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COVID-19 Re-emergence: IHR Core Capacities Evaluation at Points of Entry in Nigeria for Public Health Preparedness

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Abstract

Introduction: Points of Entry (PoEs), such as seaports, are critical for managing the movement of people and goods. Nevertheless, they are also significant vectors for the international spread of infectious diseases. As such, the International Health Regulations (IHR) established by the World Health Organisation are a cornerstone of global public health security, requiring countries to strengthen their preparedness and response capacities at PoEs. However, like many developing countries, Nigeria faces significant disparities in preparedness, leaving it vulnerable to emerging health threats, particularly in the post-COVID-19 era. Therefore, this study assessed the core capacities related to preparedness and response at three key Nigerian maritime PoEs: Lagos Apapa, Rivers, and Delta Port.

Methods: We employed a descriptive cross-sectional survey using the State Party Annual Reporting (SPAR) questionnaire to evaluate core capacity parameters, including allocated funds, training, equipment availability, inter-agency collaboration, and emergency contingency plans.

Results: Findings indicate significant regional disparities, with Lagos Apapa showing relatively better preparedness than Rivers and Delta Ports, which faced considerable challenges in funding, training, and equipment availability. Specifically, Lagos Apapa port reported 75% (functional capacity in funding, while Rivers and Delta ports face minimal functional capacity, particularly in training (15.9% and 9.1%) and equipment availability (19.1% and 16.0%).

Conclusion: These findings demonstrate critical gaps in Nigeria's public health infrastructure at PoEs and emphasise the need for targeted interventions to improve core capacities, contributing to ongoing efforts to strengthen public health systems at PoEs in developing nations, in alignment with the IHR.

Keywords: Core capacity, Emergency preparedness, Health security, IHR, Points of entry, Public health preparedness.

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Introduction

Recently, the global public health landscape has been significantly shaped by the risk of the re-emergence of new and existing diseases, which has underscored the vulnerabilities of points of entry (PoEs) and emphasised the need for robust systems to prevent cross-border disease transmission. This is exemplified by large-scale outbreaks, such as SARS in 2003, H1N1 in 2009, Ebola in 2014, Zika in 2016, and more recently, COVID-19 in 2020, highlighting the strategic importance of robust public health measures at PoEs. As such, the International Health Regulations (IHR) 2005 serve as a global framework for public health threat mitigation at borders. Member states are mandated to develop “core capacities” at designated PoEs to detect and respond to health emergencies while minimising disruption to international travel and trade [1], emphasising the need for state parties to develop and maintain core capacities at strategic locations to prevent, detect, and respond to public health risks of international concern. A critical component of IHR implementation is the development and maintenance of

core capacities at designated PoEs, including seaports [1-2], which has become the focus of assessing compliance and detecting gaps to inform public health actions [3]. Thus, highlighting their role in limiting the spread of health risks and promoting stronger national and global health security.

However, while routine capacities at PoEs have shown improvements in overall health security capacity over time [4], the effective public health response at PoEs has remained unchanged [5], with potential risks to emerging health threats, especially in the post-COVID-19 era. Reports indicate that Nigeria's compliance with core capacities at PoEs has significant gaps across multiple assessment areas. For instance, Nigeria's IHR scores for PoE capacities in 2019 revealed a substantial gap in meeting international standards [5]. Similarly, a study found modest improvements in Nigeria's capacity between 2017 and 2019, especially in areas such as surveillance and response coordination. However, challenges persist in other technical areas, such as resource allocation and personnel training [6]. Notably, this reflects a regional concern, as public health capacities at most IHR-designated PoEs across the broader 15-country West African region do not meet the required core capacity standards [7]. Thus, this study emphasises the urgent need for a comparative assessment of Nigeria's core capacities at its PoEs, with a focus on identifying the existing gaps and their implications for public health preparedness.

Therefore, given the ongoing global health threats, including the risk of COVID-19 reemergence, this study assesses IHR core capacities related to preparedness and response at three key Nigerian maritime PoEs of Lagos Apapa, River Port, and Delta Port, aiming to provide empirical evidence on the status of core capacities such as funding, training, equipment, coordination, simulation, and contingency planning. By identifying gaps in these critical areas, this study contributes valuable insights for targeted policy and operational interventions, offering a foundation for improving the country's response to future pandemics and health emergencies.

Materials and methods

Study locations

The study was conducted at three major ports in Nigeria: Lagos Apapa, River, and Delta. These ports were selected based on their strategic importance for Nigeria's international trade and their role in managing public health risks at PoE. Lagos Apapa is Nigeria's busiest port, handling a significant portion of the country's imports and exports, making it a focal point for public health preparedness. Rivers and Delta Port were selected to provide comparative data from other regional PoEs, which are critical for ensuring a balanced and representative assessment of preparedness in Nigeria. Overall, these ports were selected because they represent Nigeria's busiest and most regionally distributed maritime PoEs with designated IHR obligations, allowing for comparative analysis across geopolitical and operational contexts.

Study design

We adopted a cross-sectional descriptive design to assess core capacities at PoEs related to preparedness and response at three designated maritime PoEs in Nigeria: Lagos Apapa, Rivers, and Delta Ports. Data were collected using the IHR State Party Annual Reporting (SPAR) questionnaire, which was adapted from Kandel *et al*. [8]. The instrument was designed to capture six key domains: availability of allocated funding, staff training, equipment, inter-agency coordination, simulation exercises, and emergency contingency plans. A total of 179 port health officers (including health surveillance units, port health services, customs, and immigration) participated in the study: 72 from Lagos Apapa, 63 from River Port, and 44 from Delta Port, which were selected using purposive sampling, based on their involvement in core port health functions, availability, and willingness to participate.

To ensure validity, the draft instrument was subjected to expert review by three senior public health professionals with experience in port health services and IHR implementation. Their feedback informed revisions to enhance content clarity, contextual relevance, and alignment with WHO-recommended assessment indicators. The revised tool was pilot-tested on 15 port health officers not included in the main study, allowing for further refinement based on clarity and consistency of responses.

Data analysis

Subsequently, we adopted descriptive statistics using SPSS (v23) to summarise the categorical variables as frequencies and percentages for each core capacity, helping identify capacity levels, while Chi-square was used to test statistical significance between core capacity parameters across the ports at a $p < 0.05$ significance level.

Core capacity parameter classification

For each of the six core capacity parameters, we developed a scoring system using the following stages: (1) each response was coded as (Yes/No), then aggregated per domain and converted into a percentage score, and (2)

these were classified into five levels (Table 2), following the criteria in Kandel *et al.* [8].

Table 1. Classification and definition for levels of core capacity parameters

Levels	Percentage	Definition
Level 1	≤ 20%	Minimal functional capacity
Level 2	≤ 40%	Low functional capacity
Level 3	≤ 60%	Moderate functional capacity
Level 4	≤ 80%	Functionally capability
Level 5	> 80%	High functional capacity

Source: Kandel *et al.* [8]

Results

The assessment of core capacities at designated PoEs in Nigeria revealed substantial gaps in preparedness and response capacities across the ports of Lagos Apapa, Rivers, and Delta (Table 1). For instance, Lagos Apapa reported only 24.0% fund availability, with the River and Delta ports showing modestly higher proportions of 38.1% and 52.2%, respectively. Similarly**,** capacity-building efforts through training were also shown to be insufficient, with only 27.8% of personnel at Lagos Apapa receiving relevant training (Table 1). This was lower at River Port (15.9%) and critically low at Delta Port (9.1%), highlighting the lack of investment in human resource development.

Regarding the equipment required for health emergency response, the results revealed shortages across all sites. Lagos Apapa had 29.2% equipment availability, compared to 19.1% at River Port and 16.0% at Delta Port (Table 1), suggesting limited operational readiness. Additionally**,** while inter-agency coordination was relatively high at Lagos Apapa (87.4%) and River Port (68.3%), it was notably low at Delta Port (36.4%), which could undermine coordinated response efforts at PoE. Similarly, the existence of emergency contingency plans was uneven (Table 1), with Lagos Apapa (69.4%) and Delta Port (72.7%) reporting relatively higher availability of contingency plans, whereas only 22.2% of Rivers Port had such plans.

Notably, to assess whether the observed differences across ports were statistically significant, we conducted a chi-square test for each core capacity parameter (Table 1), with the results showing significant differences across the core capacity ($p < 0.05$), signifying that deficiencies were not randomly distributed.

Table 2. Preparedness and response to public health threats based on core capacity parameters

Preparedness and response parameters	Status	Lagos Apapa (n=72)	Rivers port (n=63)	Delta port (n=44)	p-value
Allocated fund/Budget	Yes No	54 (75.0%) 18 (24.0%)	39 (61.9%) 24 (38.1%)	21(47.8%) 23(52.2%)	0.001*
Training	Yes No	20 (27.8%) 52(72.2%)	10 (15.9%) 53(84.1%)	4(9.1%) 44(90.9%)	0.002*
Equipment	Yes No	21(29.2%) 51(70.8%)	12(19.1%) 51(80.9%)	7(16.0%) 37(84.0%)	0.001*
Synergy with other agencies	Yes No	61(87.4%) 11(15.3%)	43(68.3%) 20(31.7%)	16(36.4%) 28(63.6%)	0.006*
Simulation exercise	Yes No	21(29.2%) 51(70.8%)	5(8.0%) 58(92.0%)	10(27.7%) 34(77.3%)	
Emergency contingency plan	Yes No	50(69.4%) 22(30.6%)	14(22.2%) 49(77.8%)	32(72.7%) 12(27.3%)	

*Significant at $p < .05$

Discussion

In this study, we assessed the core capacities for public health preparedness and response across three major ports in Nigeria: Lagos Apapa, Rivers, and Delta ports, evaluating key preparedness indicators, including allocated funds, training, equipment availability, inter-agency collaborations, simulation exercises, and emergency contingency plans. Findings reveal a pattern of concentration of resources and preparedness in Lagos Apapa Port, which contrasts with the significant capacity gaps in Rivers and Delta Ports (Table 1), suggesting uneven implementation of IHR obligations, potentially due to regional administrative differences or infrastructure prioritisation. Similarly, the chi-square analysis indicates that the observed differences across ports were statistically significant ($p < 0.05$), signifying that deficiencies were not randomly distributed. These disparities echo findings documenting regional gaps in PoE preparedness across West Africa and East Asia [7, 9]. Moreover, our findings align with previous Joint External Evaluations (JEEs) of Nigeria's implementation of the IHR, 2005, documenting poor routine PoE capacities and effective responses at PoEs [10]. Thus, policymakers should establish a national PoE coordination framework that includes minimum standards for training, equipment, and contingency planning, supported by periodic simulation exercises and third-party audits.

Core capacity parameters

The allocation of funds is a cornerstone of health system preparedness, ensuring that resources are available to build infrastructure, procure essential equipment, and finance personnel training. In this study, the availability of the allocated funds varied significantly across the three ports. At Lagos Apapa, 75% of respondents reported the availability of allocated funds (Level 4), indicating functional funding (Figure 1). Similarly, the River Port showed a Level 4, indicating the availability of funding. In contrast, Delta Port showed the most concerning financial discrepancies (Level 3), with only 47.8% of respondents reporting the allocated funds. This financial disparity across ports is troubling, particularly given the growing public health threats in the globalised world, where adequate funding is critical for disease surveillance and response.

The lack of funds, particularly in River Port and Delta Port, reflects broader challenges in funding allocation within the Nigerian health sector, where resources are often disproportionately distributed across regions. These findings align with previous studies emphasising regional imbalances in public health financing, particularly in non-urban areas [11]. The availability of adequate funds is essential for developing and sustaining robust public health programs at PoE, including emergency response mechanisms and disease prevention initiatives.

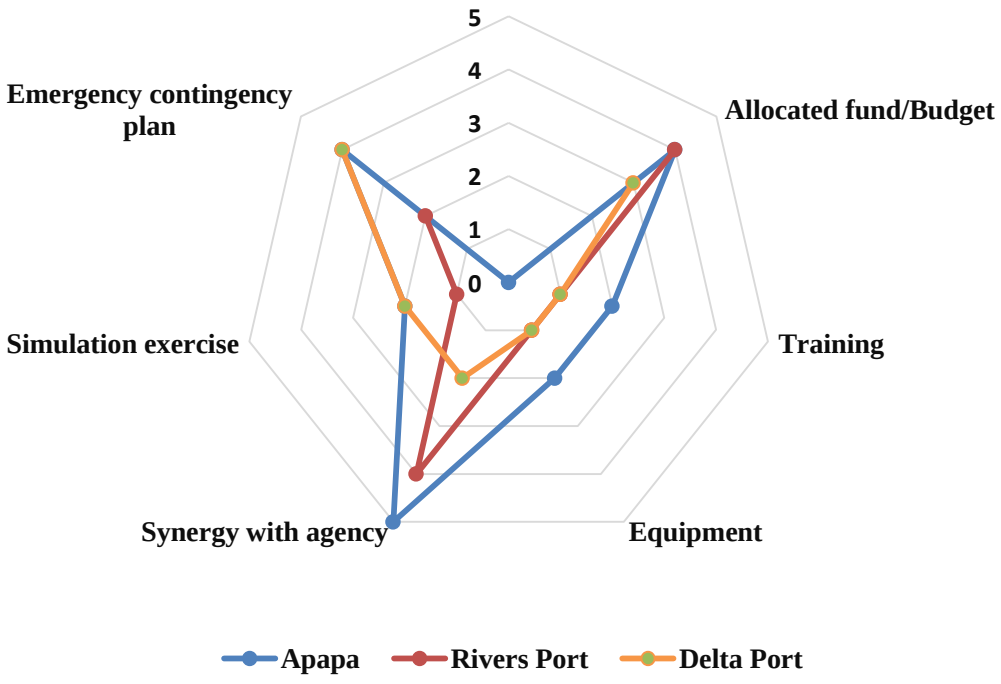

Figure 1. Core capacity levels across Nigerian maritime ports (Lagos Apapa, Rivers, and Delta Port), with 1 representing the lowest capacity and 5 the highest capacity

Regarding training as a key element of the IHR's core capacities, the findings indicate limited access to training programs across all ports (Table 1). For instance, only 27.8% of the personnel at Lagos Apapa received relevant training. This was lower at River Port (15.9%) and critically low at Delta Port (9.1%), indicating low functional capacity (Level 2) (see Figure 1). This hinders the effectiveness of personnel at points of entry and similar settings and highlights the need for urgent capacity-building interventions at these ports. These findings echo a common challenge across low- and middle-income countries (LMICs), where insufficient training and capacity building often hinder effective responses to public health emergencies [12-14], limiting their ability to identify and respond to public health threats, thus undermining the effectiveness of Nigeria's public health response systems. These findings highlight the need for training in public health emergencies and responses, and other key competencies to improve public health management and preparedness at these ports.

Additionally, regarding equipment availability for effective detection, surveillance, and management of health threats at PoEs, the results reveal that only about 20–30% of the ports reported the availability of essential equipment (see Figure 1), with River and Delta Ports particularly under-equipped (Level 1), thereby compromising the diagnostic capability and logistics necessary for outbreak response. These findings align with previous studies highlighting a lack of infrastructure and diagnostic capabilities at PoEs in LMICs [9, 15-16], and mirror Nigeria's JEE report of insufficient basic infrastructure at PoEs [6,10]. Notably, widespread equipment shortages across ports indicate significant gaps in Nigeria's preparedness to manage public health threats and respond to emerging diseases, including the detection of novel pathogens and the containment of outbreaks. This underscores the need for infrastructure improvements and enhanced diagnostic systems at PoEs to ensure global health security.

Moreover, regarding collaboration with other health and security agencies to build an effective, coordinated response to health threats at PoEs, the findings indicate high levels of collaboration at Lagos Apapa (87.4% - Level 5), underscoring the relevance of inter-agency coordination in responding to public health emergencies. This was closely followed by the Rivers port (68.3% - Level 4), suggesting functional inter-agency collaborations for improved port operations. However, Delta Ports reported low (Level 2) intersectoral coordination (36.4%), which is concerning as fragmented response efforts can lead to inefficient resource use and delayed interventions. For instance, similar concerns were raised in Nigerian legislation reviews, highlighting inadequate legal clarity and poor delineation of authority across ministries [17-18], leading to inefficiencies and governance challenges and undermining the effectiveness of port governance. Existing studies have demonstrated that successful public health responses are often the result of strong inter-agency coordination and regular testing of response plans through simulation exercises [17]. For instance, a study analysing 17 simulation exercises by the European Commission, focusing on inter-agency coordination and response to public health emergencies, demonstrated the effectiveness of inter-agency collaborations in identifying gaps and improving regional preparedness for health crises [19]. Previous studies have documented the relevance of agency collaboration in promoting effective public health preparedness and response [20-22]. Nigeria could benefit from adopting these best practices to strengthen its public health infrastructure and improve PoE readiness.

Furthermore, the existence of well-structured emergency contingency plans is crucial for ensuring coordinated and effective responses to health emergencies in the future. Findings show that besides Rivers Port (22.2% - Level 2), Lagos Apapa (69.4% - Level 4) and Delta Port (77.8% - Level 3) had a functional emergency contingency plan in place. Thus, demonstrating a relatively higher level of preparedness in this regard, suggesting that contingency planning is prioritised in some areas. Despite the availability of contingency plans at Lagos Apapa and Delta Port, the presence of documented plans does not guarantee their effectiveness. For instance, JEE reviews emphasise that without exercising and reviewing these plans, their utility during real events is limited [23]. However, the inadequacy of contingency plans in the Rivers port is particularly concerning, as the lack of a well-defined response framework can lead to confusion, delays, and inefficiencies in managing public health emergencies. According to the WHO [24], robust contingency planning is a key component of IHR core capacities, enabling PoEs to respond quickly and effectively to health threats.

Policy Implications and Limitations of the Study

The disparity in port capacity indicates an uneven implementation of the IHR requirements. While Lagos Apapa shows relative strength, the Rivers and Delta Ports remain critically underprepared. This systemic inequity undermines the overall resilience of the national health security system, which is crucial for consistently maintaining IHR core capacities at all designated PoEs, particularly in a country with extensive maritime traffic, considering Nigeria's vulnerability to infectious disease

outbreaks, as evidenced by the recent Ebola and COVID-19 crises.

Therefore, a key policy priority should be the decentralisation of funding and technical support to ensure that all ports receive adequate resources, equipment, and trained personnel. Additionally, embedding IHR compliance indicators into the monitoring frameworks of port authorities, the Federal Ministry of Health (FMOH), and the NCDC will promote accountability and ensure continuity. The government should also establish legal instruments to clarify the roles of various PoE agencies, thereby reducing fragmentation and improving response coordination. Strengthening core capacities at ports is not only a national imperative but also a regional public health priority, given Nigeria's central role in West African trade and mobility.

Beyond Nigeria, this comparative port analysis provides a template for ECOWAS countries seeking to harmonize IHR implementation. Cross-national benchmarking can help identify shared capacity constraints and inform regionally coordinated health-security strategies.

Despite its contributions, this study has some limitations that must be considered when interpreting its results. First, the study was based on self-reported data from port health personnel, which may be subject to reporting bias, including over-or underestimation of existing capacities. Additionally, the study was cross-sectional, capturing data at a single point in time, and may not reflect changes in core capacity over time. Finally, while the selected ports are representative of high-volume maritime traffic, caution should be exercised in generalising the findings to land or air PoEs in Nigeria. Despite its limitations, this study offers critical insights into the gaps requiring urgent policy attention and serves as a foundational diagnostic for future interventions.

Conclusion

This study provides a comprehensive assessment of core capacities at PoEs in Nigeria and identifies specific core capacities that require urgent improvement. Findings indicate significant gaps in core IHR capacities across ports, with Lagos Apapa performing better in most parameters, with Rivers and Delta ports facing substantial challenges that undermine their ability to respond effectively to public health threats. However, the overall levels remain suboptimal, with critical weaknesses in training, equipment, and routine preparedness activities such as simulations. Given the global and regional importance of strengthening health security at PoEs, our findings highlight the urgent need for targeted interventions aimed at improving core capacities at the nation's PoEs, contributing to the ongoing discourse on improving public health infrastructure in LMICs.

Highlights

What Is Already Known?

Given the ongoing global health threats, including the risk of COVID-19 re-emergence, achieving core capacities remains a challenging yet critical task, with multiple studies examining countries' efforts to align with IHR requirements. However, despite these concerns, a significant gap persists in the comparative analysis of operational readiness against health emergencies at PoEs, neglecting cross-PoE comparisons that consider unique socioeconomic dynamics, particularly in developing nations. This deficiency in comparative analysis poses challenges in identifying best practices and tailoring strategies to meet the specific needs of each PoE.

What Does This Study Add?

Our findings highlight the extent to which Nigeria's PoEs are equipped to respond to the evolving risk of infectious disease re-emergence, contributing core-capacity-specific insights to strengthen health security infrastructure in alignment with national and global health security.

Acknowledgement

Not applicable

Authors' Contribution

YA conceptualised the study, analysed the data, and drafted the manuscript. EO contributed to drafting and finalising the paper. OOA and HS revised the drafts and provided input. All authors have read and approved the manuscript.

Conflict of Interests

The authors declare no conflicts of interest.

Ethical Considerations

Ethical approval for this study was obtained from the Institutional Review Board of the affiliated research institution. Informed consent was obtained from all participants before data collection, and they were assured that their participation was voluntary. This study adhered to the ethical guidelines for research involving human participants outlined in the Declaration of Helsinki.

Consent for Publication

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