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Strengthening Global Health Security: Lessons from Recent Epidemic Outbreaks

Mohamed Jaffar A, Ms. Manashree Mane, Pratiksha Singh, Vaibhav Kaushik, Dr. Lakshmi Jatiya, Dr. Aurolipy Das, Thivya N

Professor, ISME, ATLAS SkillTech University, Mumbai, India, Email Id- mohamed.jaffar@atlasuniversity.edu.in , Orcid Id- 0009-0002-9900-1371
Assistant Professor, Department of Forensic Science, Jain (Deemed-to-be University), Bangalore, Karnataka, India, Email Id- m.manashree@jainuniversity.ac.in , Orcid id- 0000-0001-7169-815X
Assistant Professor, Department of Agriculture, Noida International University, Greater Noida, Uttar Pradesh, India. pratiksha.singh@niu.edu.in , 0000-0002-2886-7234
Centre of Research Impact and Outcome, Chitkara University, Rajpura- 140417, Punjab, India. vaibhav.kaushik.orp@chitkara.edu.in https://orcid.org/0009-0001-0234-3205
Department of Physiology Aarupadai Veedu Medical College and Hospital, Vinayaka Missions Research Foundation (DU) India, lakshmi.jatiya@avmc.edu.in
Professor, Department of Management, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India, Email Id- aurolipy@soa.ac.in , Orcid Id- 0009-0001-2436-4509
ASSOCIATE PROFESSOR, Department of Nursing, Sathyabama Institute of Science and Technology, Chennai, Tamil Nadu, India, Email Id- thivya.nursing@sathyabama.ac.in , Orcid Id- https://orcid.org/0000-0002-1495-7888

ABSTRACT

The COVID-19 pandemic has highlighted the necessity to enhance national monitoring programs to safeguard a globally interconnected world. In Low- and Middle-Income Countries (LMIC), the monitoring of zoonotic diseases has progressed significantly over the past twenty years. Monitoring initiatives frequently emphasize urban and neighboring rural areas. People in isolated rural regions have received substantially less support despite their regular contact with zoonotic infections via frequent interactions with animals of all kinds, coupled with limited access to healthcare. The inadequate monitoring of illnesses in isolated rural regions is a significant deficiency in global health safety. Despite previous assertions, fundamental strategies for effectively implementing tracking in resource-constrained and physically complex environments remain undiscussed. The research emphasizes the advantages of investing in monitoring diseases in distant rural regions of low- and middle-income nations for the entire world and examines existing methodologies. Utilizing arid areas as a case study, the research presents a pragmatic method to enhance monitoring in distant rural areas and incorporate it into the present systems. This perspective signifies a shift from merely emphasizing the necessity for an expanded method of monitoring diseases to a concrete strategy for achieving this objective.

Keywords: *Health, Security, Epidemic, Outbreaks, COVID-19.*

INTRODUCTION

The well-being and wellness of global people are at a critical and hazardous juncture. The COVID-19 pandemic [1] revealed health disparities and highlighted significant deficiencies in preparedness and reaction; the collective inability to establish robust and reactive healthcare systems that cater to all should not have been unexpected. These deficiencies extend beyond readiness and response to a pandemic, encompassing medical crisis preparedness and reaction in a broader context. The swift proliferation of the

COVID-19 pandemic [11] highlighted longstanding deficiencies and obstacles within the worldwide health safety net that hindered public health systems from avoiding, recognizing, and addressing transnational infections. Persistent not investing in national and subnational medical systems has further debilitated medical systems, particularly insufficient systems that allow real-time epidemiology monitoring and tracking during medical crises [2].

Universal Healthcare (UHC) [3] is a crucial but frequently neglected component in preventing health crises. While UHC primarily aims to alleviate the financial strain of healthcare, it is commonly employed to refer to the broader array of measures required to guarantee that all individuals receive complete medical care [4]. Health systems serve as the mechanisms for implementing health agendas, such as international health safety and universal health coverage [12]. Enhancing medical systems is crucial for widespread and pandemic readiness and response, underpinning vital aspects of public health such as resilient medical facilities, taught and safeguarded healthcare personnel, sufficient funding, dependable supply networks, and evidence-based strategy and collaboration. Efficient and accessible basic medical services can be a pivotal strategy for fostering synergy between international health safety and universal health coverage.
Primary health care encompasses a spectrum of basic, person-centered medical procedures and items that address the bulk of an individual's health requirements throughout their lifespan [5]. Prior research asserts that insufficient primary health care has compromised nations' capacity to implement an equitable reaction to COVID-19 or to maintain resilience amid intricate, competing medical and economic challenges. Numerous measures have been implemented following COVID-19 to enhance preparedness and response to the ongoing epidemic and potential health risks [6].

The research highlights three primary obstacles that jeopardize the efficacy of the pandemic response and readiness activities developed during the COVID-19 epidemic: (1) Disjointed methodologies in public healthcare and outbreak management, characterized by an excessive dependence on international health safety to the detriment of UHC. (2) Fragile medical systems incapable of mitigating disparities within the context of highly interrelated economic and social frameworks. (3) Insufficient involvement of critical stakeholders, leading to diminished trust in health organizations and policymakers [10]. The research identifies the nascent potential for combining international health safety and UHC by fortifying medical systems, particularly primary medical services [13]. It proposes a more unified, robust, responsive emergency preparedness and reaction framework [8].

Background

Health care worldwide has substantially advanced human health during the past century. International health is an emerging discipline within health sciences tasked with identifying worldwide answers to prevalent medical challenges, aiming to enhance wellness and reduce disparities [7]. A concise health history worldwide can be categorized into distinct phases. The initial embryonic phase included a multinational quarantine network. During the nineteenth century, European nations instituted quarantines to save susceptible port cities from significant epidemics like typhoid and plagues. The subsequent stage is the creation phase, primarily aimed at facilitating trade across borders [14]. The inaugural International Medical Congress convened in France in 1860 to reconcile the conflict between the international quarantine sector and the open exchange, marking the inception of the global healthcare sector's formation and codification. The third stage saw the establishment of the worldwide health governance structure, spearheaded by the World Health Organization (WHO) [9]. The creation of the WHO signified the inception of a global medical system with sovereign nations as the primary actors. Since then, health worldwide has advanced swiftly, promoting national and international initiatives to combat significant disease outbreaks. The fourth stage involved extensive collaboration within the context of globalization. The rise of globalization has complicated worldwide health issues and obscured national boundaries, leading to the emergence of the idea of global wellness.

The global health problem undermines the notion of the nation as the paramount administrative entity and highlights the health advancement and safety of all individuals as various contributors. Despite a significant reduction in the global illness load in the 20th century, infectious illnesses such as malaria and diarrhea continue to result in elevated death rates in poorer nations due to hunger, overcrowded dwellings, and inadequate cleanliness [15]. In December 2019, the abrupt emergence of the coronavirus illness 2019 (COVID-19) rapidly disseminated globally, revealing the inadequacies in the current international framework for viral illness management. The first shortcomings of the country's COVID-19 testing kits underscored the limitations of single-sourced diagnostic tests and the tension between quality control and the necessity to meet the demands of an imminent epidemic. The diplomatic disputes around healthcare equipment among European nations highlighted the absence of global regulations for coordinating storage protocols, establishing cooperative operating processes, and defining necessary item inventories for collective reactions. The insights gained from the COVID-19 pandemic present a significant opportunity for international healthcare advancement, necessitating the identification of existing deficiencies in managing infectious ailments worldwide.

Fig. 1. Action against infectious diseases

This research delineates existing shortcomings in controlling infectious diseases within the framework of worldwide health, encompassing healthcare systems, emergent readiness and reaction, integrated monitoring, and evaluative instruments (Fig. 1). Relevant material was retrieved from several electronic databases and augmented by hand searches. Considering recurrent epidemics, the research wants to enhance knowledge of global advancements in infectious diseases and to communicate discoveries in international medical systems to mitigate future dangers globally.

Global Health Security

The research proposes six measures to enhance monitoring in remote rural regions of Low and Middle-Income Countries (LMICs), applicable at several geographical levels—community, county or region, and national—presented through an altered illness risk assessment paradigm (Fig. 2). The research examines each step within framework due to the team's proficiency in this nation and its significant advancements in developing comprehensive infectious disease monitoring.

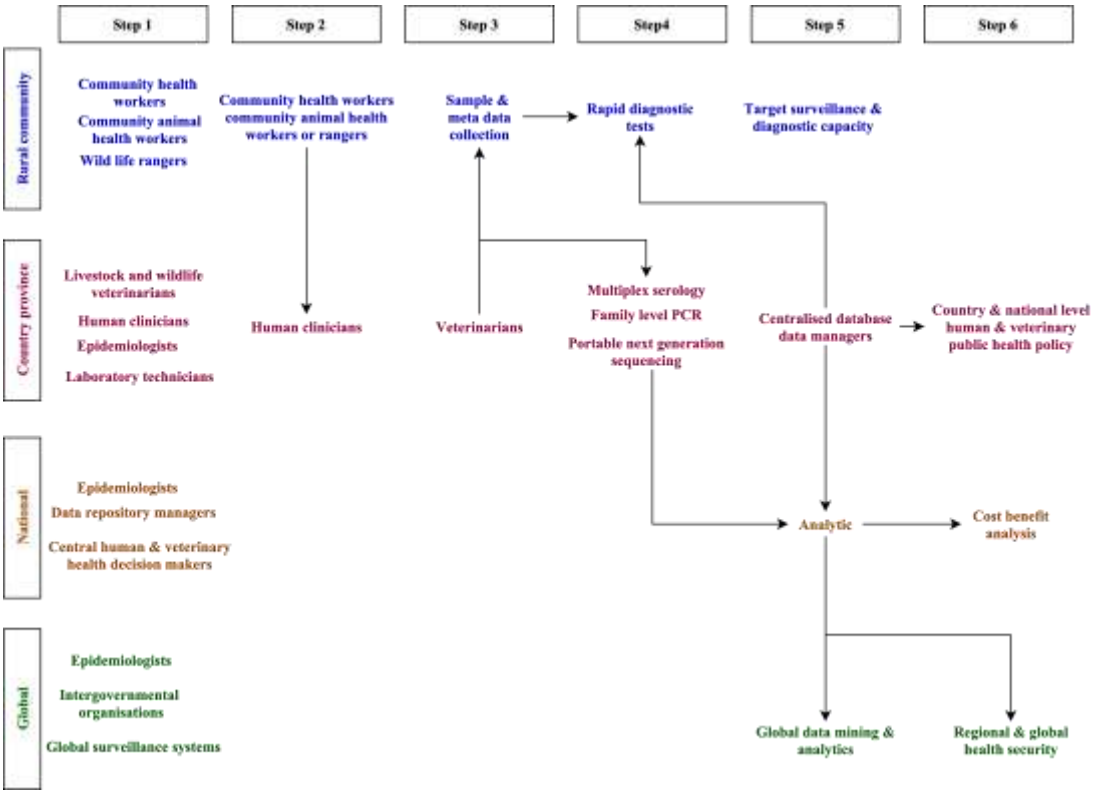

Fig. 2. Flowchart of the work

Step 1: involve all pertinent stakeholders
Zoonotic disease monitoring necessitates cross-disciplinary cooperation among stakeholders in the health of humans and animals, encompassing members of the community, local and national health personnel, scientists (such as veterinarians specializing in animals and fauna, physicians, and scientists), and politicians. Numerous stakeholders are excluded from all phases of surveillance operations (i.e., planning, execution, leadership, and assessment), resulting in an inefficient and ephemeral system. It has sought to tackle this problem nationally by establishing the Zoonotic Technological Working Group, comprising members from several health sectors who convene quarterly to deliberate on strategies to limit outbreaks of zoonotic diseases and uphold One Health norms. Medical facilities remain inequitable in several regions, perhaps because of inadequate stakeholder participation. To prevent the neglect of medical problems in distant rural areas and other nations, it is imperative to establish regional or provincial committees that engage everyone involved in every phase of monitoring efforts and communicate findings to national teams.

Step 2: implement biological and human syndromic monitoring methods to address the shortcomings of passive surveillance. Mobile phone-based monitoring for humans and animals in isolated rural regions could surmount challenges associated with isolation and inform veterinary and medical services. It has implemented an integrated biological and human monitoring structure, the Livestock Biosurveillance Station. It focuses on illness syndromes prioritized by national health organizations, facilitating the swift transmission of medical information nationwide to health officials. Connectivity is restricted to clinically educated physicians, limiting its outreach to isolated rural areas. Involving health care providers, local animal welfare employees, and animal rangers in isolated rural regions to monitor humans, domesticated

creatures, and wildlife periodically might mitigate deficits in public wellness and veterinarian capabilities in these areas.

Community medical professionals, group animal health employees, and animal rangers possess context-specific expertise regarding zoonotic illnesses, ensuring that donors and investigators address locally pertinent issues and that health suggestions for humans and animals are culturally tailored, thus enhancing acceptability and reports. Numerous contemporary mobile programs could enhance these initiatives. Animal rangers utilize the Spatial Tracking and Reporting Tool to assess wildlife in isolated rural regions throughout the tropical region. They can gather baseline animal health data to be communicated to healthcare providers. This monitoring method necessitates ongoing training and meticulous oversight to guarantee satisfactory interaction across front-line personnel and regional or provincial medical services.

Step 3: Enhance regional clinical capability
The implementation of syndromic monitoring systems in isolated rural regions must be coupled with the education of doctors in One Health practices, enabling them to adjust to various illness contexts and effectively react to syndromic data provided by frontline personnel, such as health workers from the community. Establishing zoonotic illness units, such as the Administration's Zoonotic Diseases Units (ZDU), will enhance One Health education and foster cross-sector cooperation at national and regional levels, necessitating targeted initiatives for remote rural regions. Global training enhancement for veterinarians and clinicians in remote rural locations to gather animal, human, and ecological data is essential. This method will enhance clinician awareness regarding zoonotic illnesses' manifestation, diagnosis, and epidemics, necessitating proficiency in multidisciplinary sampling and investigative techniques (e.g., post-mortem processes and clinical evaluations of the environment).
Healthcare professionals in remote rural regions require consistent and systematic training and oversight to recognize changes that signify the emergence of novel zoonotic illnesses. ZDU and collaborators, notably the National Centers for Infection Control of Disease and Prevention, are addressing this deficiency nationally via One Health training programs aimed at the swift detection and management of new zoonotic infections. These training initiatives must be expanded to encompass remote rural regions and implemented in more countries. More broadly, the focus must transition to equipping doctors with versatile skills rather than solely technical competencies, enabling them to differentiate various disease situations. Physicians can be educated to recognize novel developing zoonotic illnesses by using pertinent diagnostic tools, such as next-generation DNA sequencing, and by correctly noticing a rise in patients who are unresponsive to standard therapy.
Step 4: Enhance regional diagnostic capabilities
To guarantee prompt responses to epidemics of diseases, it is essential to enhance the accessibility of diagnostic tests and the analysis and dissemination of results in distant rural regions. LMIC has improved its diagnostics laboratory capability by establishing training programs subsidized by the Biomedical Science Institute and its international collaborators. The learning methodology could be implemented in other nations and should extend to inaccessible rural regions. Field-based fast diagnostic procedures and multiplexed serological testing might be employed by frontline personnel to circumvent cold-chain constraints and guarantee the screening of a wide array of infections in outbreaks of illness. Sequenced capabilities at the county or provincial level, in conjunction with portable DNA sequencing equipment, should be included in monitoring initiatives to facilitate the identification of novel emergent zoonotic illnesses and to comprehend transmission patterns. Strong relationships with centralized centers of superiority can provide suitable trials and instruction.
Step 5: Formulate multidisciplinary groups tasked with data administration, surveillance, and risk-based epidemiological assessment.
To effectively incorporate surveillance in remote regions into national initiatives, procedures must be established to enhance interaction and exchange of information across human and animal health industries and regions. A centralized and decentralized open-source online database, overseen by managing

information teams to assure standardization and cooperation at county, provincial, and national levels, would be essential to these initiatives. LMIC advocates for adopting this strategy, as seen by establishing the ZDU, and various regional tests have confirmed its viability. The involvement of epidemiologists in these groups for the quantitative and risk-based assessment of monitoring data is essential. Moreover, efficient long-term storage and availability of biological samples are vital for monitoring epidemiological developments over time and across different locations. Epidemiology findings must be communicated to politicians and public health professionals (e.g., doctors and public health professionals) to direct resources towards higher-risk locales, populations, and animal species while ensuring that models account for contextual variability.
Epidemiologists must be proficient in advanced modeling techniques (e.g., probabilistic compartmental methods and machine learning algorithms) and adept at managing large datasets (e.g., geospatial and microbiome sequence information). Training, oversight, and assistance provided by regional colleges, research centers, and worldwide research organizations via remote learning systems would fulfill this training criterion.

Step 6: Involve governmental and international entities
The established rules are only beneficial if their results are appropriately conveyed to authorities. Early involvement in the preparation and execution stages will facilitate this objective, disseminating the practical benefits of enhanced monitoring in distant rural regions. Creating a national infectious disease unit can improve early intervention. Fiscal analyses quantifying the expenses and benefits of expanding monitoring to far rural areas would be essential for this initial participation, with comprehensive epidemiology evaluations outlined in step 5. Enhancing monitoring in isolated rural regions necessitates foreign assistance in advising and financial capacities. Considering that zoonotic illnesses significantly contribute to poverty and frequently transcend national boundaries, world organizations should pledge sustained support for ongoing monitoring and treatment initiatives that effectively assist isolated rural populations.

Current issues in worldwide contagious disease management
Notwithstanding the advancements, the dissonance among governmental entities and the lack of data-sharing systems or tools have resulted in considerable obstacles in the worldwide management of infectious illnesses. Difficulties persist in establishing a practical global health management framework. The diversity of global health variables and the proliferation of influential actors in the field of health governance result in fragmented cooperation, ultimately undermining effective oversight of global health. Moreover, politicizing health matters to advance a nation's political objectives contradicts the principles of global health oversight and international health collaboration. The "One United Nations" reformation pilot has yielded favorable outcomes but fails to address numerous non-UN entities coordinating initiatives and dispatch representatives.

In addition, the COVID-19 pandemic revealed inadequacies in individual nations' and regional and global organizations' disaster preparedness or reaction frameworks. Although the significance of emergency readiness and response has been established, several policymakers hesitate to invest in preparation initiatives once the present danger has diminished. The inadequate vulnerability and resilience of medical systems undermine the efficacy of disease preventative and control strategies, resulting in discrepancies in preparation policies that have led to unmet objectives in the healthcare sector and a deficiency in viral illness response capabilities.

Thirdly, obstacles persist in data exchange and in formulating a worldwide monitoring system. Within the International Outbreak Alert and Response Networks structure, insufficient bilateral and multilateral collaboration impeded development and openness, resulting in inadequate and incomplete information exchange among partners. The responses to avian influenza and COVID-19 underscored the challenges in cross-sectoral cooperation among healthcare and agriculture. Still, mounting evidence indicates that

environmental alterations and land use will promote zoonotic repercussions from wild animals to individuals. Moreover, enhancing the prompt and comprehensive dissemination of sequencing information is essential to assist nations with constrained reading and computational capabilities. Fourthly, obstacles persist in developing tools for global health assessment and surveillance. The COVID-19 pandemic has underscored the necessity of tackling global health concerns through a comprehensive approach. Rigorous evaluation processes are essential to consolidate disparate proof, enabling governments to establish priorities within the broader context of decision-making practices. The quality of knowledge for global assessment is insufficient, and discrepancies arise between various sources due to the prevalence of self-reported information. Advancements in technology are essential to enhance the quality of information and the methodologies for combining information and thorough evaluation, particularly for multi-dimensional information with varied formats and sizes.

Conclusion

Enhancing zoonotic disease monitoring in isolated rural regions of LMIC can diminish human and livestock mortality due to illness and bolster resilience to pandemics and national financial stability. The strategy seeks to engage multidisciplinary partners to incorporate remote rural areas, their domesticated animals, and adjacent species into current monitoring systems, enhance training for field health professionals, and decentralize diagnostic capabilities to improve care. The methodology assists health officials and academics in establishing zoonotic disease monitoring programs in distant rural regions of LMICs.

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