostic innovation is demonstrated by the use of CDSS XGEN and MRI-based AI tools for early Alzheimer's detection, developed by CITP and Sechenov University.
4. The "Fluorography-DL" system streamlines chest image analysis, improving accuracy and efficiency in respiratory disease diagnostics.

2. Methods and Materials

To compare MAS usage in healthcare, I analyzed data from Lagos (Nigeria) and Moscow (Russia), focusing on the deployment of technology in areas, the regulatory policies, as well as the healthcare outcomes. The data received was then categorized into;

1. Academic literature, such as independent researches, studies, conference papers, and published articles.
2. Reports from government & NGOs, health policies, legal discussions and passed laws.
3. Tech start-up reports and hospital deployments (as in, industry case studies).
4. Interviews and expert opinions where available.

In addition, a Strengths, Weakness, Opportunities and Threats (SWOT) analysis was applied to evaluate the coverage, reliability and limitations of data sources for each city;

Category	Lagos, Nigeria Health	Moscow, Russia Health
Strengths (S)	Vibrant startup ecosystem and mHealth innovation (e.g., Helium Health, telemedicine platforms like SmartMedic/Uniccon, AI triage and diagnostics); high smartphone penetration in urban areas enabling mobile health apps; growing NGO and international partnerships (e.g., eHealth Africa, Gates Foundation support); increasing adoption of electronic health records (EHR/EMR) in private/urban facilities; AI applications bridging access gaps in diagnostics and patient management.	Strong national AI strategy to 2030 with dedicated healthcare focus (e.g., AI for diagnostics, imaging analysis like lung cancer/breast cancer detection); robust centralized EHR/integrated data systems in Moscow; high academic and research output (e.g., from institutions like Sechenov University, Skolkovo); government-backed AI tools and digital assistants/copilots; rapid projected market growth for health AI (potentially to RUB 78 billion by 2030); established telemedicine and remote monitoring initiatives.
Weaknesses (W)	Low overall EHR/EMR adoption (~18% in many settings); fragmented infrastructure and interoperability issues; heavy reliance on private sector with uneven public integration; limited long-term evidence and independent studies on MAS outcomes; digital literacy gaps among providers and patients; workforce shortages and inadequate training for AI/digital tools.	Low digital literacy and motivation among some healthcare providers; barriers to full digital maturity and organizational change resistance; heavy state control potentially limiting independent evaluations and innovation diversity; data privacy and sharing concerns in sensitive areas; slower adoption in non-urban or less centralized settings outside Moscow.
Opportunities (O)	Accelerating national digital health architecture (NDHA) and policies (e.g., Digital Health Services Bill 2025); rising AI integration for predictive analytics, telemedicine expansion, and EMR interoperability; international collaborations and investments in African digital health; potential for AI to address doctor shortages and rural-urban gaps; post-COVID momentum for remote care and preventive tools.	National Healthcare Development Strategy to 2030 emphasizing digital transformation; growing export of Russian health tech (e.g., AI diagnostics, SberHealth-like platforms); increasing international openness (e.g., WHO collaborations) despite geopolitical factors; high potential in AI priority areas like digital assistants, clinical preview tools, and predictive analytics; investment surge in preventive and personalized care via wearables/AI.
Threats (T)	Persistent infrastructural challenges (e.g., unreliable power, limited internet in non-urban areas, high costs for implementation); data privacy and security risks in fragmented systems; regulatory gaps and slow policy enforcement; over-reliance on donor funding or private players leading to sustainability issues; potential widening inequities if urban-focused (Lagos-centric) innovations fail to scale nationally.	Geopolitical tensions limiting international data sharing and collaborations; concerns over state surveillance via integrated AI/health systems; cybersecurity risks in centralized digital infrastructure; economic pressures or sanctions impacting tech imports/investments; potential bias in state-sponsored AI evaluations and limited independent oversight.

This SWOT framework can guide future stakeholder mapping (who and where to engage for more data), while bridging the gap on data analysis (for example, Lagos needs more academic studies, while Moscow needs more transparency as regards medical information and technology usage).

3. Multiagent AI Systems: Overview

MAS is defined as a system composed of multiple agents that can work harmoniously together to achieve a shared goal. This makes it a suitable system for helping users solve problems and make decisions [14].

In its simplest form, MAS involves distributing computing tasks across multiple devices that work harmoniously together. This means that in the development of the Artificial Intelligence of Things (AIoT), MAS must collaborate with both the Internet of Things (IoT) and artificial intelligence (AI) [15]. When Multiagent Systems (MAS) are used together with the Internet of Things, they form what is often called the AIoT framework. This combination allows smart devices and systems to exchange information, interpret it, and act on it without constant human direction [16–17].

MAS can be understood by thinking of a football team, where each of the eleven players has a specific role but success depends on how well they coordinate with one another. In the same way, each agent in a MAS handles a different task—such as diagnosis, logistics, or patient monitoring—but they all work together toward a common goal. By pooling information from these agents, the system can support medical decisions, whether for diagnosis, prevention, or treatment. One clear example is in managing sepsis, where MAS can help track patients closely and allow caregivers to respond more quickly when conditions change.

The process begins with the Data Collection and Integration Agent, which gathers and refines patient data from multiple sources to ensure reliability. The Diagnostic Agent applies machine learning to improve accuracy, while the Risk Stratification Agent evaluates disease severity and predicts outcomes. The Treatment Recommendation Agent develops personalized care plans, and the Monitoring and Alert Agent ensures continuous patient oversight. In parallel, the Resource Management Agent optimizes hospital operations, and the Documentation and Reporting Agent compiles medical records to support clinical decisions.

Together, these multi-agent systems enhance diagnostic precision, streamline treatment, and improve overall healthcare efficiency. These systems can often achieve better results compared to traditional scoring methods like qSOFA [18].

4. Case Studies

4.1. Nigerian Hospitals

4.1.1. Current State of MAS Adoption

Currently, in Nigeria, while MAS adoption is still emerging, its major roles are employed for tasks like data coordination, automation and decision making for patients [19]. Furthermore, majority of the users of MAS are private institutions, which daily outpace the governmental applications.

Notable users of MAS in Nigeria are: Helium Health (EHR automation in 500+ private clinics)

(*TechCabal*, NCDC: Disease Surveillance using DHIS2, MDaaS Global: Diagnostic

Coordination via BeaconOS [20-21].

4.1.2. Challenges

This usage does not come without its flaws, however, as the current tech stack most often than not makes use of

centralized databases, some "urgent" tests are flagged manually on a rule-based lab prioritization and manual data entries may result in delayed alerts.

Furthermore, due to lack of infrastructure (unstable power, low internet usage due to high costs), a heavy reliance on the private sector (as in the case of Helium Health) and lack of a national MAS framework, the application of MAS in Nigeria is faced with a gargantuan challenge of improvement and fast adoption [22].

A perfect example of such challenge can be seen in the fact that only 2.7% of Lagos healthcare facilities have full internet access currently (*NDHS, 2021*), while 60% of MAS usage rely on offline solutions as a first resort due to power outages [23].

4.1.3. Exemplary Projects

Lagos State Government SmartCare EHR, a statewide electronic health record system (EHR) employed in Lagos public hospitals. With this SmartCare EHR, patients' records are digitized and it reduces paperwork while improving care coordination. Administrative paperwork has been reduced by 40% in pilot hospitals [24]. The current capabilities boast a centralized patient database, basic appointment scheduling (patient wait times have been cut by 25% by automating appointments) and drug prescription and usage alerts.

In Nigeria, Clafiya, a telemedicine health platform linking community health workers to doctors boasts of patient data collection via mobile apps, allowing doctors to review cases remotely and prescribe treatment (*TechCabal, 2023*) [20]. With this telemedicine platform, health workers reduced neonatal mortality by 15% in pilot zones [20].

Additionally, via Helium Health Case Study, 2021, diagnosis time for malaria and fever cases have been reduced by 30% through pre-screening chatbots, with another 12% improvement in maternal health tracking through SMS reminders [25].

4.2. Russian Hospitals

4.2.1. Current State of MAS Adoption

In Russia, MAS are gaining huge traction in telemedicine and robotic surgery automation, as well as preventive procedures and early diagnosis of diseases.

With the enactment of Federal Law No. 242-FZ dated 29 July 2017 "On amending certain legislative acts of the Russian Federation on the application of information technologies in the field of healthcare". The law went into effect on January 1, 2018, provided the impetus for the implementation of telemedicine. Renowned Russian-based online telemedicine providers, such as Yandex.Health and Telemed Doctor Nearby, clearly stated in their user agreements that they provide consultation services only, however, for proper diagnosis and prescription, a specialist should be contacted in person [26].

Additionally, one of Russia's leading robotic surgery hubs (da Vinci systems) at Pirogov National Medical Surgical Center has seen the implementation of MAS in Operating Room (OR) coordination, as agents manage equipment, staff and analytics. MAS also guide robots in pre-operation planning and execution [27].

4.2.2. Challenges

As expected, this approach has inherent limitations, as online consultations typically capture only superficial and nonspecific/general symptoms, which are often inadequate for identifying subtle or less apparent medical conditions [26].

A risk of misdiagnosis may occur, and allergic reactions to medications constitute another major concern due to an incomplete or unreliable medical history. Also, due to a lack of a centralized patient data, there may be delays in accessing patients' medical histories when switching Telemedical platforms.

Also, with robotic surgeries, the procedure may last longer than anticipated with longer doses of

anesthesia. There is also the risk of the system failing to perform the task, resulting in serious injury or the need to switch to another type of surgery, which in turn reflects off the first concern and challenge of longer durations and an increase in the number of complications.

4.2.3. Exemplary Projects

Telemedicine companies, such as SmartMed, BestDoctor, Dr.Smart, Yandex.Health, Sber.Health etc can be used in many cities in Russia due to proper infrastructure and government investment

[28]. With the emergence of new platforms and the already existing ones, it has become easier to remotely monitor the occurrence of complications and symptoms associated with treatment, alongside home health monitoring [29].

Sber Health has reduced hospital readmissions by 20% via chronic disease monitoring agents

[30], with a 15% faster drug inventory restocking, as against the conventional method [31].

In April 2025, a team of vascular surgeons under the leadership of the head of the Research institute of Vascular and Interventional Surgery (Dr. M.A Chernyavsky) performed a series of successful aortofemoral bypass surgeries in patients with abdominal aortic occlusion using the daVinci robotic system at ALMAZOV center [32]. In addition, robotic surgeries in recent times have achieved 92% success rates in prostatectomies (Moscow City Health Dept, 2022) [33].

Lastly, with the growing e-health startups, there has been an annual growth of 35% in AI health ventures [34].

5. Comparative Analysis

Factors	Nigeria	Russia
Primary Use of MAS	Electronic Health Records (EHRs), Diagnostics	Telemedicine, Robotic surgery, Medical check-up and oncological assessment of patients
Financial Infrastructure and Set-up	Limited (as it is majorly private sector driven)	Private and public sector driven, with governmental investments and funding
Policies	Weak	Strong
Key Barriers	Lack of funding, power outages, low digital literacy	Policy resistance in certain cases, lack of a centralized data system for patients

Russian MAS policies have been instituted for longer periods of time than Nigeria, and as
such, have a stronger policy in comparison with Nigeria. However, the imperfection of the legal
framework regulating IT technologies in healthcare (stemming from lack of specific structural
changes) decelerates a widespread implementation in comparison with EU countries [35].

6. Challenges & Recommendations

6.1. Shared Challenges

Patient care and health practices have improved as a result of the rapid growth and adoption of MAS in the form of Electronic Health Records (EHRs). However, most of the time, patients cannot access the data that is recorded in an EHR; only the specialists and providers within an organization can. Thus, the idea of a Personal Health Record (PHR) emerges, which enables individuals to manage and record their health information outside of the EHR and, if feasible, examine the EHR information within the PHR [36].

To bridge this gap, there is the need for a data standard that allows different healthcare systems to exchange medical information seamlessly. This need for a "universal language" produced FHIR/HL7* data standards [36]. Currently, in Russia, there are emerging pilots in the USHIS project (*HIT report, 2023*, Digital Health in Russia: FHIS Readiness) [37], and there is a moderate HL7 adoption in major hospitals (e.g., Pirogov Center). However, in Nigeria, there is a limited HL7 adoption (as this is majorly in private institutions), while the use of non-HL7 data standards dominates public health reporting [38].

Finally, it is especially critical to address the issue of digital literacy among medical professionals. Achieving a high level of employee devotion to contemporary technologies is essential for digital transformation, which will change the mindset of healthcare professionals and guarantee a private introduction of information technology [19].

6.2. Country-Specific Solutions

6.2.1. Nigeria

To achieve a decent percentage growth in the use of MAS in healthcare (thus, increasing the health standard of the country), there needs to be a public-private partnership. The second edition of the National Strategic Health Development Plan highlights serious concerns about the state of Nigeria's healthcare facilities, revealing that around 80% are in poor condition—a result largely attributed to weak maintenance culture (Federal Government of Nigeria, 2018) [39].

It also emphasizes the need to address disparities between public and private healthcare infrastructure across all levels—primary, secondary, and tertiary. Building an effective digital health system requires three key elements: people, processes, and technology [40]. *People* include patients, healthcare providers, and policymakers; *processes* involve clinical workflows that should be digitized and designed with provider input for efficiency; and *technology* covers the functionality, platform, and cost considerations essential for sustainable digital healthcare [39].

There should be an adoption of FHIR to unify state-led EHR with private systems, to reduce
fragmented data and improve EHR to ensure faster and better MAS adoption and healthcare.

Also, addressing the issue of non-representative training data would reduce error rates for certain underrepresented groups in datasets. Most diagnostic AI models are trained on datasets that not all inclusive, and certain areas of the country record underperformance of these AIs due to this cultural gap [41].

6.2.2. Russia

To build trust in MAS, there should be provision of Explainable AI (XAI). This way, decisions made by the AI can be justified and explained to the attending physician (or health worker).

Also, the presence of Federated Learning allows hospitals to collaboratively train AI models without sharing real patient data, which is very vital for privacy and potential scalability. A real-world case can be seen in Google's Federated Learning for EHRs [42]. In addition, a synergy between Federated Learning and XAI would ensure health workers understand and trust the decisions made by MAS, while protecting patient data in the long run.

Lastly, providing patient consent protocols, mandating transparency waivers for high-risk procedures would ensure clarity, safety and consent from patients (already proposed in Duma Bill No 456, 2024) [43].

7. Conclusions

Despite Nigeria's nascent adoption of MAS, albeit growing via private entities, there's much to learn from Russia's state-led approach towards scalability and health-first involvement. By addressing the policies made at the executive level of government, real changes can begin to take form in the health care sector of Nigeria, with state-led funding leading the vanguard for the involvement of MAS as a whole. Infrastructural development (in terms of power generation, internet access), alongside proper digital literacy would go a long way in transforming the digital health architecture of the country, reducing mortality rate, and assisting health workers (attending physicians, surgeons, community health workers) in making the right decisions in record time, while ensuring that patients are properly diagnosed, treated and rehabilitated.

Furthermore, by implementing MAS, pandemics can be controlled and prevented with early notifications and shared information from all parts of the country. Both countries must address the topic of data sharing to exchange medical information seamlessly, while working on new projects and hands-on training for all staff to unlock MAS potential.

Lastly, critical analysis of policies made by law makers should be done with medical professionals to bridge the ethical gaps, and ensure that with the growing health benefit of the populace through MAS, their safety, privacy and security is also assured.

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