ORIGINAL ARTICLE

Assessing District Hospital Preparedness During a Public Health Emergency of International Concern (PHEIC): Development of a Comprehensive Checklist in the Indian Context

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ABSTRACT

Background: The COVID-19 pandemic exposed critical weaknesses in healthcare systems, particularly in low- and middle-income countries such as India. In Delhi, district hospitals faced severe challenges during successive waves, including inadequate infrastructure, staffing, and poor emergency coordination. These shortcomings underscore the need for a standardized, context-specific tool to assess and improve hospital preparedness for future Public Health Emergencies. **Material & Methods:** A preparedness checklist was developed using a mixed-methods approach. The initial draft was developed through a literature review of global and national frameworks, followed by expert consultations with public health specialists, physicians, administrators, and infectious disease experts. Feedback was incorporated through structured consensus-building exercises, ensuring contextual relevance and technical rigor. **Results:** The resulting checklist encompasses six core domains: (1) Infrastructure, Equipment and Supplies, (2) Health Worker Safety, (3) Patient Care, (4) Biomedical Waste Management and Disinfection, (5) Health Information, Outreach and Communication, and (6) Monitoring and Reporting. Each domain includes actionable items with standardized response formats for scoring and gap identification. **Conclusion:** This checklist provides a comprehensive, adaptable framework aligned with WHO health emergency standards. It supports institutional learning, staff preparedness, and policy planning. Field validation is needed, but it presents a practical solution for enhancing hospital readiness in future health emergencies.

KEYWORDS

COVID-19 pandemic; Hospital Preparedness; Public Health Emergencies

INTRODUCTION

On March 11, 2020, the World Health Organization (WHO) declared COVID-19, caused by SARS-CoV-2 virus, a global pandemic. The virus rapidly mutated, resulting in several variants, severely impacting the global health system.(1) In low- and middle-income countries like India, the pandemic exposed critical vulnerabilities, especially among healthcare workers and strained public hospitals.(2,3)

India recorded over 10 million infections and 45,000 deaths by September 2021, with the second wave in early 2021 overwhelming the healthcare infrastructure.(4,5) Urban centres like Delhi (India) faced acute shortages of ICU beds and oxygen cylinders, forcing hospitals to turn patients away, disrupting routine care services.(6,7)

Districts, as the backbone of India's public health administration, play a pivotal role in planning and implementing health services.(8) Their preparedness, or lack thereof, directly affected the pandemic response.(4)

Despite being the capital city, Delhi's district healthcare system encountered challenges. As of 31st July 2022, Delhi reported 1,955,771 COVID-19

cases, and 26,311 deaths.(10,11) Therefore, evaluating and strengthening district-level hospital preparedness became crucial for future health crises.(12) Present study aims to develop a comprehensive, standardized checklist to assess preparedness of district hospitals for effective response to future Public Health Emergencies.

MATERIAL & METHODS

Study type & Study design: A mixed-methods approach was adopted to develop a comprehensive checklist for assessing the preparedness of district hospitals in India for future Public Health Emergencies of International Concern (PHEIC). The study comprised of two sequential phases: a comprehensive literature review and expert consultations.

Study Setting: Consultations with the experts were conducted virtually through structured interviews and electronic correspondence.

Study Duration: The study was conducted over a Period.

Study Population: The study involved multidisciplinary public health experts, including hospital administrators, emergency physicians, infection control professionals, and academic researchers experienced in hospital preparedness and pandemic response.

Sample Size Calculation: Experts were selected through purposive sampling to ensure diversity in disciplinary backgrounds and geographic representation. A total of three thematic expert groups were formed for in-depth review and feedback.

Strategy for Data Collection:

Literature Review

A comprehensive review of published and grey literature was conducted to identify existing frameworks, assessment tools, and best practices related to hospital preparedness for public health emergencies. Electronic databases, including PubMed, Google Scholar, and Web of Science, were searched. Additionally, relevant documents were retrieved from institutional websites such as the World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), the National Disaster Management Authority and the Pan American Health Organization (PAHO).

The search strategy incorporated the following keywords: "COVID-19," "hospital preparedness," "emergency response," "pandemic management," and "checklist development."

Inclusion Criteria:

Literature published between January 2019 and October 2024 was considered. Studies and guidelines were included if they focused on hospital preparedness for infectious disease outbreaks, emergency response capabilities, or checklist/tool development, with particular attention to applicability in low- and middle-income countries (LMIC) settings, especially India.

Exclusion Criteria:

Studies not focused on hospital preparedness or irrelevant to the Indian or LMIC context, non-English literature without available translation, and experts lacking relevant domain experience or unwilling to participate in consultations were excluded.

After initial screening for relevance and removing duplicates, eligible documents were subjected to thematic analysis. Key domains and items pertinent to hospital preparedness were extracted and synthesized to inform the development of a preliminary draft checklist.

Expert Consultation

Following the literature review, a structured expert consultation was undertaken to refine and contextualize the preliminary checklist. A multidisciplinary expert panel, comprising public health specialists, hospital administrators, emergency physicians, infection prevention and control experts, and academic researchers with experience in hospital preparedness and pandemic response, was constituted. The panel was subdivided into three thematic working groups based on areas of specialization:

- Service Delivery and Patient Safety
- Infection Prevention and Control
- Program Management and Community Engagement

Data Analysis: Data from literature and expert feedback were analyzed using NVIVO 12. Each working group critically reviewed relevant domains of the draft checklist, considering contextual factors specific to district hospital settings in India. Iterative rounds of feedback were sought, and checklist items were revised accordingly. Areas of disagreement were addressed through group discussions, and consensus was achieved through a combination of majority agreement and expert judgment.

The draft checklist underwent multiple rounds of refinement based on expert input. The final version was validated for content relevance, clarity, comprehensiveness, and contextual appropriateness, ensuring its practical utility for assessing district hospital preparedness for future PHEIC in the Indian context.

Checklist Development and Structure: The final checklist incorporated both global best practices and context-specific inputs from India's health system. It comprised six domains: (1) Infrastructure, Equipment and Supplies, (2) Health Worker Safety, (3) Patient Care, (4) Biomedical Waste

Management and Disinfection, (5) Health Information, Outreach and Communication, and (6) Monitoring and Reporting. Responses to each indicator were appropriately selected to ensure a closed-ended, definitive response.

Working Definition: Public Health Emergency of International Concern (PHEIC) was defined in line with WHO's IHR (2005) as an extraordinary event posing a public health risk through the international spread of disease and requiring a coordinated international response.

Ethical Considerations: This study involved the development of a checklist tool to assess pandemic preparedness in district hospitals. The tool was developed through a structured literature review and expert panel discussions. No human participants or personal data were involved at any stage of the study. As such, ethical approval was not required. All expert panelists participated voluntarily and provided informed input in their professional capacity. The process adhered to principles of transparency, respect for expert opinion, and integrity in data handling and reporting.

RESULTS

A structured, evidence-informed checklist was developed to assess the preparedness of district hospitals in India for responding to future **Public Health Emergencies of International Concerns (PHEIC)**. This tool was the outcome of a comprehensive process involving an extensive review of global and national literature, current hospital preparedness guidelines, and iterative consultations with a panel of domain experts including epidemiologists, health systems researchers, hospital administrators, and public health practitioners.(Figure 1)

Development Process and Expert Panel Composition

The checklist's development followed a two-step process: (1) synthesis of preparedness frameworks and policy documents from WHO, MoHFW, and other relevant authorities, and (2) incorporation of expert feedback through structured interviews and Delphi rounds. Table 1 outlines the characteristics of the expert panel, including their areas of expertise, affiliations and academic degrees, which ensured that the resulting checklist reflected both academic rigor and operational feasibility.

Figure 1: Process of checklist development

Table 1: Characterization of the Expert Panel

Affiliation	Academic Degree	Technical Expertise
Head of disaster risk reduction department	MD-MPH	Physician
Hospital laboratory expert (2 people)	MD	Pathology/Microbiology
Pre-hospital centre management	MSc	Nursing
Head nurse of emergency department	MSc	Nursing
Head of emergency department	Medical specialty	Emergency medicine
Head of centre for disease control and prevention	MD-MPH	Physician
Head of infectious diseases department (2 people)	Medical specialty	Infectious diseases
Head of virology department (2 people)	PhD	Virology
Head/Incharge of drug hospital store	PhD/MSc	Clinical pharmacy
Infection control officer	MD	Pathology/Microbiology
Head of hospital (2 people)	Medical specialty	Emergency medicine
Hospital director	MD-MPH	Physician
Head of hospital nursing office (matron) (2 people)	MSc	Nursing
National centre for disease control and prevention (2 people)	Medical specialty, MD-MPH	Infectious diseases

Affiliation	Academic Degree	Technical Expertise
Head of university medical emergencies management centre	MD, PhD	Health in disasters
Head of emergency operation centre	MSc	Health care management
Hospital supervisor (2 people)	MSc	Nursing
Bacteriology laboratory expert	MD	Pathology/Microbiology
Member disaster management committee	MSc/Variable	Disaster management
Head of reference laboratory	MD	Pathology/Microbiology
Head of pulmonary diseases department	Medical specialty	Pulmonary diseases

Structure of the Final Checklist

The final instrument was organized into **six core domains** of hospital preparedness, with each domain further broken down into subdomains and specific assessment items. The domains were selected to comprehensively capture the key functional areas critical for hospital readiness during PHEIC scenarios:

Infrastructure, Equipment, and Supplies (18 items)

Focused on ensuring basic utilities, designated clinical spaces, essential medical stockpiles, and functional communication infrastructure.

Health Worker Safety (11 items)

Covered training, provision and usage of personal protective equipment (PPE), wellness tracking, and risk zoning of healthcare spaces.

Patient Care (11 items)

Assessed the segregation of patient flow, clinical triage processes, emergency referral mechanisms, and continuity of care protocols.

Biomedical Waste Management and Disinfection (8 items)

Included evaluation of waste segregation practices, disinfection routines, staff compliance with hygiene protocols, and disposal infrastructure.

Health Information, Outreach and Communication (7 items)

Addressed internal and external communication strategies, health promotion materials, community outreach mechanisms, and stigma mitigation.

Monitoring and Reporting (6 items)

Focused on periodic staff capacity building, preparedness audits (e.g., mock drills), reporting lines, and review of essential performance metrics.

Each checklist item was linked to one or more critical preparedness capacities as outlined in the WHO Health Emergency Preparedness and Response Framework (12).

Scoring and Response Metrics

The checklist adopted a **four-point ordinal response scale** to capture the level of implementation at each facility:

Yes / No / Partially / Not Applicable.

For items requiring planning or documentation, a different set of status options was used:

Completed / In Progress / Not Started / Not Applicable.

This dual-format response mechanism allowed both quantitative scoring and qualitative identification of gaps, enabling tailored follow-up actions at the facility level.

Key Features of the Checklist

One of the primary strengths of the developed checklist lies in its **comprehensive coverage of critical preparedness domains** relevant to hospital-level response to any future PHEIC. The tool captures the full spectrum of institutional readiness, ranging from infrastructure and supply logistics to clinical management, workforce protection, infection control, and community interface. This broad scope ensures that no essential operational aspect is overlooked and that the checklist remains relevant across different phases of emergency preparedness and response.

The checklist is **practical and action-oriented**, designed to facilitate rapid, on-the-ground assessments that can directly inform corrective and preventive measures. Unlike theoretical assessment frameworks, this tool emphasizes feasibility and applicability in routine district hospital settings. Each item in the checklist is worded clearly to avoid ambiguity and promote uniform interpretation by hospital teams, thereby enhancing inter-rater reliability and consistency across different assessors.

An important innovation in the checklist is its **integration of frontline health worker training, safety, and wellness monitoring** as essential components of preparedness. It acknowledges the human resource element as a cornerstone of emergency response, ensuring that staff are not only adequately equipped with personal protective equipment (PPE) but are also regularly trained, monitored for wellness, and supported through clear protocols and role definitions. This enhances institutional resilience during prolonged health emergencies.

The tool also highlights the **critical role of community communication and outreach**, recognizing that hospital preparedness cannot be isolated from its broader catchment population. It

incorporates assessment of awareness materials, helpline visibility, anti-stigma messaging, and mass communication strategies, ensuring that the hospital remains a trusted and responsive node in the local public health ecosystem during a crisis.

Another notable feature is the checklist's **adaptability and scalability**. It was deliberately designed to be context-sensitive, allowing for customization based on different hospitals' specific constraints and capacities. Whether a facility is resource-rich or operating in a low-resource setting, the tool provides a framework for self-assessment and priority setting. This flexibility enhances its applicability across diverse geographic and administrative contexts within India.

Finally, the checklist promotes a **culture of continuous monitoring and institutional learning**. By including domains such as internal review mechanisms, mock drills, regular staff meetings, and designated points of contact for guideline dissemination, it encourages hospitals to institutionalize preparedness as an ongoing process rather than a one-time exercise. This approach is aligned with global best practices in health emergency risk management and fosters long-term system strengthening.

DISCUSSION

Hospital preparedness for public health emergencies has become a critical priority following the COVID-19 pandemic.(13) The structured checklist developed through this study provides a comprehensive and context-specific tool for systematically assessing district hospital readiness in India for PHEIC events.

Previous studies have shown that hospitals often struggle with implementing coordinated, multi-sectoral responses during pandemics, largely due to fragmented preparedness systems.(14,15) The checklist developed in this study addresses these challenges by integrating service delivery, infection control, infrastructure, and risk communication elements into a single, comprehensive tool.

Similar to efforts by Seyedin et al. (16), this checklist was developed through a rigorous mixed-methods approach, ensuring integration of global best practices while adapting them to local operational realities. Including domains such as health worker safety, infrastructure readiness, infection prevention, and biomedical waste management aligns with international guidelines proposed by WHO (17) and CDC.(18) Additionally, it supports the objectives set forth by the International Health Regulations (IHR) 2005 for health system strengthening.(19)

While multiple hospital assessment tools exist,(20,21) most tend to be either too generic or limited to high-resource settings. By focusing on practical action points (such as availability of handwashing stations, segregation of patient pathways, PPE stockpiling, and communication protocols), the present checklist addresses key gaps identified in earlier research, where operational shortcomings critically undermined pandemic responses. (22,23)

Internal monitoring mechanisms such as conducting mock drills, ensuring biomedical waste segregation, and maintaining health worker wellness checks were incorporated into the tool. These features facilitate real-time gap identification and enhance hospital resilience against prolonged emergencies.(24,25) The checklist's emphasis on preparedness at both facility and community interface levels aligns with the Sendai Framework for Disaster Risk Reduction 2015-2030, highlighting the need for resilient health infrastructure.(26)

Moreover, systematic training and drills for healthcare workers embedded in the checklist respond to prior evidence indicating that targeted, continuous education improves emergency response outcomes and reduces health worker infections.(27,28)

The tool's modular structure ensures that district hospitals of varying capacities can adapt it flexibly, addressing a significant shortfall observed during the COVID-19 response, where uniform tools proved unsuitable for diverse healthcare settings.(29)

Finally, it must be mentioned that this study has several notable strengths. It adopts a rigorous mixed-methods approach, combining a comprehensive literature review with iterative expert consultations to ensure the developed tool is evidence-based and grounded in real-world operational contexts. Including a multidisciplinary expert panel with representation from diverse fields such as infectious diseases, emergency care, public health, and hospital management adds to the credibility and comprehensiveness of the findings. The structured development process, including consensus-building across expert groups, enhances the relevance and contextual adaptability of the checklist for district hospitals in India. Moreover, the study aligns with internationally recognized frameworks like the WHO Health Emergency and Disaster Risk Management Framework and the Sendai Framework, situating the work within broader global health preparedness goals.

CONCLUSION

Following the COVID-19 pandemic, the critical importance of systematic preparedness and

standardized assessment in enhancing the resilience of district hospitals during public health emergencies has been brought to the fore. The development and validation of a comprehensive preparedness checklist, tailored to the Indian context, addresses key domains that align with global frameworks and recommendations. By integrating global frameworks and expert inputs, the checklist will serve as a practical and pragmatic tool to identify strengths and weaknesses in a district hospital's preparedness. The comprehensive nature and adaptability of the checklist allow it to be a valuable resource for healthcare administrators, policymakers, and frontline workers in India and other low-resource settings. Future research should focus on field testing the checklist across diverse hospital settings, evaluating its impact on improving preparedness outcomes, and refining its content to address emerging challenges and lessons learned from real-world emergencies.

RECOMMENDATION

The developed checklist should be adopted as a standardized tool for assessing district hospital preparedness for public health emergencies in India. Health authorities should integrate it into routine evaluations, supported by regular training, mock drills, and gap assessments. Piloting the checklist across diverse healthcare settings is essential to validate its utility and ensure adaptability. Future revisions should include feedback from frontline workers and community stakeholders to enhance practical relevance.

LIMITATION OF THE STUDY

One of the study's limitations is that the checklist has not yet been piloted. The next step of this research will be to do a pilot study to asses this checklist The study is based largely on expert input, which may not fully reflect the real-life challenges faced by frontline health workers and hospital staff during emergencies. Additionally, the study is limited to the Indian context and may require adaptation for use in other low- and middle-income countries. The lack of involvement from community stakeholders or patients in the development process represents another limitation, as their insights could have further enriched the tool's scope and applicability. Future research should focus on piloting the checklist across varied hospital settings and incorporating feedback from a broader range of stakeholders to refine its utility and implementation framework.

RELEVANCE OF THE STUDY

This study fills a critical gap by providing a practical, context-specific checklist to assess district hospital preparedness in India. It aligns global standards with local needs, offering a valuable tool for strengthening health system resilience and meeting international health emergency guidelines.

AUTHORS CONTRIBUTION

Conceptualization, Methodology, PK & AK; Software, PK; Formal Analysis, Investigation, PK; Resources, PK & AK; Writing – Original Draft Preparation, PK; Writing – Review & Editing, PK and AK; Validation, Supervision, AR, SSK, and SQ; Project Administration, AK All authors have read and agreed to the published version of the manuscript."

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CONFLICT OF INTEREST

There are no conflicts of interest.

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DECLARATION OF GENERATIVE AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors haven't used any generative AI/AI assisted technologies in the writing process.

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