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Global stockpile for health emergency response: A distributed strategy for pandemic preparedness in a post–COVID-19, fragmenting world

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Abstract

The COVID-19 pandemic exposed deep structural weaknesses in global health emergency preparedness. Even countries considered highly capable experienced severe shortages as sudden surges in demand overwhelmed national stockpiles. The global scramble for public protection resources was intensified by limited manufacturing capacity, export restrictions, supply-chain nationalism, and the absence of enforceable international norms governing allocation of critical medical supplies. As COVID-19 spread across continents, mutual-aid systems collapsed simultaneously. Attempts to import essential supplies were hindered by border closures, manufacturing shutdowns, transportation disruptions, hoarding, black-marketing, and political bias in bilateral transactions. Millions were left without timely access to testing, treatment, or life-saving equipment.

The pandemic demonstrated that emergency health resources required for global biological crises exceed the governing capacity of individual nations or traditional multilateral institutions. With weakening international obligations and declining influence of the United Nations, a new model of distributed global health security is urgently required. This paper proposes GSHER a hybrid, multi-actor system combining regional alliances, private-sector capabilities, and limited UN coordination to ensure equitable, rapid, and depoliticized access to essential medical resources during future pandemics.

Keywords: Pandemic Preparedness; Global Health Security; Distributed Governance; COVID-19; Supply-Chain Resilience; Regional Stockpiles; Multilateralism

1. Introduction

Pandemics differ from conventional disasters because they strike multiple jurisdictions simultaneously, eliminating the possibility of mutual aid. COVID-19 revealed that even the most advanced health systems can be overwhelmed within weeks. It also exposed the fragility of global governance structures, especially the UN system, which struggled to coordinate equitable access to vaccines, diagnostics, and medical supplies. The world is now entering a period of geopolitical fragmentation, where nations prioritize self-reliance, regional blocs act independently, supply chains are re-nationalized, and trust in multilateral institutions is declining. In this environment, pandemic preparedness must evolve beyond the traditional UN-centric model.

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2. Materials and methods

This paper uses a qualitative, conceptual, and governance-focused analytical approach. It synthesizes evidence from global reports, institutional assessments, and pandemic-response evaluations to identify structural weaknesses in existing stockpile systems. The method includes:

- Review of international COVID-19 response evaluations
- Analysis of supply-chain disruptions and export-control behaviors
- Examination of governance failures in global solidarity mechanisms
- Assessment of private-sector roles in vaccine and medical-supply production
- Synthesis of regional preparedness frameworks

No human or animal subjects were involved. No experimental materials, chemicals, or instruments were used. All data referenced are publicly available institutional reports.

3. Results and discussion

3.1. Lessons from COVID-19 in a Changing Global Order

3.1.1. Supply-Chain Nationalism

Countries imposed export bans on PPE, vaccines, oxygen, and medicines, exposing the fragility of global interdependence. Concentrated manufacturing hubs and hoarding behaviors created cascading shortages, disproportionately affecting low-income regions.

3.1.2. Collapse of Global Solidarity

COVAX struggled to secure vaccines as wealthy nations pre-purchased global supply. Bilateral deals undermined multilateral fairness and prolonged the pandemic.

3.1.3. Weak Enforcement of International Obligations

The International Health Regulations lacked enforcement mechanisms. Compliance remained voluntary, limiting transparency and coordinated action.

3.1.4. Rise of Private-Sector Dominance

Pharmaceutical companies-controlled vaccine technology, pricing, and distribution. Governments depended on corporate decisions, highlighting the need for clearer public-interest safeguards.

3.1.5. Digital Surveillance and Misinformation

Infodemics undermined public trust, while digital surveillance tools raised ethical concerns. Both issues revealed the need for balanced, transparent communication systems.

3.1.6. Limitations of the UN-Centric Model

The UN and WHO remain essential but face structural constraints: limited funding, political influence, slow decision-making, and lack of enforcement authority. Global supply chains and manufacturing capacity lie outside UN control, limiting its ability to guarantee equitable access during crises. A more distributed architecture is required—one that empowers regional institutions, leverages private-sector capabilities, and positions the UN as a normative coordinator rather than an operational hub.

3.2. GSHER: A Distributed Global Health Security Network

3.2.1. Tier 1: Regional Pandemic Stockpiles

Regional stockpiles (AU-CDC, HERA, ASEAN/SAARC, PAHO, GCC) serve as the first line of defense, ensuring proximity, rapid deployment, and region-specific inventories.

3.2.2. Tier 2: Private-Sector and Philanthropic Partnerships

Private-sector actors provide surge manufacturing, cold-chain logistics, AI-driven forecasting, and financing support.

3.2.3. Tier 3: UN/WHO Coordination

The UN provides standard-setting, certification, surveillance, and arbitration, ensuring harmonized governance without centralized control.

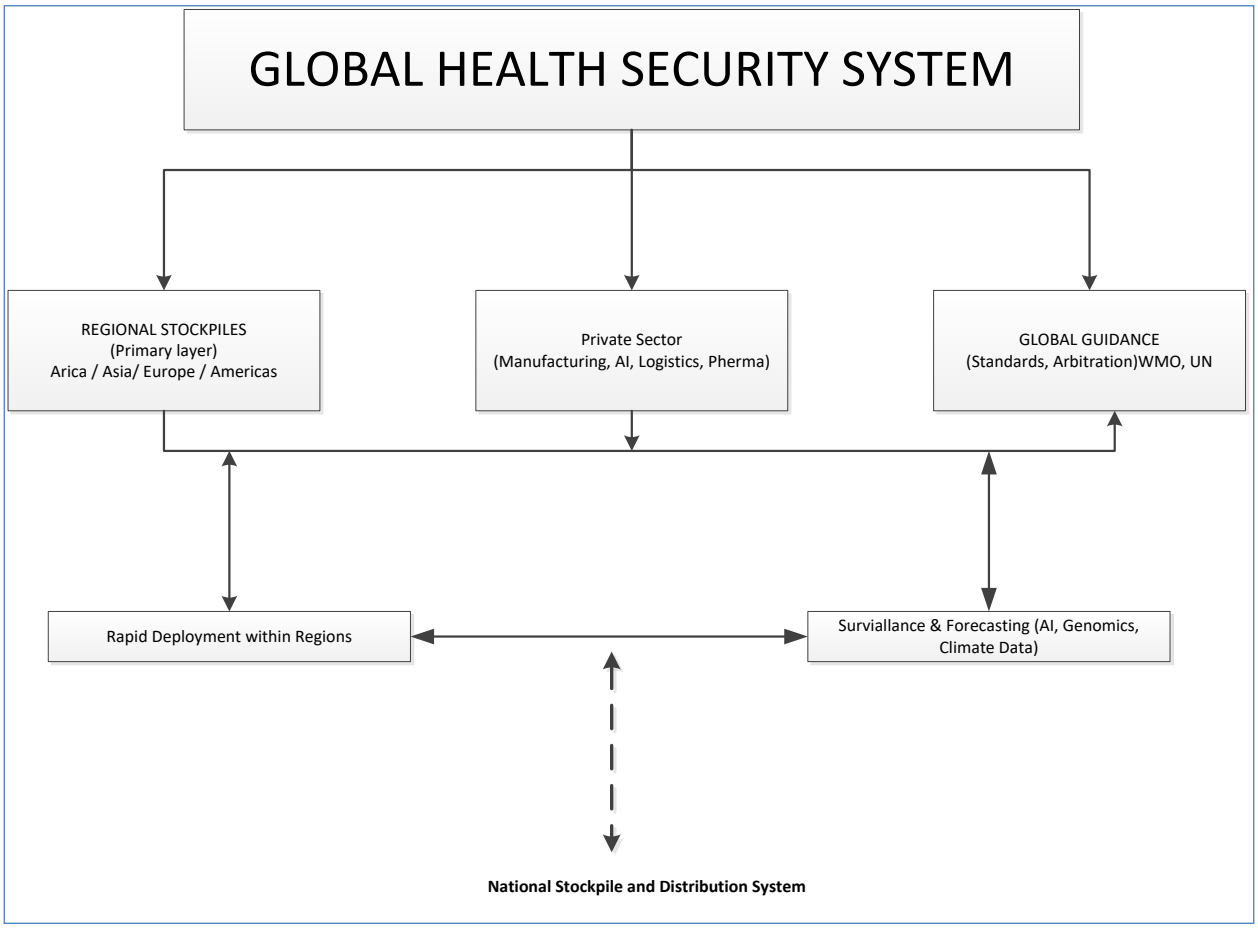

Figure 1 Distributed Global Health Security Architecture

3.3. Operational Architecture of GSHER

3.3.1. Surveillance and Forecasting

AI-enabled global disease monitoring integrates clinical, environmental, and digital data streams to support proactive decision-making.

3.3.2. Resource Categorization

Standardized categories (PPE, oxygen systems, diagnostics, antivirals, field hospitals, surge personnel) ensure interoperability and quality control.

3.3.3. Deployment Protocol

The deployment protocol operationalizes the entire GSHER system by translating surveillance insights into rapid, coordinated action. It ensures that resources move quickly from warehouses to affected populations through a predictable, time-bound sequence. The inclusion of private-sector logistics guarantees speed and reliability, while WHO certification provides transparency, quality assurance, and accountability. The protocol is designed to be iterative, allowing continuous adjustment as needs evolve during the crisis.

A time-bound sequence ensures rapid activation, needs assessment, cross-border deployment, private-sector logistics, and WHO certification.

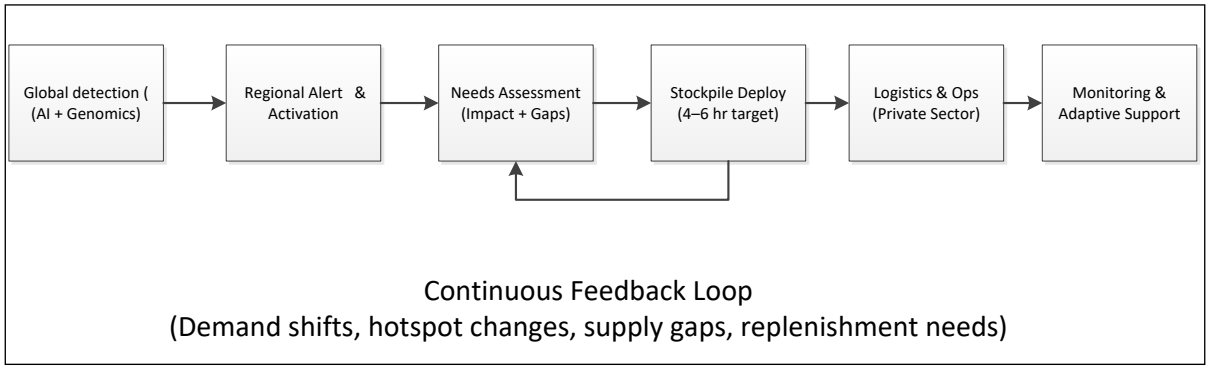

Figure 2 Pandemic Response Workflow

This model reduces dependence on a single global authority, accelerates deployment, enhances resilience, leverages private sector innovation, and aligns with current geopolitical dynamics (McKinsey, 2020). The distributed model is designed to overcome the structural limitations exposed during COVID-19 by decentralizing capacity, diversifying governance, and embedding redundancy into the global health security system. It provides a pragmatic alternative to centralized architecture that struggle under geopolitical pressure, supply chain disruptions, and institutional inertia.

3.4. Key Advantages

3.4.1. Reduced Dependence on Single Global Authority

A distributed system avoids bottlenecks associated with centralized decision making and political gridlock. Regional autonomy ensures that preparedness and response activities continue even when global consensus is slow or contested. This reduces vulnerability to geopolitical tensions and enhances operational continuity during crises.

3.4.2. Accelerated Deployment Through Regional Proximity

Regional stockpiles positioned closer to affected populations dramatically shorten response times. By eliminating long-distance transport and customs delays, the model enables rapid mobilization—often within hours—preventing health system collapse and containing outbreaks before they escalate.

3.4.3. Enhanced System Resilience Through Redundancy

Multiple regional hubs create built-in redundancy, ensuring that if one node is compromised due to conflict, disaster, or supply chain failure, others can compensate. This mirrors resilient network design principles used in cybersecurity and critical infrastructure, reducing the risk of catastrophic system wide failure.

3.4.4. Leveraging Private Sector Speed and Innovation

The private sector brings unmatched capabilities in logistics, manufacturing, data analytics, and supply-chain optimization. Integrating these strengths into the response architecture enhances agility, scalability, and technological sophistication areas where governments and multilateral institutions often lag.

3.4.5. Alignment With Current Geopolitical Dynamics

The global landscape is shifting toward regionalism, multipolarity, and strategic competition. The distributed model aligns with these realities by empowering regional blocks while maintaining a light but essential global coordination layer. This makes the system politically feasible, operationally sustainable, and more resilient to geopolitical fragmentation.

3.4.6. Improved Equity and Context Specific Response

Regional stockpiles can tailor their inventories to local disease profiles, cultural contexts, and health system capacities. This ensures that response measures are not only rapid but also relevant and equitable, particularly for low-income or historically underserved regions.

4. Conclusion

The world is entering an era where pandemics will be more frequent, complex, and politically contested. GSHER—a distributed, multi-actor, regionally anchored system offers a realistic, resilient, and future-ready model for pandemic preparedness. By empowering regional alliances, leveraging private-sector innovation, and maintaining a light but essential global coordination layer, GSHER aligns preparedness with the realities of a multipolar world. This model shifts the paradigm from reactive crisis management to proactive, intelligence-driven readiness.

To operate this model, the following steps are essential

- Establish legally protected regional stockpiles with clear governance frameworks, transparent inventories, and rapid-deployment protocols.
- Formalize public-private partnerships for surge manufacturing, cold-chain logistics, and AI-enabled surveillance, ensuring equitable access for low-income regions.
- Strengthen WHO's normative functions standard-setting, certification, and arbitration—while avoiding unrealistic expectations of centralized control.
- Invest in interoperable digital platforms for real-time surveillance, needs assessment, and cross-border coordination.
- Promote regional manufacturing ecosystems to reduce dependence on global supply chains during crises.
- Conduct regular stress tests and simulation exercises to validate readiness and identify gaps across all three tiers.

In sum, GSHER provides a pragmatic blueprint for a world where pandemics will increasingly intersect with geopolitics, economics, and technology. By embracing distributed governance and multi-actor collaboration, the global community can build a preparedness architecture that is not only resilient but also equitable, adaptive, and fit for the challenges of the 21st century.

Compliance with ethical standards

Disclosure of conflict of interest

The author declares no conflicts of interest.

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