

Research Article

Assessment of Core Capacities at the Designated Points of Entry According to the International Health Regulations 2005: Cote D'Ivoire

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Abstract

Background: rapid population growth, urbanization, and global interconnectedness have accelerated infectious disease spread, prompting WHO member states, including Côte d'Ivoire, to adopt the International Health Regulations (IHR) to strengthen surveillance, preparedness, and response at points of entry (PoE) and enhance global health security. Objective: to assess Côte d'Ivoire's capacity to detect and respond to public health emergencies at designated points of entry (PoE), and indicate the strengths and weaknesses identified. Methods: a normative evaluation was carried out from August 1st to 30th, 2021, using the WHO tool for core capacity requirements at designated airports, ports, and ground crossings. Three PoE were selected as a purposive sample based on criteria including the type, highest volume of passengers, and international traffic. This tool collected information on three specific technical capabilities. The tool generated scores for each core competency, always including routine (capacities), responding to events that might constitute a public health emergency of international concern (PHEIC), and coordination and communication. Data analysis was color-coded based on assigned scores. Results: Overall, the evaluation demonstrated that all POEs garnered a score surpassing 50%, except for the Noe crossing border (23%). AERIA obtained the highest score of 87%, following (53%). For routine capacity, PAA and Noe ground crossing border scored 28% and 30%, respectively, while AERIA scored 80%. Regarding PHEICs, the Noe ground crossing had the lowest proportion (40%). AERIA demonstrated superior strengths by virtue of the existence of comprehensive procedures and legally mandated administrative provisions for conducting inspections, the availability of sufficient medical services, and designated space to facilitate interviews with potentially infected or suspected travelers. One the opposite Noe has the most weaknesses include lack of an international communication network with competent authorities of the destination POEs, lack of simulation exercises to test the developed plans, unavailability of capacity for isolation or quarantine of sick travelers. Conclusion: Designated points of entry were not fully complied with international health regulations. Further efforts are still needed to bring designated points of entry up to RSI requirements.

Keywords

International Sanitary Regulation, Core Capacity Requirements, Points of Entry, Cote d'Ivoire

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Received: 2 December 2024; **Accepted:** 27 December 2024; **Published:** 16 January 2025



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1. Introduction

The explosive population growth, rapid urbanization, and interconnectedness of today's world through transportation are factors of the rapid spread of emerging and re-emerging infectious diseases and public health emergencies [1].

These diseases constantly threaten global health security when they are not controlled and contained. Thus, the influence of such phenomena is not only focused on human health but also affects animal health, the environment, and other sectors, including economics, and tourism [2]. Therefore, there is a need for building a surveillance system that can respond effectively to these threats.

In response to the potential risk of such events, the Member States of the World Health Organization (WHO) have adopted the International Health Regulations (IHR). The IHR provides States with a series of binding provisions to develop, strengthen, and maintain the capacity to detect, assess, report, and notify the country of the events that may threaten global health security and to address the risks of international spread of diseases in international travel, transport, and traffic [3].

The IHR has undergone several changes in its evolution. It was in 1951 that the first IHR was created following the assembly. The IHR of 1951 dealt with several diseases with epidemic potential, including cholera, plague, recurrent fever, smallpox, typhoid, and yellow fever [4]. However, the limitations of the 1951 RSI and the different health situations led to several amendments and revisions of the RSI in 1969, 1973, 1981, and 1995 and 2005 [5, 4]. The IHR (2005) is the most recent version adopted by the 58th World Health Assembly on 23 May 2005 and entered into force on 15 June 2007 [6].

Côte d'Ivoire, a country located in West Africa, is a WHO Member State committed to achieving the MDG 3 through its National Health Development Plan (NHDP) 2021-2025. This commitment is materialized by strengthening epidemiological surveillance, preparedness, and response to epidemics and public health events of national or international scope. Therefore, the country has adopted the IHR and has decided to upgrade the minimum capacities required to implement the International Health Regulations (2005). Indeed, among the obligations and provisions applicable to States Parties, the IHR contains sanitary requirements at points of entry, including ports, airports, and land [7-9]. Therefore, to meet these obligations, the country has evaluated the implementation of the IHR at the ports of entry.

There is a lack of scientific publication on International Health Regulations 2005 in the country. In addition, there is no publication on core capacities at the designated points of entry (POE). The only study published, focused on assessing the minimum capacity required to implement the IHR (2005) [2]. However, it did not address POE through the lens of the three competencies, including routine (group I), responding to

events that might constitute a Public Health Emergency of International Concern (PHEIC) (group II), and coordination and communication (group III).

The objective of this study is to document the country's capacities to prevent, detect and respond to public health threats per the IHR (2005) core capacities at PoE. By focusing on three key competencies, the study sought to delineate the strengths and weaknesses inherent in Côte d'Ivoire's capacity framework, thereby shedding light on areas ripe for improvement and areas where the country excels.

2. Materials and Methods

2.1. Setting

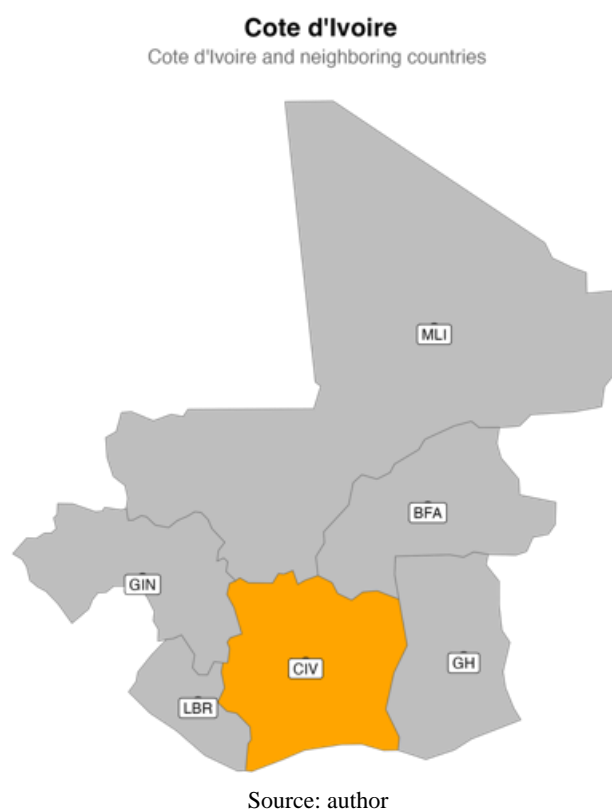


Figure 1. Ivory Coast and neighboring countries.

Côte d'Ivoire (figure 1) is in West Africa, in the intertropical zone, at the edge of the Gulf of Guinea. The country is bordered to the south by the Atlantic Ocean, east by Ghana (GH), north by Burkina Faso (BFA) and Mali (MLI), west by Guinea (GIN) and Liberia (LBR) [10]. Several options exist to access the country. Thus, 46 entry points—land, sea, river-lagoon, rail, and air-port—have been designated [11].

2.2. Selection of PoE

In this study, three points of entry were selected as a purposive sample based on criteria including the type (air, water, and land), highest volume of passengers, and international traffic. This criterion responds to the greater vulnerability of the country's points of significant flow regarding the risk of international transmission of diseases. Thus, Félix Houphouët-Boigny International Airport of Abidjan (AERIA), the Autonomous Port of Abidjan (PAA) and the land border post of Noé were selected in this study (figure 2).

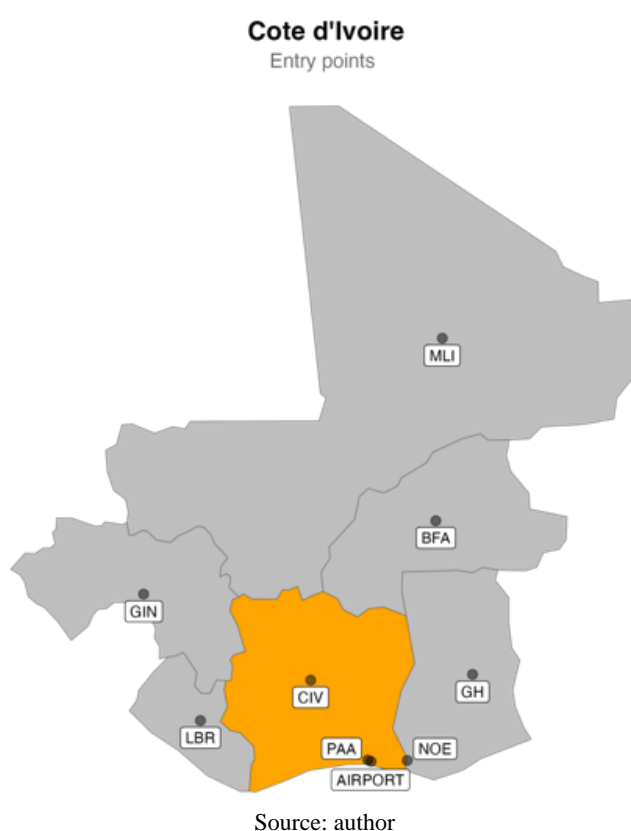


Figure 2. Ivory Coast, neighboring countries, and entry points.

2.3. Data Collection

Data was collected using the WHO tool from August 1st to 30th, 2021 by a multidisciplinary team—medical technicians, epidemiologists experienced in PoE, and representatives of

public and private entities with relationship to activities registered at the PoE. The tool includes items for each core competency that require data sources from interviews with multiple stakeholders from PoE, documentation, and observation [9]. Data collection was carried out following methods established by WHO [9].

The WHO International Health Regulations (IHR) assessment tool utilized in this study is widely recognized and has been extensively validated through its application in various countries, including prior use in Côte d'Ivoire. This established track record underscores its reliability for evaluating core public health capacities. Given its proven effectiveness, the study relied on the standardized methodology prescribed by WHO without conducting additional pre-testing. This ensured alignment with global practices while leveraging the tool's demonstrated robustness in similar contexts.

2.4. Data Analysis

The WHO tool was supported by an excel matrix that generated scores for each core competency.

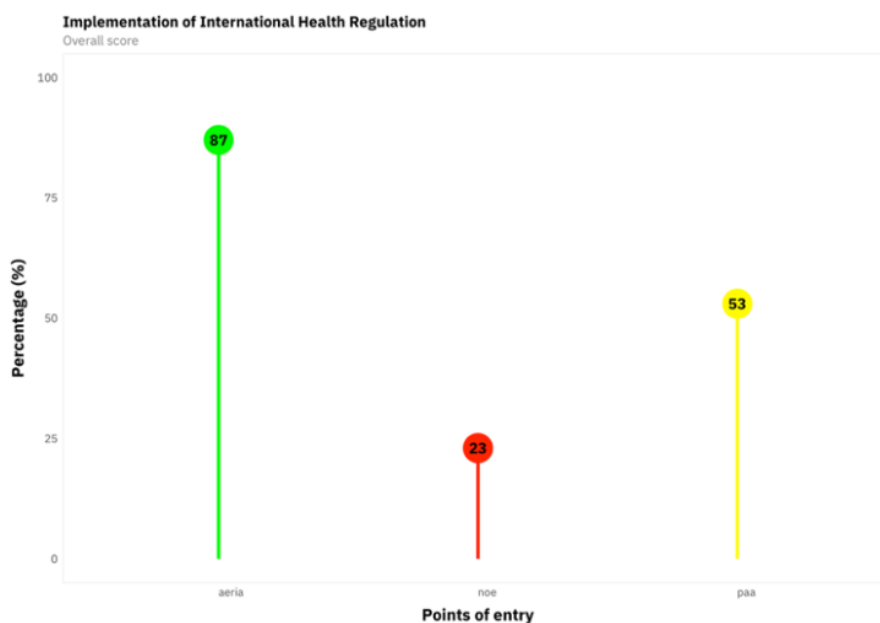
Then data analysis was color-coded based on assigned scores. Colors range from red to green and designated PoE was considered: with significant improvement for scores <50% (red); 50-80% (yellow) with some improvement, and > 80% (green) with fairly consistent with the requirements of IHR. Finally, we exported results in Rstudio 2021.09.0 Build 351 for data visualization.

3. Results

3.1. Overall HIR's Score Across Designated PoE

Overall, the evaluation demonstrated that all Points of Entry (POEs figure 3) garnered a score surpassing 50%, with the exception of the Noé border crossing (23%). AERIA obtained the highest score of 87%, and PAA secured the second-highest score of 53%.

Note: While lower scores, such as Noé's 23%, raise important concerns, it is essential to highlight that the WHO tool is designed to evaluate performance rather than to analyze specific determinants influencing these scores. Exploring socio-economic conditions, infrastructure, or historical health crises could be valuable areas for future research, but they fall outside the scope of this assessment.

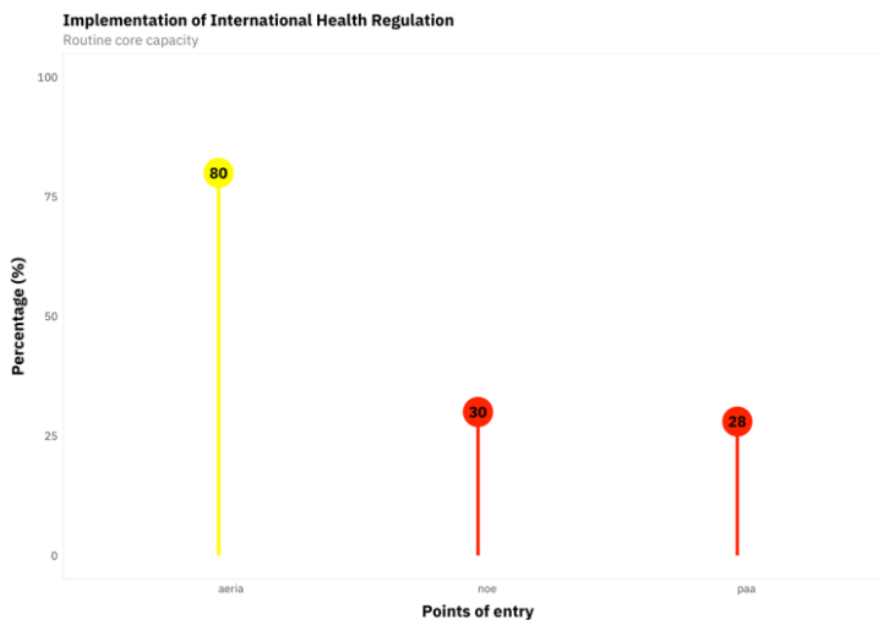


Source: author

Figure 3. Overall score of PoE.

3.2. Implementation of HIR at Designated PoE by Routine Capacities

The routine capacity assessment (figure 4), conducted using the WHO tool, indicated that PAA and Noe ground crossing scored 28% and 30%, respectively, whereas AERIA scored significantly higher at 80%.



Source: author

Figure 4. Routine capacity.

3.3. Implementation of HIR at Designated PoE by PHEIC's Capacity

The Noe ground crossing demonstrated the lowest capacity to respond to Public Health Emergencies of International Concern (PHEICs), with only 40% of the required capabilities in place (Figure 5).

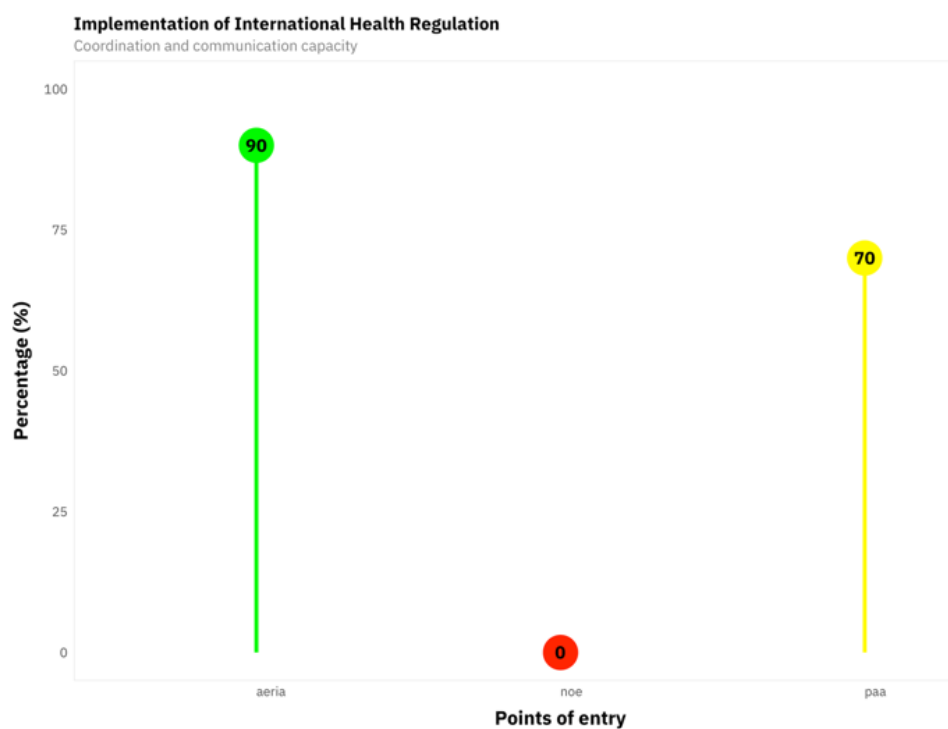


Source: author

Figure 5. PHEIC's capacity.

3.4. Implementation of HIR at Designated PoE by Coordination and Communication's Capacity

The assessment of coordination and communication at the Points of Entry (PoEs [Figure 6](#)) reveals varying levels of performance. AERIA achieved the highest score, with a rating of 90%. PAA scored 70%, and, Noe crossing border received a score of 0%.



Source: author

Figure 6. Coordination and communication capacity.

3.5. Strengths and Weaknesses

3.5.1. Strengths

In Table 1 (appendix), we presented an evaluation of the strengths of Points of Entry (PoEs) in Cote d'Ivoire for the year 2021. AERIA demonstrates good communication links with conveyance operators, travelers, and service providers, along with established procedures for inspections. Similarly, PAA and NOE exhibit fair to good communication links and legal procedures for inspections. Routine services such as medical assistance, equipment availability, and trained personnel for inspection are adequately present at all PoEs. Moreover, PoEs display readiness for PHEIC, with the availability of emergency contingency plans, facilities for isolating or quarantining sick travelers, and trained personnel in personal protective equipment (PPE) use.

3.5.2. Weaknesses

Table 2 (appendix) presents the Assessment of Points of Entry (PoEs) weaknesses in Cote d'Ivoire for the year 2021. AERIA exhibits deficiencies in communication between airport authorities and local/intermediate-level health authorities. PAA and NOE also show communication gaps, with inadequate links between airport authorities and health authorities at various levels. In routine services, all PoEs lack programs for vector and reservoir control and exhibit insufficient hygiene measures. Furthermore, there is a lack of specialized capabilities tailored to the specific type of entry point. Regarding preparedness for Public Health Emergencies of International Concern (PHEIC), there is a notable absence of simulation exercises to test plans, inadequate reviews, and deficiencies in capacity for isolation or quarantine of sick travelers. Additionally, entry and exit screenings for travelers are lacking, and there is no regional center for managing public health.

4. Discussion

4.1. Limitations

The study has multiple noteworthy limitations that require careful consideration. Firstly, the World Health Organization (WHO) questionnaire employed in the study was not pre-tested, despite being assumed to have undergone such a process.

However, the WHO tool is widely recognized and extensively validated through prior use in Côte d'Ivoire and other countries, ensuring its reliability for evaluating public health capacities. The lack of pre-testing in this specific study context is mitigated by its established global credibility and standardized methodology, which aligns with WHO guidelines.

This was discovered during the first administration of the questionnaire, where it was noted that several questions were repeated. To improve the quality of future studies utilizing

similar questionnaires, it is recommended that questions are thoroughly piloted and revised to avoid redundancy.

Our intended sample of stakeholders could not be entirely captured during the evaluation or meeting period, although we made efforts to select officials with extensive knowledge of the core capacity requirements when key officials were unavailable. Moreover, we only assessed three points of entry, and as such, our findings may not be generalizable to the entire country. Nonetheless, it should be noted that these selected points of entry represent the primary entry points to the country. While the sample may not fully represent all PoEs in Côte d'Ivoire, these sites were selected based on criteria that make them critical to the country's public health capacity, including passenger volume and international traffic. This provides a strong basis for extrapolating findings to similar contexts or PoEs.

4.2. Overall HIR's Score Across Designated PoE

The capacity of countries to detect and respond to public health emergencies is a crucial component of implementing the International Health Regulations (IHR). This is binding on all WHO member states and provides a surveillance network for preventing, assessing, and controlling health risks that may lead to the international spread of disease [12]. Compliance with sanitary requirements at points of entry (POE) is a critical component of this implementation, as the IHR 2005 is essential for global health security [13].

The study aimed to evaluate Cote d'Ivoire's capacity to detect and respond to public health emergencies at designated points of entry and identified strengths and weaknesses in three competencies: routine, responding to potential public health emergencies of international concern (PHEICs), and coordination and communication. Using the WHO tool for core capacity requirements, the normative evaluation found that Cote d'Ivoire's designated points of entry were not fully compliant with international health regulations. The evaluation focused on three entry points, AERIA, PAA, and Noe, and found that only AERIA had a score consistent with the IHR requirements. AERIA receives the largest number of human travelers, PAA handles primarily cargo, and Noe has a lower volume of both passengers and goods. The study suggests that the varying risks posed by different points of entry to human health necessitate different responses. Entry points that receive the most human travelers require greater attention to health regulations and monitoring to prevent disease transmission. In contrast, cargo entry points may require less attention as the risk of disease transmission through goods is lower than through human travelers. The differences in the volume and type of travelers and goods at each entry point may explain the variations in scores attained in relation to the IHR requirements. Therefore, it is crucial to tailor responses to the specific risks posed by each entry point to ensure effective implementation of the IHR and promote global health

security.

However, regional collaboration is also critical to enhancing preparedness at PoEs, especially in regions like West Africa where cross-border health threats are prevalent [17]. Strengthening partnerships between countries within ECOWAS can facilitate resource-sharing, coordinated surveillance, and rapid responses to outbreaks [18]. Practical barriers, such as limited funding, weak infrastructure, and political instability, must be addressed to achieve effective cross-border cooperation. Additionally, enhancing logistical support, such as transportation networks and communication systems, is vital for overcoming these challenges [17].

4.3. Implementation of HIR at Designated PoE by Routine Capacities

The implementation of routine competencies at the designated points of entry in Cote d'Ivoire needs significant improvement in 2 out of 3 POEs based on the evaluation. PAA, and NOE, scored below the minimum acceptable level for routine competencies, indicating that they have poor ability to establish measures for regular surveillance and screening of passengers for potential public health risks. This is consistent with a study in Cameroon, where all PoEs including airports, seaport, and ground crossings had lower scores and required significant improvement to acquire IHR routine capacity [14]. However, it contrasts with findings in India [15], which reported fairly consistent IHR compliance at ground crossings.

4.4. Implementation of HIR at Designated PoE by PHEIC's Capacity

The present study's results demonstrate a suboptimal level of preparedness and coordination at Cote d'Ivoire's designated PoE for responding to PHEIC. Specifically, NOE and PAA displayed poor results in this core competencies, indicating their limited ability to recognize, evaluate, and communicate events that might pose a threat to global public health. This insufficiency was uncovered in 2021 when a suspected Ebola case traveled over 500 km by bus from northern Guinea to Ivory Coast without being detected, potentially exposing more than 140 individuals to infection [16]. These findings emphasize the need to prioritize building capacity for responding to PHEICs at designated PoE, to enhance global health security. Comparison with prior studies underscores the urgency of dedicating increased attention and resources towards this aspect of IHR implementation.

4.5. Implementation of HIR at Designated PoE by Coordination and Communication's Capacity

The results of this study showed that the three points of entry assessed did not meet all the core competencies required by the WHO tool. In terms of routine competencies (group I),

all three points of entry scored above the minimum acceptable level, indicating that they had established measures for regular surveillance and screening of passengers for potential public health risks. However, the scores for responding to events that might constitute a PHEIC (group II) and coordination and communication (group III) were below the minimum acceptable level, indicating a lack of preparedness and coordination to respond to public health emergencies.

4.6. Strengths and Weaknesses

The established communication channels between AERIA, conveyance operators, travelers, and service providers reflect the guidelines set forth by the World Health Organization (WHO) for effective collaboration at POEs [4, 9]. Moreover, the presence of legal procedures for inspections and routine services, such as medical assistance, equipment availability, and trained personnel, indicates a fundamental capacity for implementing regular public health measures. Additionally, the existence of emergency contingency plans, isolation/quarantine facilities, and personnel trained in Personal Protective Equipment (PPE) usage demonstrates a level of preparedness for handling PHEIC, in accordance with the International Health Regulations (IHR).

These strengths align with Lokossou's findings [17], who noted that most African countries have adopted and adhere to WHO recommendations for managing healthcare for sick travelers within the region. This preparedness could be attributed to the delayed impact on the Economic Community of West Africa States (ECOWAS) region, where the first case was recorded in Nigeria in late February 2020, in contrast to the early reports of cases in Africa to the WHO in January 2020. This afforded the region, including Cote d'Ivoire, a certain degree of preparation time.

The identified weaknesses are concerning and require immediate attention. The lack of formal communication between airport authorities and local/intermediate health authorities at AERIA, PAA, and NOE poses a significant challenge during emergencies. Effective communication is crucial for rapid response and coordinated action, as emphasized by Merrill [18] in her study.

Another critical weakness lies in the absence of programs for vector and reservoir control, coupled with insufficient hygiene measures at all POEs. This creates a breeding ground for disease transmission and undermines efforts to prevent outbreaks. Studies like the one by Ellwanger [19] highlight the importance of vector control measures at POEs to prevent the introduction of mosquito-borne diseases. Similarly, proper hygiene practices are essential for maintaining a sanitary environment at POEs, as demonstrated by various studies [20, 21] on the role of hygiene in preventing the spread of infectious diseases.

The absence of simulation exercises to evaluate PHEIC response plans emerged as a significant concern across all Points of Entry (PoEs). This issue resonates with findings in other contexts, such as Liberia and Sri Lanka [21, 22]. These

simulation exercises are crucial for pinpointing gaps, enhancing coordination, and verifying the efficacy of emergency response protocols [23].

Moreover, the insufficient review of existing plans and deficiencies in isolation/quarantine capacity further compromised the overall preparedness for PHEICs. Standardized plans are crucial because they provide a framework for coordinated and effective responses to emergencies, ensuring that all stakeholders are well-prepared and aware of their roles and responsibilities. The absence of screening procedures and isolation amenities increases the vulnerability of staff and fellow passengers to contagious illnesses at the Point of Entry (PoE), potentially resulting in a significant disease outbreak within the country if not adequately addressed. Establishing an isolation zone and ensuring safe transportation of ill travelers from the PoE to designated treatment facilities could prevent another widespread disease outbreak, benefiting not only the country but also the entire West African region [21, 17]. Additionally, the absence of entry and exit screenings for travelers presents a significant vulnerability, as highlighted by Lokossou [17] within the region. Such screenings are vital for early detection and containment of infectious diseases, thereby reducing the risk of transmission and the potential impact on public health.

The lack of a regional center for managing PHEICs presented a challenge for coordinated regional response efforts during outbreaks. The establishment of such centers is recommended by WHO for effective disease surveillance and control across borders [4].

5. Conclusion

This study revealed that designated PoEs in Cote d'Ivoire were not fully complying with international health regulations. Targeted efforts, such as enhancing coordination, upgrading infrastructure, and implementing regular training programs, are essential to address these deficiencies. The results of this study provide valuable insights into the strengths and weaknesses of Cote d'Ivoire's capacity to detect and respond to public health emergencies at designated PoEs. To guide policymakers effectively, specific strategies should be prioritized, including establishing inter-agency task forces to improve communication, upgrading technological and physical infrastructure at PoEs, and designing standardized training modules for personnel.

Moreover, regional collaboration through ECOWAS and other mechanisms is critical to enhancing cross-border preparedness. Coordinated initiatives, such as resource-sharing, harmonized protocols, and regional training programs, can address shared challenges and foster resilience in responding to health threats.

These actionable recommendations aim to strengthen Côte d'Ivoire's preparedness and contribute to global health security, particularly in regions prone to cross-border public health threats.

Abbreviations

AERIA	Aéroport International d'Abidjan
ECOWAS	Economic Community of West Africa States
IHR	International Health Regulations
MDG 3	Millennium Development Goal 3
NHDP	National Health Development Plan
PAA	Port Autonome d'Abidjan
PHEIC	Public Health Emergency of International Concern
PoE	Points of Entry
WHO	World Health Organization

Acknowledgments

This section serves to recognize contributions that do not meet authorship criteria, including technical assistance, donations, or organizational aid. Individuals or organizations should be acknowledged with their full names. The acknowledgments should be placed after the conclusion and before the references section in the manuscript.

Author Contributions

Bangaman Christian Akani: Conceptualization, Formal Analysis, Methodology, Writing – original draft

Youssef Traore: Conceptualization, Methodology, Writing – review & editing

Alfred Douba: Data curation, Methodology, Writing – review & editing

Awa Madaho Samassi-Sokodogo: Supervision, Writing – review & editing

Dionkounda Aristide: Funding acquisition, Validation, Writing – review & editing

Marie Noelle Ano: Writing – review & editing

Nicaise Bernadin L'Épri Aka: Validation, Writing – review & editing

Funding

This work is supported by Tackling Deadly Diseases in Africa.

Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

Appendix

Table 1. Assessment of PoEs' strenghts, Cote d'Ivoire 2021.

Core capacity	AERIA	PAA	NOE
Coordination and communication	Good communication link with conveyance operators, travelers for health-related information, service providers Existence of procedures and legal and administrative provisions to conduct inspections good communication link between the airport health post and the national IHR focal point via an internal communication network for the transmission of information and recommendations from WHO	Existence legal procedures for inspections of conveyances Fair communication link with travelers for health-related information and service providers	
Routine	Availability of a medical service Availability of equipment and personnel to enable the transport of sick/suspect passengers to an appropriate medical facility Availability of trained personnel for inspection Availability of special capacities	Availability of a medical service Availability of equipment and personnel to enable the transport of sick/suspect passengers to an appropriate medical facility Availability of trained personnel for inspection Availability of program for vectors and reservoir control and trained personnel to undertake the vector disease surveillance	Availability of trained personnel for inspection
PHEIC	Availability of public health emergency contingency plan Availability of capacity for assessing care for affected travelers/ animals Availability of space for interview suspect/ suspect travellers Availability of capacity for isolation or quarantine of sick travellers Trained personnel on PPE use	Availability of capacity for assessing care for affected travelers/ animals Availability of space for interview suspect/ suspect travellers Trained personnel on PPE use	Availability of capacity for assessing care for affected travelers/ animals Availability of capacity for isolation or quarantine of sick travellers Trained personnel on PPE use

Table 2. Assessment of PoEs' weaknesses, Cote d'Ivoire 2021.

Core capacity	AERIA	PAA	NOE
Coordination and communication	Communication deficiency between airport authorities and local/intermediate-level health authorities.	Fair an international communication network with competent authorities of the destination POEs Fair communication link with conveyance operators Fair communication between airport authorities and local/intermediate-level health authorities Fair communication link between the seaport health post and the national IHR focal point via an internal communication network for the transmission of information and recommendations from WHO	Lack of an international communication network with competent authorities of the destination POEs Lack of communication between airport authorities and local/intermediate-level health authorities Lack of communication link between the seaport health post and the national IHR focal point via an internal communication network for the transmission of information and recommendations from WHO Lack of procedures and legal and administrative provisions to conduct inspections

Core capacity	AERIA	PAA	NOE
Routine	Lack of a program for vectors and reservoir control and trained personnel to undertake the vector disease surveillance	Fair hygiene of services used by travelers at the entry point Fair specialized capabilities tailored to the specific type of entry point.	Lack of a program for vectors and reservoir control and trained personnel to undertake the vector disease surveillance Lack of hygiene of services used by travelers at the entry point Lack of specialized capabilities tailored to the specific type of entry point
PHEIC	Lack of simulation exercises to test the developed plans Lack of pre- and post-action reviews	Lack of simulation exercises to test the developed plans Lack of in- and after-action reviews Lack of capacity for isolation or quarantine of sick travellers Lack of entry and exit screenings for travelers upon arrival and departure Public health emergency contingency plan not yet approved	Lack of simulation exercises to test the developed plans Lack of pre- and post-action reviews Lack of entry and exit screenings for travelers upon arrival and departure Availability of space for interview suspect/suspect travellers No regional center for the management of public health emergencies

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