Implementation of an Alert and Response System in Haiti during the Early Stage of the Response to the Cholera Epidemic

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Abstract. The start of the cholera epidemic in Haiti quickly highlighted the necessity of the implementation of an Alert and Response (A&R) System to complement the existing national surveillance system. The national system had been able to detect and confirm the outbreak etiology but required external support to monitor the spread of cholera and coordinate response, because much of the information produced was insufficiently timely for real-time monitoring and directing of a rapid, targeted response. The A&R System was designed by the Pan American Health Organization/World Health Organization in collaboration with the Haiti Ministry of Health, and it was based on a network of partners, including any institution, structure, or individual that could identify, verify, and respond to alerts. The defined objectives were to (1) save lives through early detection and treatment of cases and (2) control the spread through early intervention at the community level. The operational structure could be broken down into three principle categories: (1) alert (early warning), (2) verification and assessment of the information, and (3) efficient and timely response in coordination with partners to avoid duplication. Information generated by the A&R System was analyzed and interpreted, and the qualitative information was critical in qualifying the epidemic and defining vulnerable areas, particularly because the national surveillance system reported incomplete data for more than one department. The A&R System detected a number of alerts unrelated to cholera and facilitated rapid access to that information. The sensitivity of the system and its ability to react quickly was shown in May of 2011, when an abnormal increase in alerts coming from several communes in the Sud-Est Department in epidemiological weeks (EWs) 17 and 18 were noted and disseminated network-wide and response activities were implemented. The national cholera surveillance system did not register the increase until EWs 21 and 22, and the information did not become available until EWs 23 and 24, when the peak of cases had already been reached. Although many of the partners reporting alerts during the peak of the cholera epidemic have since left Haiti, the A&R System has continued to function as an Early Warning (EWARN) System, and it continues to be developed with recent activities, such as the distribution of cell phones to enhance alert communication.

INTRODUCTION

On October 21, 2010, cholera was confirmed for the first time in Haiti in over a century. The outbreak spread rapidly through an earthquake-devastated country; in less than one month after initial detection (from October 19 to November 15 of 2010), cholera had spread throughout the ten departments of Haiti and into neighboring Dominican Republic.

Since the beginning of the epidemic in Haiti, the Pan American Health Organization, Regional Office of the World Health Organization (PAHO/WHO) provided urgent technical support in the response to this emergency to the Haiti Ministry of Health (Ministère de la Santé Publique et de la Population [MSPP]). During the first phase of the response from October of 2010 to March of 2011, PAHO/WHO deployed more than 150 personnel, including experts from the Global Outbreak Alert and Response Network (GOARN). Key to response support was the Alert and Response (A&R) System set up in early November of 2010 in collaboration with the MSPP to detect, verify, assess, and urgently respond to cholera events requiring immediate action. This A&R System complemented

the existing national cholera surveillance system in monitoring the spread of the disease and guiding the allocation of prevention and control resources across the country.

This paper aims to describe the A&R System and draw lessons from this experience to strengthen research and analysis of A&R Systems, contribute to building capacity of both national and international multisectorial institutions, and improve the application of A&R Systems in the future by national and international actors in the context of the new International Health Regulations (IHR) (2005).[1]

Historical context. In January of 2010, Haiti was struck by an earthquake measuring 7.0 on the Richter scale. It left an estimated 230,000 people dead, 300,000 people injured, and 1.3 million people homeless. The impact of the earthquake on the structures of the health sector was dramatic. The three most affected departments in the country, Nippes, Ouest, and Sud-Est, experienced severe damage or complete destruction of 60% of their hospitals. Management capabilities of the MSPP were also greatly affected, because 40% of MSPP buildings and training facilities were destroyed; also, 67% of MSPP staff were left homeless. Around 600,000 people were internally displaced to other departments because of the earthquake, causing a new category of vulnerable persons to emerge in the form of internally displaced persons (IDPs). The increase in IDPs put pressure on host populations and local healthcare systems.[2]

In early 2010, national epidemiological information in Haiti came primarily from two sentinel systems, one system

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managed by the Cuban Medical Brigades (BMC), with personnel in 83 of 133 municipalities, and the other system from the US Centers for Disease Control and Prevention (CDC), which included 51 sentinel sites in the President's Emergency Plan for AIDS relief (PEPFAR)-funded surveillance network for reporting on human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS). These sites became the post-disaster National Sentinel Site Surveillance (NSSS) System.[3] In addition, a complementary system was developed to support disease surveillance among IDPs. This system, known as the IDP Surveillance System (IDPSS), was created by the MSPP, PAHO/WHO, and CDC to monitor communicable diseases in temporary clinics serving IDPs after the earthquake.[4] The MSPP with CDC support also expanded diagnostic capacity at the national laboratory of Haiti (Laboratoire National de Santé Publique) to identify reportable pathogens, including *Vibrio cholerae*.[5]

Data were also being collected by many private and independent response partners, such as international non-governmental organizations (NGOs), for their own reporting and documentation needs.

Emergence of the cholera outbreak. On October 19, 2010, the emergence of cholera, an epidemic disease new to Haiti,[6] made the already difficult humanitarian situation even more complex. The absence of health facilities in many areas and any practical knowledge about cholera as well as the poor pre- and post-earthquake water, sanitation, and living conditions throughout Haiti posed a major public health threat as cholera began to spread. The lack of experience and capacity of local actors in assessment resulted in an underestimation of the speed at which cholera would become a major outbreak across the entire country and rapidly overwhelm the already limited national capacity to respond.[7] Outbreaks in remote rural areas were of special concern, because of both scant resources and limited infrastructure to treat cases and implement cholera prevention activities.

During the first weeks of the epidemic, a *National Response Strategy against cholera* was developed by the MSPP with technical support from PAHO/WHO, CDC, and other United Nations (UN) agencies and partners. This response strategy had two primary objectives:

(1) Save lives through the early detection of cases and appropriate treatment, by establishing oral rehydration posts (ORPs), cholera treatment units (CTUs), and cholera treatment centers (CTCs).
(2) Prevent the spread of disease by reducing the rate of infection at the community level through social mobilization and health promotion, deployment of community workers, distribution of oral rehydration packets, management of dead bodies, and other response activities.

In response to the outbreak, PAHO/WHO provided rapid technical support to the MSPP that included material resources and mobilization of epidemiologists and international experts in risk communication, case management, disaster response, laboratory diagnosis, water and sanitation, and outbreak logistics, such as the Logistics Support System and Humanitarian Supply Management System (LSS/SUMA).[8]

On October 24, 2010, five days after the cholera outbreak was detected, the MSPP and PAHO/WHO sent an alert to GOARN and requested assistance for support with field epi-demiologists, case management and infection control experts, and logisticians. As of October 31, 2010, the epidemic was already affecting five of ten departments—Artibonite, Center, Nord, Nord-Ouest, and Ouest—in Haiti.[9] The national health system had been able to detect and confirm the outbreak etiology but required external support to monitor the spread of the disease and direct and coordinate response.

National cholera surveillance system. On November 1, 2010, a disease-specific indicator-based surveillance system supported by the CDC was initiated, because the existing reportable disease surveillance systems were unable to provide the necessary accurate and timely information on cholera.[5]

This disease-specific surveillance was set up in parallel to the existing NSSS and started operating on November 1, 2010. A case definition for cholera was commonly agreed on among the MSPP, PAHO, CDC, and other partners and distributed to healthcare institutions together with a specific case reporting form.[10] Up to December of 2010, the case definition included any person with three or more liquid stools with or without vomiting in the last 24 hours. From mid-December of 2010, the case definition was any case of profuse acute watery diarrhea with or without vomiting in a department affected by cholera (from November 21, 2010, all departments were affected).

All treatment facilities were requested to report the number of cholera cases and deaths (observed and hospitalized) separated by age group (less than 5 years and all ages) to the Health Directorates at the department level on a daily basis. The department-level data were aggregated and sent to the national level (Directorate of Epidemiology, Laboratory and Research). Reporting facilities included the NSSS sentinel sites, health facilities from IDP camps, and all CTCs and CTUs, regardless of their affiliation—most CTCs and CTUs were affiliated with NGOs or the BMC.

Data collected were analyzed at the national level, and daily reports with the number of cases and deaths, institutional and global case-fatality rates, and epidemic curves for each department were posted on the MSPP website: www.mspp.gouv.ht.

Setting up an A&R System during a cholera outbreak. In Haiti, the quantitative data provided by the national cholera surveillance system implemented at the beginning of the epidemic proved sufficient to describe the trend of the epidemic. However, this indicator-based system lacked an early warning component, and the information produced was untimely and insufficient for real-time monitoring and to direct a rapid, targeted response. For instance, daily cholera reports were generally published by the MSPP with a two to three week time lapse and limited to cases observed at healthcare facilities; information on community cases and deaths (for example, cases treated at ORPs) was not included.

Disease surveillance in humanitarian emergencies requires the rapid detection of any outbreak and must always be linked to additional verification, investigation, and response. Early warning (EWARN) systems are timely surveillance systems that collect information on potential risks to public health to trigger prompt public health action and should be implemented early in an emergency.[11,12]

An EWARN detects alerts or clusters and sudden changes in trends of events that could be a potential hazard to health through an epidemic intelligence[13,14] process, which integrates both indicator- and event-based components. The

indicator-based component refers to the information coming from routine surveillance systems based on the regular reporting of a number of previously well-defined items or indicators provided mainly by healthcare facilities. The event-based component refers to unstructured and diverse information coming from multiple types of sources, both official and informal (including unverified rumors from the media), that usually needs to be verified, assessed, and investigated. The aim of event-based surveillance is event detection before official reporting, confirmation, and eventual notification.[15–17]

The early warning functions of surveillance are fundamental for national, regional, and global health security. The importance of early detection and response to health risks is reflected in the IHR (2005).[1] The regulations were unanimously approved by the World Health Assembly in May of 2005 and entered into force in June of 2007. They constitute a significant advance in global surveillance and public health security[18–20] and a major paradigm shift compared with the previous regulations. The IHR (2005) expand the range of events that States must notify to the WHO and to which the regulations apply, and they introduce a new class of event, the Public Health Emergency of International Concern (PHEIC). Other substantive changes consist of the inclusion of a decision instrument to facilitate the identification of the new events to be reported, the requirement for Member States to establish National IHR Focal Points for communication with WHO and develop core capacities for surveillance and response, and the new responsibilities of the WHO.[1]

METHODS

The A&R System was designed to assist and support the MSPP in detecting and receiving, verifying, assessing, and urgently responding to cholera alerts requiring immediate action. This system started operating in early November of 2010 with the deployment of eight field teams and complemented the dedicated cholera surveillance system by adding an EWARN component, which is key for real-time monitoring of the spread of a disease and directing allocation of prevention and control resources across a country.

Objectives. The initial A&R System objectives were to (1) save lives through early detection and treatment of cholera cases and (2) control the spread of cholera through early intervention at the community level. To achieve its objectives, the main activities of the system were to (1) identify and assess cholera alerts and hotspots and (2) organize a rapid response with partners to provide immediate support based on needs identified in the field (e.g., supplies, training, social mobilization, water, and sanitation).

As the situation improved and the increased risk of disease transmission lessened, the objectives of the A&R System evolved to cover a broader range of public health risks, ultimately establishing the basis for an event-based surveillance within the Haitian national surveillance system in the context of the IHR (2005) requirements.[1]

Principles and structure. The PAHO–MSPP A&R System was based on a network of partners supported by the health cluster mechanism that included any institution, structure, or individual that could identify, verify, and respond to alerts. The system was composed of a national alert team (an Alert and Response coordinator, an epidemiologist or public health expert with experience in event-based disease surveillance and disease control) based in Port-au-Prince and the PAHO/WHO field teams based at the departmental level covering all departments in Haiti. During the first phase of the response, both the A&R coordinator/epidemiologist and the field teams were mainly staffed by GOARN personnel and supported by the PAHO/WHO structure.

Essential to this system was a broad network of partners, including MSPP staff at national and departmental levels, partners from different response clusters (http://haiti .humanitarianresponse.info/), NGOs, the CDC, the BMC, the UN Stabilization Mission in Haiti (MINUSTAH) and other UN agencies, public and private hospitals, local authorities or leaders, and other governmental and non-governmental institutions (Figure 1).

Response Clusters consist of groups of humanitarian organizations (UN and non-UN) working in humanitarian action sectors, such as shelter and health. They are created when clear humanitarian needs exist within a sector, there are numerous actors within sectors, and/or national authorities need coordination support. They provide a clear point of contact for the partnerships created across international, national, and local authorities and civil society, and they are accountable for adequate and appropriate humanitarian assistance.[21] The UN's Inter-Agency Standing Committee (IASC) decided in 2006 to organize international response in 11 groups or clusters, each led by a UN agency and composed of all UN system institutions and other international institutions and NGOs interested in the subject. The Health Cluster leadership was assigned to the WHO, signifying that it should ensure coordination of response activities by international actors in health in an affected country.[22,23]

Function. The operational hub of the A&R System was in Port-au-Prince, where alerts were received by the national alert team either directly through field teams, partners, and clusters or by e-mail and phone. The A&R coordinator analyzed and communicated alerts on a daily basis, characterizing hotspots and assessing the need for a response.

The focal points in the field were the MSPP–PAHO/WHO A&R field teams. These teams consisted of two experts with experience in cholera: one expert being a field epidemiologist, public health officer, and/or medical officer (for instance, a case management and infection control expert) and the other expert being a logistician and/or water, sanitation and hygiene (WASH) specialist. The composition of these teams was initially mainly international staff, with a gradual incorporation of national staff, and it varied over time from five to eight teams covering all ten departments.

The field teams' objectives were to (1) strengthen the epidemiological surveillance system (detection and alert) at the departmental level by training and assisting national officials in case and event detection, reporting, and data analysis; (2) support the response capacity, particularly to cholera (both at healthcare facilities and the community level), by training health professionals and setting up new CTUs, providing material resources, essential drugs and supplies, and establishing community brigades for social mobilization and health promotion; and (3) strengthen standards of clinical care and improve infection control practices, water and sanitation activities, and outbreak logistics at the local level by designing and distributing case management flowcharts, guidelines, and diagnosis and treatment protocols, training health and local staff, and providing water and sanitation to CTCs and CTUs.
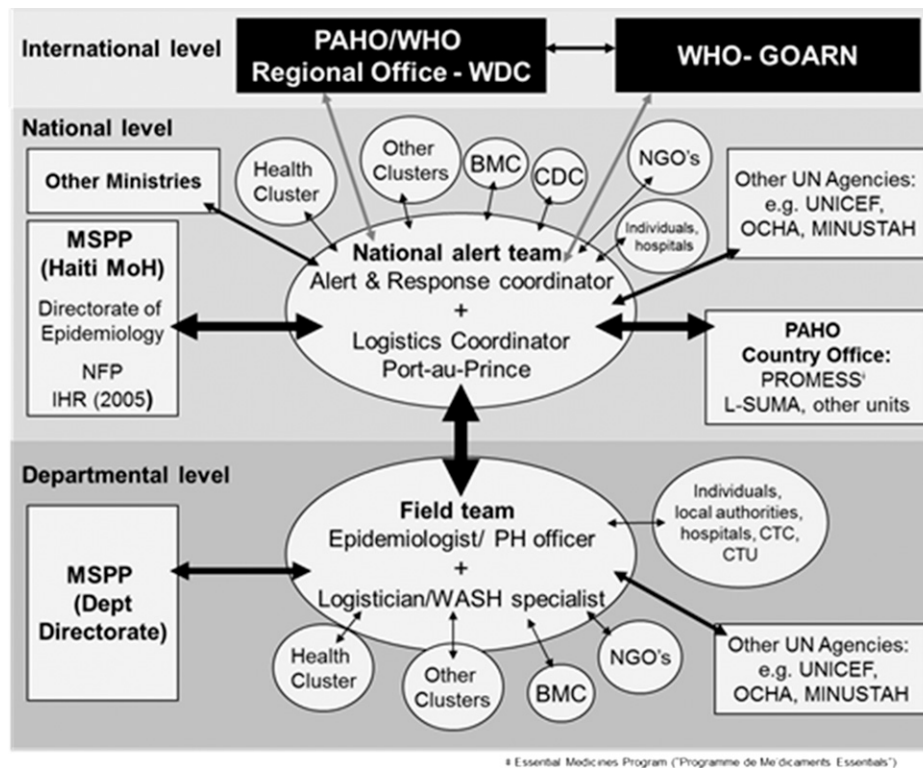
FIGURE 1. Structure of the A&R System network in Haiti from 2010 to 2011.

Operation. The primary operational components of the PAHO–MSPP A&R System were (1) the alert/early warning function; (2) a process of verification and assessment of alerts; and (3) a response function.

(1) Alert/early warning function. The PAHO–MSPP A&R System initially focused on the detection of any cholera event requiring an immediate response through retrieving information on (a) first cases or deaths (in previously cholera-free areas), (b) deaths in the community (cholera or other cause), (c) significant increases of numbers of cases or deaths (in areas with confirmed cases of cholera as indicated by local partners and/or field team members), (d) insufficient treatment capacity (hospitals, CTCs, and CTUs), (e) need for partners, drugs, and/or equipment supplies or staff for the CTCs, CTUs, or ORPs, (f) lack of access to healthcare services and/or potable water, (g) lack of a sanitation strategy (body management and disposal and waste management), and (h) lack of training (for example, in case management or prevention).

After the initial setting up of the A&R System, the alert criteria and the information and types of alerts to be collected were standardized, and specific collection forms were designed for daily and weekly reports. As the situation began to improve, the focus was widened to cover any event that could pose a public health risk using the framework established by the IHR (2005).

The A&R coordinator in Port-au-Prince received reports by e-mail—dedicated gmail and yahoo addresses—or telephone (24 hours a day, 7 days a week); these contact details were widely distributed to all partners. Field teams reported alerts detected on the same day in the shortest time possible and at least on a daily basis, including reporting zero alerts if applicable. In addition to the daily reports, weekly reports

were generated, highlighting the number of alerts received during the week, results from onsite investigations, contributing factors, and type of response conducted. This weekly report also contained the departmental epidemiological data from the cholera surveillance system as well as an analysis of gaps and constraints in surveillance and response.

(2) Verification and assessment. After the information received was classified as an alert, verification was done as soon as possible (within the first 24 hours). This process was carried out either directly by the A&R coordinator or the field teams in place or through the network of partners in the field.

Information received from official or reliable sources, such as health cluster members, was considered as verified, signifying no necessity for additional verification.

After information was verified, a request was made to the source or direct investigation was done by the field teams (for instance, when facing conflicting information from different sources) for more details concerning approximate number of cases or deaths, time frame, specific location, accessibility, resources already in place, needs (if known), partners in the area, available partners and resources for the response. This investigation was done to (a) assess the public health risk posed by the reported event, (b) assess the need for and urgency of such a response, and (c) define the type of response and appropriate partners.

(3) Response function. Response was coordinated at the national hub in Port-au-Prince by the A&R coordinator in collaboration with PAHO's Emergency Preparedness and Disaster (PED) Advisor and PAHO's Logistics Officer as well as staff from the MSPP or Civil Protection and in the field, through the PAHO/WHO field teams and MSPP staff at the departmental level (Health Directorate).
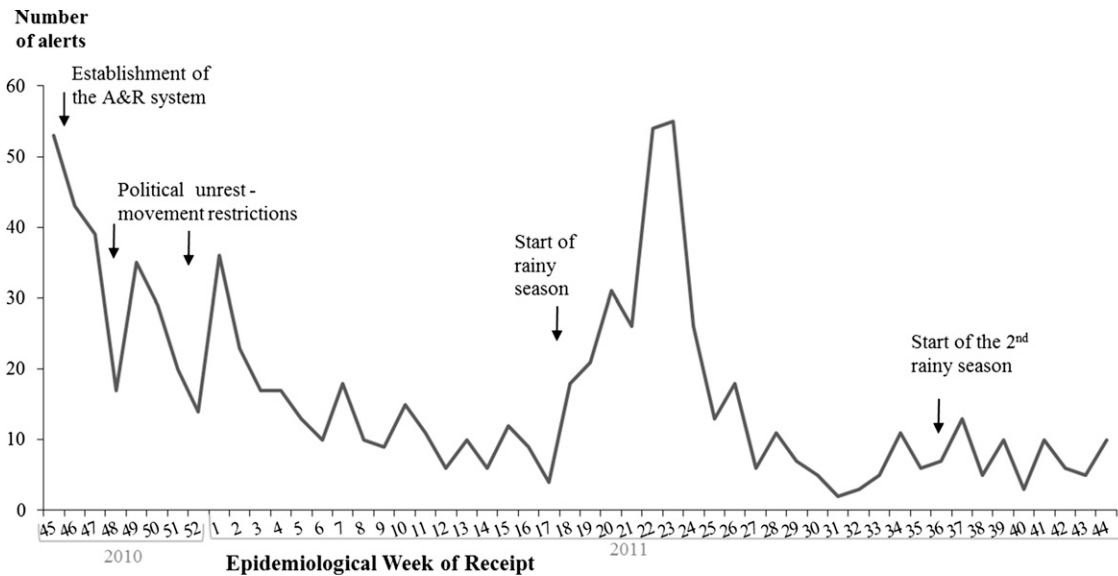
FIGURE 2.   Number of alerts related to public health events by week of receipt ($N = 863$; from November 8, 2010 to November 6, 2011 in Haiti).

In humanitarian emergencies, the arrival of many new players poses an additional challenge and compromises the capacity of understaffed and overwhelmed national and local authorities to lead the public health response and handle international aid. PAHO/WHO supported the MSPP to strengthen the coordination of these activities and avoid duplications to ensure an efficient and timely response and ensure that all partners contributed to a common strategy. This coordination was mainly done through the health and other cluster meetings. Most of the cluster meetings in the departments were organized by the PAHO/WHO field teams and at times, by an NGO. In departments where an MSPP cholera focal person was identified, coordination was more effective. However, because of a lack of human resources, this person quite often ended up being the MSPP Departmental Director. As a result, coordination was more difficult, because the directors had limited time due to competing obligations inherent to their positions.

RESULTS

Data analysis and interpretation. The information generated by the A&R System was analyzed and interpreted by the A&R coordinator to inform the public health interventions of the PAHO, MSPP, and partners. It was also used to update donors and other agencies on the evolution of the epidemic.

The A&R System produced key qualitative information that was critical to qualify the epidemic and define vulnerable areas. From November 8, 2010 to November 6, 2011, 863 alerts on public health events were received by the PAHO/MSPP A&R System, with an average of 17 alerts per week, ranging from 2 (Epidemiological Week [EW] 31 of 2011) to 55 (EW 23 of 2011) alerts. There were no weeks without alerts (Figure 2). Alerts referred to unique events defined by a specific occurrence (as described above) in a set location and date; follow-up information of a specific event was not counted as a new alert. Alerts with information concerning a location previously reported in another alert but pertaining to a different timeframe were counted as new.

A peak in the number of alerts was observed during EWs 45–47 of 2010 (November; coinciding with the establishment of the alert system), from EW 49 of 2010 to EW 2 of 2011 (end of December and early January), and EWs 18–24 of 2011 (May to mid-June). The latter period coincides with a time during which many partners were closing their cholera treatment facilities and scaling down their cholera activities. It also coincides with the start of the rainy season in 2011.

These peaks in the numbers of alerts matched an observed increase in the number of new cholera cases in the country based on the cholera epidemiological data from the MSPP. From EW 25 of 2011, the number of alerts received decreased. This trend could have been related to a real decrease in the number of new cholera cases or the departure of many partners
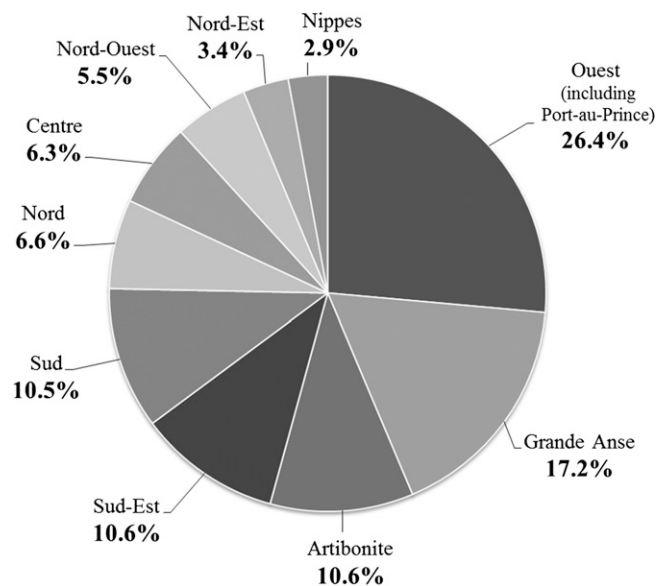
Data Source: Alerts received through A&R System

FIGURE 3.   Distribution of alerts (in percentages) by department based on available data from the A&R System ($N = 859$); from November of 2010 to November of 2011; Haiti.

Number of cases reported by MSPP
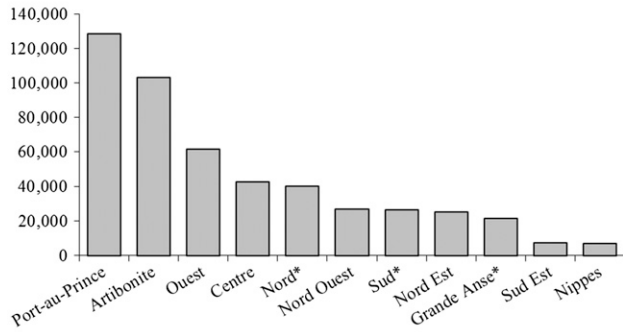
Data Source: MSPP (http://mspp.gouv.ht/site/index.php); *Reported as Incomplete Data

FIGURE 4.   Number of observed cholera cases by department (*N* = 491,096); from November of 2010 to November of 2011; Haiti.

(mainly NGOs) from the field, which may have affected the capacity of the system to detect and report alerts.

Included in the alerts were three alerts that originated outside of Haiti (Canada, the Dominican Republic, and the United States) because of detection by partners while in the field but reported through the agency's offices outside of the country. One other alert affected several departments in Haiti.

The departments reporting the highest numbers of alerts for the first year of functioning of the A&R System were Grande Anse (17.2%), Ouest (13.6%; metropolitan area excluded), and the metropolitan area (12.8%; Port-au-Prince) followed by Artibonite (10.6%) (Figure 3).

With the exception of Grande Anse, these departments also reported the highest number of cases (Figure 4). Because routine surveillance data for cholera was incomplete for Grande Anse, epidemic monitoring in this department was mainly done through the A&R System. This department is characterized by its lack of communications, difficult access, and paucity of partners.

The majority of the alerts (89.6%) were related to cholera. Nevertheless, the system also detected 76 non-cholera alerts, including threats such as rabies (canine and human), acute flaccid paralysis, diphtheria, varicella, suspected cases of measles, anthrax, intoxications, and other hazards, like riots, strikes, and others.

Cholera alerts described increases in cases, deaths, lack of supplies (medical and/or WASH), lack of human resources, and/or prevention activities. Alerts also reflected the phasing out of CTCs and CTUs and signaled calls for heightened attention from health authorities and partners at healthcare facilities and in communities.

Over 95% of the alerts received had a documented response, and the remainder had no documented response, because
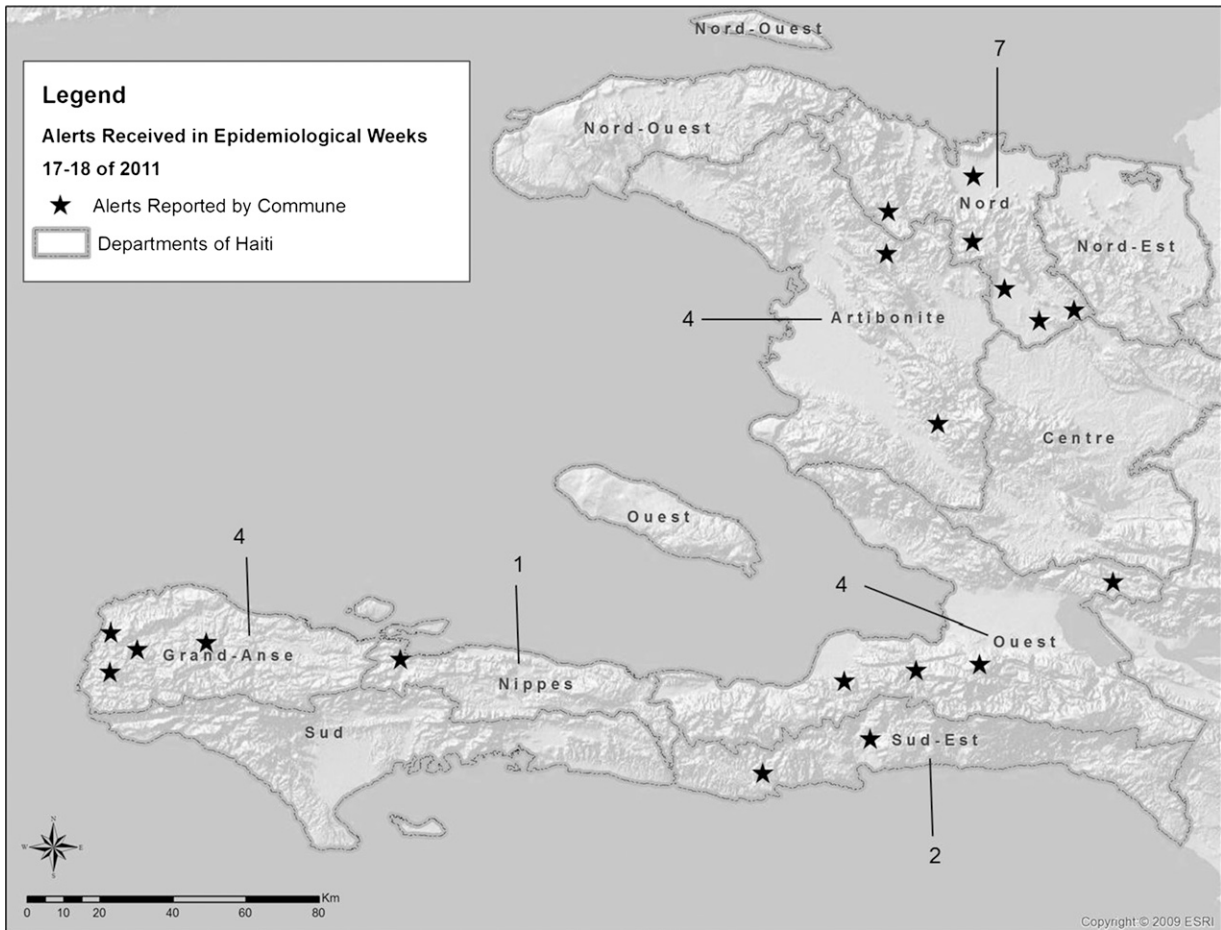
Sources: PAHO-MSPP Alert and Response System, 2011. Map production: PAHO/HSD/IR/ARO.

FIGURE 5.   Geographical distribution of cholera alerts by department for EWs 17 and 18 of 2011. Data source: PAHO–MSPP Alert and Response System Graph: PAHO/HSD-IR.

either the information was not confirmed/verified or response was not needed or could not be effected. Verification of and response to the alerts in the field was conducted by the PAHO/WHO field teams in collaboration with several partners, mainly NGOs and the BMC as well as the MSPP.

Actions that were taken in response to alerts included (1) field investigation of outbreaks and alerts; (2) rapid set-up of a CTC/CTU or ORP; (3) WASH response: chlorination of water, distribution of Aquatabs, access to latrines, waste management, dead body management, and household decontamination; (4) provision of supplies (medical and non-medical) and equipment; (5) provision of human resources for health facilities and community mobilization activities; (6) training on case management, cholera prevention, and control; and (7) training for community workers (brigadiers and health agents).

The sensitivity of the system and its ability to react quickly was illustrated in early May of 2011. Starting between EW 17 and 18 of 2011 (first week of May), the A&R System detected an abnormal increase in the number of alerts coming from several communes in the Sud-Est Department (Figure 5). This information was immediately disseminated network-wide (Health Cluster Bulletins #24 [May 3, 2011] and #25 [May 27, 2011] posted at the cluster's web site: http://www.paho.org/hq/index.php?option=com_content&view=article&id=4404&Itemid=3487). A rapid risk assessment was done by the A&R national team, and as a result, the MSPP and partners were alerted of the high risk of further spread into the Ouest Department and specifically, to the metropolitan area of Port-au-Prince, both of which had previously been defined as very vulnerable to cholera spread. This alert proved of vital importance given the fact that several partners were, at that time, scaling down cholera activities. Two weeks later, by May 21, a significant increase in cholera alerts was reported in the metropolitan area (EW 21 of 2011) (Figures 6 and 7).

Immediately, outbreak control measures were ready for implementation, and in that same week (EW 21), PAHO/WHO was installing ORPs in Port-au-Prince, supporting medical response in CTCs and CTUs, supporting partners with material and supplies, and guiding WASH interventions in the metropolitan area and Ouest Department along with departmental authorities. As of May 31, through PAHO coordination as the health cluster leader, 1,779 beds in CTCs and CTUs had been set up, bringing the total number of bed capacity to approximately 2,388 in the metropolitan area and Ouest Department as reflected in PAHO/WHO's Situation Reports from May 27 to June 3, 2011 (http://www.paho.org/hq/index.php?option=com_content&view=article&id=4404&Itemid=3487). The national cholera surveillance system did not register an increase in cases until EWs 21–22 of 2011, and this information, aggregated by department, was not available until
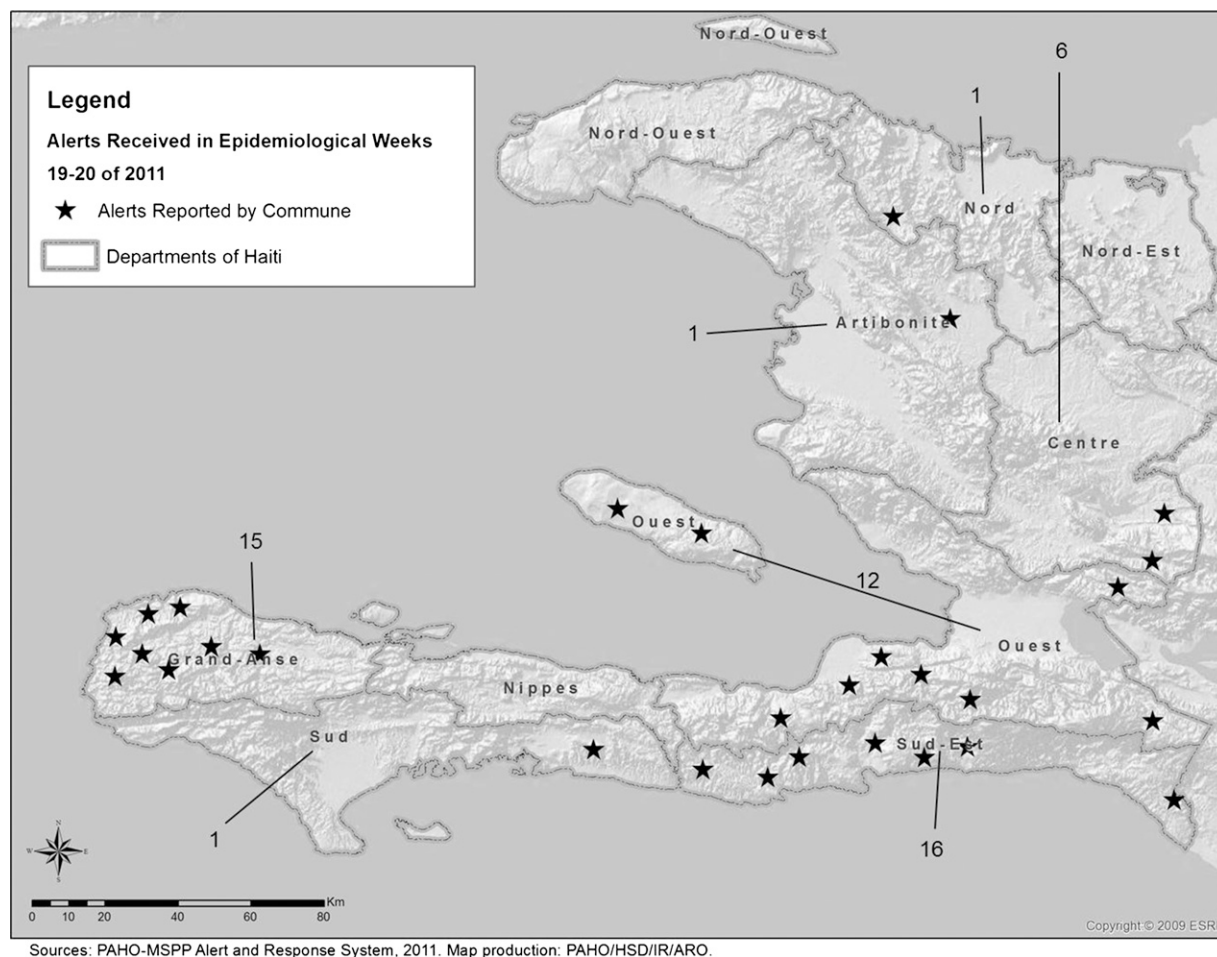

Sources: PAHO-MSPP Alert and Response System, 2011. Map production: PAHO/HSD/IR/ARO.

FIGURE 6. Geographical distribution of cholera alerts by department for EWs 19 and 20 of 2011. Data source: PAHO–MSPP Alert and Response System Graph: PAHO/HSD-IR.
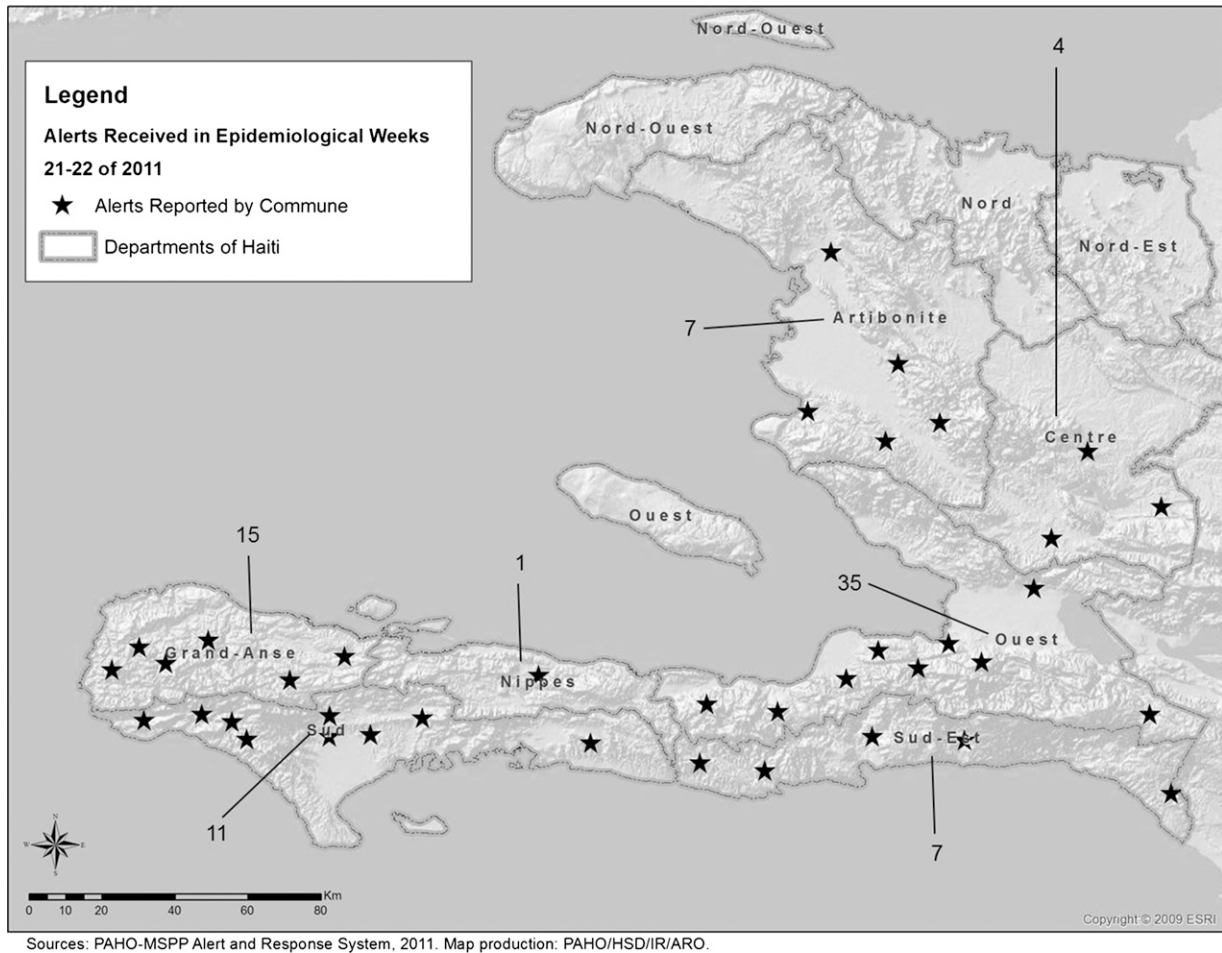
FIGURE 7. Geographical distribution of cholera alerts by department for EWs 21 and 22 of 2011. Data source: PAHO–MSPP Alert and Response System Graph: PAHO/HSD-IR.

EWs 23–24, when the peak of cases had already been reached. Had the A&R System not existed, this new outbreak would not have been controlled as swiftly.

Information on filtered alerts for each day was compiled on a daily alerts bulletin and disseminated by e-mail to the main actors involved in response at both the national and departmental levels. The guiding principle for sharing information was to help responders achieve the best use of their resources.

Exit strategy. Since its implementation, the A&R System aimed at ensuring that the national surveillance system was strengthened through establishing the basis for an event-based component within the Haitian national surveillance system in the context of the IHR (2005) requirements. One of the main activities of the PAHO/WHO A&R national coordinators was to build local capacity for early detection, investigation, and rapid response. This building was done through both formal organized training and constant on-the-job training, with joint investigation of alerts as they came up. To facilitate the institutionalization of the A&R System, the IHR (2005) was used as an overarching framework for advocacy of such a system and to promote strengthening of core surveillance and response capacities.

Initially, the MSPP had been concerned that the A&R System would duplicate the existing surveillance; however, the MSPP officials showed an increasing acceptance and support for the A&R System as time progressed. The acceptance and support came from witnessing how the information coming from the A&R System was near real time and allowed for close monitoring of the epidemic, consequently enabling the ability to define needs and set up a rapid response. Despite the support, the involvement of national officials in running the A&R System remained a challenge because of a lack of resources and the limited technical capacity available. To date, the system is still operating, with the MSPP staff supported by the epidemiologists of the PAHO/WHO Country Office. To ensure that reports on alerts reach both the MSPP epidemiologists on the field and departmental coordinators as well as the managers of the MSPP's CTCs and CTUs, the MSPP distributed cell phones to them and developed a system with PAHO for transmitting data through text messages. Training visits on entering data were conducted by PAHO in each department, and an MSPP statistician has been trained to analyze data from all departments.

DISCUSSION

Improved national surveillance and response systems and information sharing are key elements to prevent and contain epidemics in a timely manner, as shown by recent outbreaks,

such as the severe acute respiratory syndrome (SARS) and avian (H5N1) and pandemic (H1N1) influenza.[17,24–26]

Given the complex situation in Haiti and its vulnerability to natural and epidemic disasters, the likelihood of local events becoming a major public health risk was and still is very high. Surveillance systems current at the time the cholera epidemic emerged proved ineffective for both timely detection for containment and monitoring the spread of the disease. In this context, an event-based surveillance system becomes of paramount importance to improve core surveillance capacities to detect, assess, notify, and respond to health threats as well as prevent and control the spread of diseases inside and beyond borders, as reflected in the IHR (2005).[1,11,27]

The A&R System set up by the PAHO/WHO with GOARN support showed how the rapid detection of cholera alerts was a key element to the identification of outbreaks and to direct and coordinate urgent response. In contrast, the national cholera surveillance only had access to data from healthcare facilities in a context where one-half of the national population does not have access to a health center.[28,29] The A&R System was able to identify, verify, and respond to outbreaks in hard-to-reach communities. The investigation that followed each alert identified major gaps in prevention and response, such as the lack of WASH partners in several departments, and highlighted the need to improve the implementation of prevention and control strategies at the community level.

A main strength of the system was the immediate feedback and action that followed reporting. This strength increased acceptance of the system by partners. The strong collaboration of all partners in identifying hotspots, verifying rumors, and collectively supporting the response was key to the success of the A&R System.

The number of alerts qualitatively correlated with the number of cases. This finding could be explained by the fact that a higher number of cholera cases may have occurred in more densely populated areas, where more partners are likely available to alert the system. However, it is worthwhile noting that the department reporting the highest number of alerts was Grande Anse, which was the department with the least number of partners.

The A&R System, through the ability to verify and investigate other disease outbreaks, demonstrated how the system could complement the national surveillance system (indicator-based) in identifying unexpected events.

Finally, the international community's support of the A&R System, through GOARN, was fundamental to the MSPP and PAHO/WHO's decentralization strategy in the response to the cholera epidemic. International experts were rapidly mobilized to affected areas and staffed the system for the first 6 months, working with the MSPP. This response was used as an opportunity to build capacity in the country.

Because of the MSPP's overall very limited resources, at both the departmental and national levels, there was a reliance on partners to detect, verify, and respond to alerts. The gradual decrease in the number of partners affected the capacity of the MSPP and the A&R System to operate.

A major challenge of the international support in low-resource settings, such as in Haiti, is to ensure that it does not replace or undermine pre-existing national capacity and responsibilities. For this reason, it is critical that the road map for the deployment of international assistance take into consideration the need for capacity building and has a realistic and clearly agreed on exit strategy.[11]

To address continuing challenges for surveillance (indicator- and event-based) in Haiti, there is a need to, first, get an efficient and functional system and second, ensure technical support is made available to maximize the efficient use of scarce human and other resources.

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