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Applying a New Framework for Public Health Systems Recovery following Emergencies and Disasters: The Example of Haiti following a Major Earthquake and Cholera Outbreak

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Abstract. Emergencies can often directly impact health systems of an affected region or country, especially in resource-constrained areas. Health system recovery following an emergency is a complex and dynamic process. Health system recovery efforts have often been structured around the World Health Organization's health systems building blocks as demonstrated by the Post-Disaster Needs Assessment. Although this structure is valuable and well known, it can overlook the intricacies of public health systems. We retrospectively examine public health systems recovery, a subset of the larger health system, following the 2010 Haiti earthquake and cholera outbreak, through the lens of the 10 essential public health services. This framework illustrates the comprehensive nature of and helps categorize the activities necessary for a well-functioning public health system and can complement other assessments. Outlining the features of a public health system for recovery in structured manner can also help lay the foundation for sustainable long-term development leading to a more robust and resilient health system.

INTRODUCTION

Emergencies often have a direct impact on the health systems and public health systems of an affected region or country, particularly in resource-constrained areas.[1–5] The effects of an emergency on the performance and capacity of these systems depend upon a variety of interrelated factors, which include the predisaster status of the systems, the type of emergency, the effectiveness of the response, and the initiation of recovery activities.[6,7] Health system recovery following an emergency is an intricate and dynamic process. The response is often still occurring as the steps toward recovery begin, although during this period recovery work is not recognized as the primary focus.[8]

The strategic objectives and operating procedures used to guide, develop, and initiate health system response and recovery plans are often framed by the World Health Organization (WHO) health system building blocks (Figure 1[9]), which are primarily used to inform health development priorities and plans. For example, the health subsector of WHO's Post-Disaster Needs Assessment (PDNA) guidelines focuses on this framework.[10] Although this structure has proven quite useful and there is extensive familiarity with it, it can overlook the intricacies of public health systems. In addition, the building blocks have often been used to characterize health systems rather than analyze them. To highlight public health system recovery, we retrospectively examined recovery work in Haiti through the framework of the 10 essential public health services (EPHSs) (Figure 2[11]). We used this alternate framework to illustrate the comprehensive nature of the public health systems recovery effort undertaken by the Haitian Ministry of Public Health and Population (MSPP) in conjunction with the U.S. Centers for Disease Control and Prevention (CDC), other U.S. government (USG) and United Nations agencies, as well as nongovernmental organizations, private foundations, and other bilateral organizations in response to the earthquake and cholera outbreak in Haiti in 2010. In addition, the EPHS can provide a complementary approach to the PDNA or other assessments, which can add value to current frameworks. We also discuss the applicability of the EPHS to a global context and how they relate to other frameworks that have applicability to recovery settings.

Recovery and public health services. Early recovery work aims to accompany response activities by capitalizing on existing emergency and humanitarian programs, supporting community initiatives, and establishing a path for longer term recovery.[12–15] Early recovery also complements the response in addressing emergent postdisaster issues that existing health plans may no longer adequately address. Existing country programs may need to be reviewed in the context of new and evolving postdisaster priorities, to create new operational strategies.[12,16] Transitional strategies for the reinvigoration of disrupted health services need to be implemented, while reexamining longer term operational plans.[8,16] Nonetheless, the movement between relief, recovery, and development is fluid, especially in fragile states where emergencies may be frequent or recurring.[17] This is evident in Haiti as well, where the recent Humanitarian Response Plan states that the transition from response to longer term programming "should be seen as a convergence process rather than sequential since the humanitarian and development needs occur simultaneously."[18]

WHO has developed and expanded on a general framework for describing health systems composed of six building blocks including service delivery, health workforce, health information, medical commodities (including products, vaccines, and technology), financing, and leadership and governance (Figure 1).[19,20] Although the WHO framework incorporates essential public health systems to some extent, further emphasis on public health services and programs is needed, especially in the context of recovery. That emphasis needs to account for many factors that influence the organization, priorities, quality, and performance of a public health system.

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Service Delivery	Deliver effective, safe, quality personal and non-personal health interventions to those who need them, when and where needed, with minimum waste of resources
Health Workforce	Works in ways that are responsive, fair and efficient to achieve the best health outcomes possible, given available resources and circumstances. I.e. There are sufficient numbers and mix of staff, fairly distributed; they are competent, responsive and productive
Information	Ensures the production, analysis, dissemination and use of reliable and timely information on health determinants, health systems performance and health status
Medical Products, Vaccines and Technologies	Ensures equitable access to essential medical products, vaccines and technologies of assured quality, safety, efficacy and cost-effectiveness, and their scientifically sound and cost-effective use
Financing	Raises adequate funds for health, in ways that ensure people can use needed services, and are protected from financial catastrophe or impoverishment associated with having to pay for them
Leadership/Governance	Ensuring strategic policy frameworks exist and are combined with effective oversight, coalition building, the provision of appropriate regulations and incentives, attention to system-design, and accountability

Source: WHO. Everybody's Business: Strengthening health systems to improve health outcomes. 2007

FIGURE 1. The World Health Organization (WHO) Health Systems Framework. Source: WHO.[9]

These factors are often driven by a country's history, the broader political climate, socioeconomic conditions, governance, and in some cases, existing internal capacity to respond and recover from disasters.[18] Each country has unique obstacles in strengthening its public health system and must decide how best to prioritize and address them. In the case of Haiti, a history of instability, insecurity, and recurring emergencies has contributed to increased vulnerability and this context must be kept in mind. Involvement of national and local governments is therefore also essential to developing suitable recovery plans.[8,10,12] As previously indicated, we used the EPHS framework in this paper to retrospectively examine issues related to public health system recovery in Haiti (Figure 2).

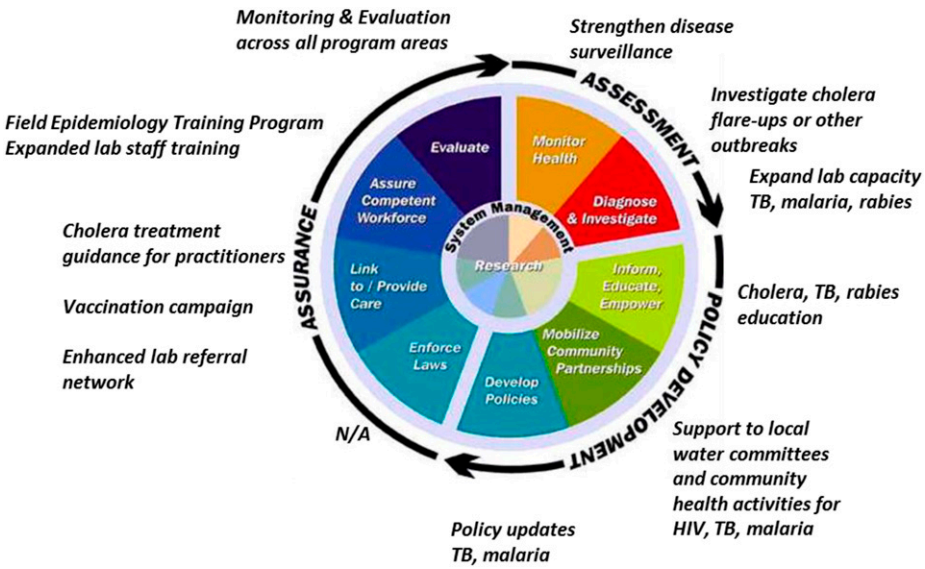

FIGURE 2. The 10 essential public health services and Centers for Disease Control and Prevention Health Systems Recovery Program in Haiti. Source: CDC.[11] This figure appears in color at www.ajtmh.org.

Public health systems recovery in Haiti. On January 12, 2010, Haiti was struck by a 7.0-magnitude earthquake, which was estimated to have killed over 200,000 people, left millions in need of urgent medical attention, and devastated an already weak national infrastructure.[10] More than 1.5 million people were displaced when their homes were destroyed, raising concern for increased risk of epidemic-prone diseases.[21] Although disease outbreaks do not spontaneously follow natural disasters, risk can be increased given such factors as displaced populations, poor water and sanitation, and decreased access to health services.[22,23] However, this did not occur immediately in spite of the size of the movement of population, the environmental condition, or the high incidence level of most common communicable diseases.

A large-scale response to the earthquake was mounted that involved multiple organizations and included the activation of the health cluster coordination group, a coordinating group for both local and international organizations that is typically led by the host country ministry of health and Pan American Health Organization (PAHO)/WHO. Less than a year after the earthquake, Haiti was hit by another disaster. It had its first case of cholera suspected by Cuban brigades and PAHO on October 18 and confirmed by the Haitian National Public Health Laboratory on October 21, 2010.[24] The cholera outbreak placed further stress on an already fragile health system in the early stages of recovery following the earthquake. The lack of water and sanitation infrastructure and services compounded by the weakness of the system and the economy were the main contributors to the widespread epidemic.[25,26]

Several recovery plans were developed in the wake of these two emergencies. Following the earthquake, the government of Haiti, with support from the international community, developed an Action Plan for National Recovery and Development, which was based on the PDNA and other considerations.[27,28] The cholera outbreak in October 2010 saw a similar collaboration between the Haitian government and partners with the development of a specific national plan for the elimination of cholera.[29] In keeping with the PDNA process, these plans included elements of risk reduction to increase resilience. In the public health arena, MSPP, in close collaboration with key national and international partners within the health cluster, developed recovery plans focused on national public health issues of importance that were also linked to previous government health strategies. Immediate public health priorities for cholera concentrated on improving surveillance, water and sanitation, alert and response, and laboratory capacity to assist with detection and response of cholera and other public health threats.[13,25,30] Additional public health priorities were determined by examining public health programs in need of investment in the medium to long-term time frame.[31,32] Developing workforce and emergency response capacity within public health were some of the areas included in these longer term efforts. Although disease burden was a factor in determining areas of focus, it was not the only consideration, as MSPP priorities, including expanding access to public health services for all Haitians, also influenced the process.[33,34] Furthermore, MSPP sought to increase collaboration across programs recognizing the value of integrating public health services and leveraging the limited resources available in the country.[35] A body within MSPP was entrusted with the coordination of the cholera response. Finally, the Millennium Development Goals were an additional reference point in the development of recovery plans, underscoring the fundamental interconnection between response and longer term programming, even in fragile situations where recurrent emergencies occur.

The PDNA and other assessments, allowed the Haitian government, along with key stakeholders to develop a public health recovery strategy addressing surveillance, laboratory strengthening, and water, sanitation and hygiene (WASH), in addition to longstanding public health development challenges the country had faced before the earthquake and cholera outbreak, such as tuberculosis (TB), human immunodeficiency virus, and maternal and child health.[36] Stakeholders, including MSPP, the PAHO, WHO, USG, and other partners, participated in defining high-level public health goals to improve the public health system in Haiti through post-earthquake and cholera recovery efforts.[37,38] This work was initially done through the health cluster, which at the beginning of the response was led by PAHO/WHO.[39] This cluster approach resulted in sector-specific gap analyses, which were used to guide MSPP and partners through the process of strategic planning that aligned goals and defined qualitative and quantitative indicators and implementation targets. This approach assisted in defining priorities, mobilizing stakeholders, targeting funding, informing program development, and monitoring implementation.[36] There were challenges with the cluster system, including initial coordination and information management, but there were also eventual successes as seen with surveillance and WASH.[40] As recovery progressed over the years, coordination transitioned from the health cluster to MSPP and longer term goals were jointly developed to further focus resources and align priorities as is seen in the Haiti Health Plan, 2012–2022.[34] These goals were broadly disseminated to encourage, with limited success, coordination of resources by partners investing in health in Haiti. In addition, programs examined where resources could be shared and aligned to maximize impact, in line with recent studies examining the side effects of disease-specific programs that may have the unintended consequence of decreasing overall health system capacity with a focus on vertical systems.[41]

A framework for public health systems recovery. The public health recovery efforts undertaken by MSPP and other partners in response to both disasters in Haiti were intended to achieve the broader goal of strengthening the health system and core public health services. These services can be seen as those fundamental actions performed to address the determinants of health with the aim to improve, promote, protect, and restore the health of the population through the organized efforts of society.[42,43] For the purposes of this paper, we examine public health recovery efforts in Haiti through the lens of CDC's EPHS framework. This was done retrospectively to examine the utility of this framework in complementing assessments such as the PDNA. The EPHS were not used to structure activities during recovery, although there was a conscious effort by MSPP and partners to ensure that a broadly comprehensive approach was taken. The EPHS "describe the public health activities that all communities should undertake," and provide both a conceptual basis and reference for defining and organizing key activities necessary for a well-functioning public health system.[11]

Figure 2 illustrates the three core functions (assessment, policy development, and assurance), and the 10 essential

services of public health as outlined in the EPHS.[44,45] Research is one of the essential services, as well as a cross-cutting activity that, along with systems management, spans across the core functions and other essential services. Recovery efforts in Haiti covered virtually the entire spectrum of these public health activities, as outlined in Table 1. This is by no means an exhaustive list; however, its purpose is to highlight examples of key aspects of the public health recovery effort as they align with the EPHS. Although these efforts have been summarized elsewhere,[30,31] the purpose of this paper is to place them within a comprehensive public health framework illustrating the integrated nature of the recovery program in Haiti. Figure 2 also illustrates the broad range of recovery activities that CDC and other partners supported in Haiti and demonstrates how they align closely with the core functions and essential services, helping to maximize the impact of recovery activities as program efforts returned to development. For example, within the assessment phase, strengthening disease surveillance and laboratory capacity were key elements of recovery and development; this included a variety of diseases beyond cholera. In the policy development phase, health education was crucial for prevention, both at the community level for cholera, and in health-care facilities for TB. Within the assurance phase, multiple efforts aimed at strengthening public health workforce capacity were implemented, including the establishment of the Field Epidemiology Training Program to train Haitian epidemiologists.[36] Developing workforce capacity also took place through helping establish other new programs, such as the Rural Water and Sanitation Technicians for the Communes of the National Directorate for Potable Water and Sanitation (DINEPA)[46] and providing cholera treatment guidance for practitioners initially unfamiliar with the disease. Leveraging existing system financial and administrative management capacity was also included, as exemplified by the financial oversight provided by MSPP through the program management unit originally set up under the President's Emergency Plan for AIDS Relief program and expanded for response and recovery work. Research was an integral aspect of multiple programs such as vaccine effectiveness and coverage studies included in oral cholera vaccination efforts.

Resources were directed to MSPP and other Haitian government agencies such as DINEPA, as building their capacity was critical to long-term recovery and development efforts. Recovery efforts in Haiti were also designed to be multipurpose and mutually reinforcing. For example, strengthening laboratory-enhanced disease surveillance before and after the earthquake facilitated rapid detection and identification of the cholera outbreak.[25] Similarly, training programs for health-care workers were designed to take advantage of cross-training opportunities to broaden expertise among staff, so they could support several programs at their sites, as opposed to only working on a single-funded program.[36]

The above discussion illustrates the integrated, inclusive, and "diagonal" approach to postdisaster public health system strengthening taken in Haiti.[47,48] This method was designed to broadly strengthen public health programs in Haiti using a horizontal approach, while also allowing for integration of vertical, disease-specific programs that are commonly seen in public health. As such, it provides a potential example for structuring public health systems strengthening programs whether in the postdisaster setting or for routine development.

Recovery activities in Haiti predated the development of the Global Health Security Agenda (GHSA) and the Joint External Evaluation (JEE) process associated with GHSA. In addition, the JEE is designed more as an assessment rather than a tool for recovery. Nonetheless, the areas identified and activities undertaken during recovery in Haiti reflect public health priorities of GHSA, namely, strengthening surveillance, laboratory, and workforce capacity and improving emergency response.[49–51] These same priorities reflect key elements related to public health that are included within the 2005 International Health Regulations (IHRs) core capacities, including surveillance, laboratory, preparedness, and response.[50,52] This underscores the broad nature of the EPHS, which is to say that they can be used throughout response, recovery, and development to structure public health activities.

DISCUSSION

The Haiti earthquake and cholera emergencies depended on a large coalition of national and international partners to assist in response and recovery efforts. This extensive action followed many of the suggested modalities for recovery work in a postemergency or disaster setting, as exemplified by the use of the PDNA to provide information for policy and strategy setting.[8] In addition, plans from MSPP, such as the Action Plan for National Recovery and Development of Haiti and the Haiti Health Plan, 2012–2022,were established early that served as a basis for the strategic planning for recovery efforts.[27,34] Many of the priorities helped reinforce the EPHSs of the health system. Six years after the earthquake, progress is evident in many areas as demonstrated by examples listed in Figure 2 and Table 1 and also documented elsewhere.[30,31,36] However, Haiti faces yet another challenge in the aftermath of Hurricane Matthew.

Though the field of health systems recovery remains relatively nascent, several frameworks have been developed.[8,12,14,53] However, many of these examine the broader health system in the context of the WHO building blocks, with considerable emphasis on service delivery systems. We have presented the EPHS as a complementary model focused on public health systems. We applied the EPHS to retrospectively examine the structure of public health system recovery activities in Haiti. This analysis indicated that public health system recovery in Haiti was comprehensive and broadly based and a broad spectrum of accomplishments was noted (see Figure 2 and Table 1). As indicated in the aforementioned documents on various frameworks for recovery, increased detail for the various recovery sectors is needed to tailor strong recovery plans toward an eventual reconvergence with long-term development programs with a prioritized strategic and operational approach that is well aligned with national and international health sector priorities. Developing such a plan-assisted MSPP, PAHO, CDC, and other partners to develop comprehensive and integrated activities and indicators, helping to lead to multiple successful outcomes.[30] PAHO's cooperation with Haiti was completely reviewed including major change in staff and

TABLE 1
Recovery Programs examples in Haiti and the 10 EPHS

Core function	EPHS	Recovery activities in Haiti
Assessment	Monitor health	Launched national syndromic surveillance system in health facilities and IDP camps
		Established national laboratory-enhanced sentinel surveillance system linking laboratory testing for priority diseases (e.g., measles, rubella, diphtheria) to epidemiologic data
		Strengthened/established disease/condition-specific surveillance activities, including for cholera, malaria, maternal health, rabies, and TB
	Diagnose and investigate	Identification/investigation of cholera flare-ups and other outbreaks
		Development of response plans for cholera flare-ups and Ebola preparedness
		Improved laboratory capacity to diagnose TB, malaria, rabies
Policy development	Inform, educate, empower	Community health education/promotion, including by mass media, on cholera prevention, including WASH
		Health-care worker training on TB, including infection, prevention, and control
	Mobilize community partnerships	Support to local water committees managing rural piped drinking water systems through DINEPA
		Established regional coalition for water and sanitation to eliminate cholera in Hispaniola, with membership from over 20 international organizations
		Funding of community health activities for HIV, TB, malaria
	Develop policies	Revised national policies on malaria diagnosis and case management
		Assisted in development of national policy/procedures on TB testing
Assurance	Enforce laws	No specific activities are included here, but technical assistance to develop policies provided
	Link to/provide care	Provided guidance and training on cholera treatment guidance for practitioners initially unfamiliar with the disease
		Rapid restoration and expansion of HIV/AIDS treatment services following earthquake
		Implemented and evaluated national measles-rubella vaccination campaign
		Greatly expanded mass drug administration against lymphatic filariasis
		Enhanced laboratory specimen referral network, which has included HIV, TB, cholera, and other disease-surveillance specimens
	Assure competent workforce	Established Field Epidemiology Training Program, resulting in over 200 graduates that have worked on cholera, dengue, and chikungunya outbreaks in Haiti
		Established Rural Water and Sanitation Technicians for the Communes program within the National Potable Water and Sanitation Directorate, placing over 250 technicians in all communes outside metropolitan Port-au-Prince
		Trained laboratory staff on testing for TB, rabies, malaria
		Established GIS capacity within MSPP
	Evaluate	Evaluation of immunization campaigns, including measles-rubella and oral cholera vaccines
		Evaluated KAP related to cholera in Artibonite Department
Cross-cutting across all core functions	Research	Compared RDTs and microscopy for malaria diagnostic testing
		Conducted vaccine effectiveness and coverage studies for OCV
	Systems management	Strengthened management capacity in MSPP and DINEPA through technical assistance and funding support
		Reinforced existing financial management capacity originally established within MSPP by PEPFAR

AIDS = acquired immune deficiency syndrome; DINEPA = Directorate for Potable Water and Sanitation; GIS = geographic information system; HIV = human immunodeficiency virus; IDP = internally displaced persons; KAP = knowledge, attitudes and practices; MSPP = Haitian Ministry of Public Health and Population; OVC = orphans and vulnerable children; PEPFAR = President's Emergency Plan for AIDS Relief; RDT = rapid diagnostic test; TB = tuberculosis; WASH = water, sanitation and hygiene.

funding for example in essential medicine, vaccination, or attention to pregnant women.

Within the context of public health system recovery work in Haiti, several lessons learned reinforce what has been documented elsewhere, but their importance merits being highlighted. Priority setting at a more refined level is key to ensuring the most relevant and impactful activities are implemented.[8,33] This activity should take into account new, exigent priorities driven by the emergency in context with preexisting country objectives. The feasibility of implementing prioritized activities, including accounting for the capacity of implementing partners such as ministries of health, must also be examined when setting priorities. With reference to the EPHS, the significance of policy development, workforce, communication, and research was critical. The WHO European office, with their Essential Public Health Operations (EPHOs), has designated these as enabler functions, which are those functions that allow the other functions to operate.[54]

For broader application in the global context and potential use in other settings, some modifications to the EPHS would be needed and other frameworks can inform those changes. For example, the EPHS do not encompass governance and financing, both of which are crucial features for any system, as demonstrated by their importance in the WHO building blocks and the EPHOs. Governance is embedded within the EPHS through the cross-cutting element of system management, but may need to be elaborated and made more specific. All of these factors together aim to create a more resilient health system. In addition, any framework used to structure or analyze recovery activities, should ensure alignment with and integration of principles from IHR core capacities, as these have been become global guidelines for public health functions. As discussed earlier, the EPHS, as one potential framework, do incorporate many key elements from the IHR. Nonetheless, further alignment with the IHR would strengthen the framework in addition to making it more familiar to a global audience.

Stakeholder and implementing partner activities and timelines for implementation need to be regularly addressed. This is in line with the Inter-Agency Standing Committee (the primary mechanism for interagency coordination of humanitarian assistance and designation of clusters) on humanitarian assistance recommendations to use the 4Ws (Who, What, When, Where) to map activities from all partners.[55] Although it was initially tailored to the response, similar recommendations can be made for recovery.[12] An appropriate timeline will enable smoother handover to the government or another implementing partner and prevent avoidable gaps in activities and the provision of services.

A strong public health system recovery contributes to broader recovery and health development objectives as a whole. This complements the integrated process for disaster risk reduction. The response and recovery process are being seen as part of the disaster risk reduction continuum, which also includes preparedness, response, mitigation, and sustainable development.[56] Capitalizing on the response and recovery process to enhance established development programs is more easily accomplished with strong, detailed frameworks from which countries and partners can work. The EPHS provide one potential model for such a framework, although, as discussed earlier, some modifications may be necessary for broad global applicability.

CONCLUSION

Public health systems recovery from emergencies and disasters is complex. Nonetheless, when undertaken in a structured and transparent manner, it can help to lay a foundation for transitioning to sustainable long-term development and make public health systems more robust and resilient to future disasters.[57] Recovery should build on and augment response programs while also complementing previous health system plans that were in place before an emergency or disaster. Ideally, planning for recovery begins during the response phase. Utilizing a framework such as the 10 EPHSs can help to structure public health recovery activities, and ensure that they are comprehensive and integrated, especially when implemented in conjunction with multiple stakeholders, including host governments. As Haiti begins its recovery from Hurricane Matthew, this type of framework may prove useful. Other frameworks such as the JEE process within the GHSA, which were not yet available during Haiti's recovery from the 2010 emergencies could also be used to help ensure that recovery is undertaken in a structured and comprehensive manner. The EPHS were used in this analysis because they provided a straightforward, existing structure and method to retrospectively examine public health recovery in Haiti.

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