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Evaluation of the Disease Early Warning System in crisis-affected areas of Pakistan

Final report

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Francesco Checchi MHS PhD
Faculty of Infectious and Tropical Diseases
London School of Hygiene and Tropical Medicine

Hammad Habib MBBS MSc MPH
Muslim Aid
Islamabad, Pakistan

Peter Mala MBBS MPH
Disease Control in Humanitarian Emergencies unit
Global Alert and Response Department
World Health Organization, Geneva

Shafiq Uddin MBBS
Helping Hand for Relief and Development
Islamabad, Pakistan

Ainuddin Khan DrPharm
World Health Organization
Quetta, Pakistan

Muhammad Naveed Khan DrPharm MS
World Health Organization
Peshawar, Pakistan

Muhammad Shahzad Khan Bpharm MPhil
World Health Organization
Peshawar, Pakistan

Faisal Nadeem Malik DrPharm
World Health Organization
Sukkur, Pakistan

Hammad Raza BSc
World Health Organization
Multan, Pakistan

Asif Soomro DrPharm
World Health Organization
Hyderabad, Pakistan

Summary

Background

The Disease Early Warning System (DEWS), implemented by the World Health Organization (WHO) in collaboration with the Ministry of Health and National Institute of Health, is the main national surveillance system to detect and respond to infectious disease epidemics in Pakistan. The DEWS was initially implemented in response to natural disaster and displacement emergencies in Pakistan, most notably the 2010 floods. However, the system has now expanded to cover about 107 million people, or 57% of Pakistan's population. Its approaches for outbreak detection include immediate alert reporting and weekly data collection on several syndromes from about 2800 health facilities. In March-April 2011, we conducted an evaluation of the DEWS at the request of the WHO country office.

Methods

We reviewed data held by the DEWS central team so as to describe the system's output and completeness since July 2010 (the start of the floods). We also visited the five largest provinces in Pakistan (Khyber Pakhtunkhwa, Sindh, Punjab and Balochistan), and, within each, conducted in-depth interviews with DEWS, Ministry of Health counterparts at provincial and district level, and staff in a random selection of health facilities. In total, we visited 15 districts and, within these, 24 basic health units, 12 rural health centres and 12 hospitals. We used mainly qualitative techniques to analyse interview data.

Results

About two fifths of health facilities received DEWS training since July 2010, and respondents perceived a strong need for retraining. DEWS staff made frequent visits to health facilities, and case definitions were mostly well understood by clinical staff. Numerous barriers to participation were mentioned, including remoteness and communication problems; completeness of reporting, however, was higher in peripheral units (about 50-70%) than in hospitals (20-30%). Various means of data transmission were in use, including SMS, with local solutions being implemented and poor communications a ubiquitous problem. Some data transmitted appeared unreliable, particularly for acute respiratory infections.

Since July 2010, the DEWS detected 940 alerts and 256 outbreaks, mainly of suspected cholera, measles and dengue. Importantly, 83% of alerts were detected not through weekly data collection, but rather through informal or health system alerts. Alert investigation appeared well structured and timely, but problems with laboratory confirmation were evident.

The DEWS had some (partly beneficial) overlap with other surveillance systems (polio and EPI), but not with routine government surveillance. Government counterparts were appreciative of the system, but their involvement was often limited.

Recommendations

The DEWS is an invaluable resource for epidemic control in Pakistan, and must enjoy continued institutional and donor support. In general, the system appears effective in its core functions of alert detection and early outbreak containment. Stronger quality assurance procedures should however be implemented, with retraining of health facility staff. Weekly data collection can be streamlined and better integrated with routine, polio and EPI surveillance, with transmission simplified by SMS reporting where possible; importantly, data should be managed more effectively so as to maximise their usefulness, through a new software application. Alert detection should be enhanced further by involving community health workers and better communication with health facilities. Over the next few years, the DEWS should be progressively integrated with routine surveillance. More detailed recommendations are found in the main body of the report.

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Abbreviations

ALRI	Acute lower respiratory infection
ARI	Acute respiratory infection
AURI	Acute upper respiratory infection
AWD	Acute watery diarrhoea
BHU	Basic health unit
DEWS	Disease Early Warning System
EDOH	Executive Director of Health (district government)
KP	Khyber Pakhtunkhwa Province
PPHI	People's Primary Healthcare Initiative
RHC	Rural health centre
RU	Reporting unit
SO	Surveillance officer
WHO	World Health Organization

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1 Introduction

1.1 Recent crises in Pakistan

During the past decades, Pakistan has been heavily affected by both natural and man-made disasters. The most significant of these in recent times have been:

- A Richter scale magnitude 7.6 earthquake in October 2005 (known as the Kashmir earthquake), which resulted in some 75,000 deaths, as well as widespread destruction of houses, infrastructures and livelihoods;
- Floods in KP, Sindh and Balochistan provinces in July-August 2007 due to heavy monsoon rains and Cyclone Yemyin; these floods caused about 1000 deaths and affected at least 2 million people;
- A Richter scale magnitude 6.5 earthquake in 2008 affecting Balochistan province and causing some 250 deaths;
- Internal displacement of 2.2 million people between 2008 and 2009 due to armed conflict between the Taliban insurgency and the Pakistan armed forces in the Federally Administered Tribal Areas (FATA) and KP province;
- Widespread floods throughout the Indus River Basin in July-September 2010, affecting KP, Punjab and Sindh provinces most heavily, with additional impacts in Balochistan and Gilgit-Baltistan provinces; the floods affected some 20 million people and caused about 2000 deaths, in addition to unprecedented economic damage.

1.2 The Disease Early Warning System

So as to support the Ministry of Health (MoH) and other health agencies intervening in the areas affected by the above crises, the World Health Organization, in collaboration with MoH and the Pakistan National Institute of Health (NIH), has repeatedly established a Disease Early Warning System (DEWS). DEWS is a prospective, health facility-based infectious disease surveillance system. The overall goal of DEWS is to minimize morbidity and mortality due to communicable diseases. The objective is to detect potential outbreaks at their earliest possible stage and to facilitate timely interventions.

DEWS was first set up in 2005 in earthquake-affected districts. The DEWS was reinstated and expanded to additional affected districts during ensuing crises, with the greatest expansion (27 new districts) occurring in July-September 2010 after the countrywide flood emergency (Figure 1). As of 18 March 2011 (the starting date of this evaluation), 93 districts in all provinces of Pakistan (including three tribal agencies in FATA and Islamabad Capital Territory) were included in the DEWS, covering an estimated population of > 107 million (population figures not available for six small districts), or about 57% of the total population of Pakistan, projected at 187 million [1].

Pakistan: DEWS implemented districts by year
as of 18 April 2011

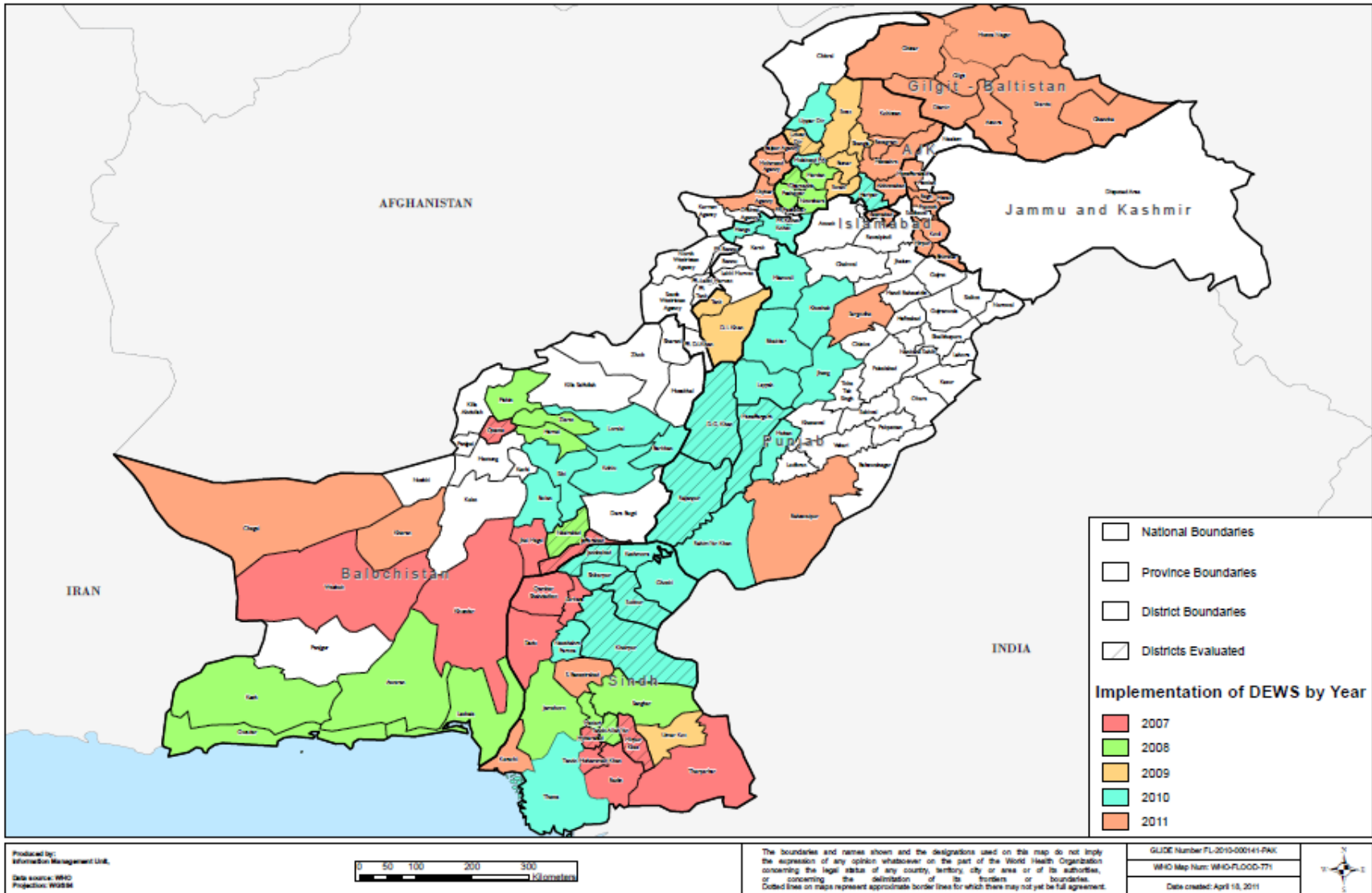


Figure 1. Districts in Pakistan covered by the DEWS as of 18 March 2011, with date of DEWS implementation in the district.

DEWS activities

In its current state of implementation, the DEWS:

1. Collects data on a weekly basis (Friday to Thursday) from health facilities in each covered district (hereafter referred to as reporting units or RUs) on the number of new cases and deaths due to various reportable diseases and syndromes (Table 1 and see below), among persons < 5y and ≥ 5y of age;
 - 1.1. Broadly speaking, in each district DEWS attempts to capture data from all public sector or not for profit RUs, including primary health care outpatient health facilities (Basic Health Units or BHUs, and, in some districts, community dispensaries, representing an even more peripheral level);
 - 1.2. RUs compile data on a standardised weekly DEWS report (Annex 8) and transmit the report to the DEWS District Surveillance Officer (SO). Transmission occurs in various ways (see Results), including directly to the DEWS; indirectly through government (Executive District Office of Health, or EDOH), which administers many of the RUs, particularly hospitals and rural health centres (RHCs); or indirectly through the People's Primary Healthcare Initiative (PPHI), a para-statal non-profit organisation that manages nearly all BHUs in several provinces. In Punjab, data are transmitted through government circuit all the way to provincial level, and only at that level collated and shared with the DEWS.
2. Detects alerts, either based on application of a series of thresholds (Table 1) to the weekly data it receives, or through more immediate reports by health system staff and other information sources; note that immediate alerts are encouraged even outside weekly reporting, and for a few additional conditions other than those to be reported weekly (see below);
3. Investigates alerts through formal field investigations, which, depending on the suspected causative agent, may entail review of clinical cases, line listing of cases, contact tracing, active case finding, sampling for laboratory confirmation, investigation of possible sources of disease transmission, and initial, limited containment interventions (e.g. distribution of water purification tablets, health education);
4. Responds to confirmed outbreaks; responses, often carried out in collaboration with government counterparts, vary from reactive vaccination of villages and neighbourhoods to emergency water and sanitation interventions, supply of drugs and materials to health facilities and hygiene promotion.
5. Disseminates information. This is done more or less informally at hub and district level, and more formally countrywide through a weekly bulletin (http://www.who.int/hac/crises/pak/sitreps/epi_bulletin/en/index.html).

The above work, and in particular the alert and response activities, is conducted in collaboration with MoH staff and programmes, albeit to a differing degree depending on local MoH capacity.

In many districts, WHO also operates a clinical intervention to reduce mortality due to non-epidemic diarrhoea and acute respiratory infections (ARI), consisting of specialised, seasonally active (diarrhoea during summer months, ARI during winter months), paediatric wards within government hospitals. DEWS staff supervise this intervention and the system supplies drugs and supplies.

Diseases and syndromes monitored by the DEWS

In its current form, the DEWS collects weekly aggregate data for the following diseases and syndromes:

- Priority epidemic-prone illnesses: Acute watery diarrhoea/suspected cholera, bloody diarrhoea, suspected malaria, suspected measles, suspected meningitis, acute jaundice syndrome, acute flaccid paralysis, and suspected haemorrhagic fever; for malaria, recognising that the proportion of parasite-positive tests (blood slides or rapid diagnostic tests) is a useful and timely epidemic indicator, the number of tests performed and the number positive are also collected;

- Diseases with high burden (“that make up a large portion of the out-patient visits to a health facility” [2]) or that “include some other epidemic-prone diseases which are more difficult to define” [2] (e.g. rotavirus, influenza): other acute diarrhoea, acute upper respiratory infection, acute lower respiratory infection, unexplained fever >38.5°C;
- Diseases that were deemed of high burden during the floods, and that also indicate problems with water, sanitation and hygiene conditions: skin disease, eye infection and snake bites.

Note that immediate alerts due to any of the above should be generated, in addition to weekly reports, if alert thresholds are crossed on any day of the week.

The DEWS also monitors other diseases and syndromes, but without weekly reporting. These include clusters of potentially epidemic-prone diseases including diphtheria, pertussis, leishmaniasis, neonatal tetanus, chickenpox, rubella and mumps. The childhood Expanded Programme on Immunization (EPI) diseases in this list are also monitored with an intent to describe trends in age and severity, as a proxy of the coverage and effectiveness of EPI vaccination.

Structure and staffing of the DEWS

The DEWS is headquartered at the WHO country office in Islamabad, within the Emergency Health Action programme. Here, data are centralised; a weekly country-wide epidemiological bulletin is prepared and disseminated to partners; technical guidance is developed; and monitoring is done.

At the provincial level, the DEWS is managed from five UN hubs (Peshawar for KP province; Multan for Punjab province; Sukkur for northern Sindh province; Hyderabad for southern Sindh province; and Quetta for Balochistan province). At the hub level (which also corresponds to WHO sub-offices), there is a full-time DEWS coordinator, as well as staff involved with data management or hospital coordination. Each hub manages a team of surveillance officers (SOs), who are each deputised to one or more districts, and, with some exceptions, are based in the districts themselves. Altogether, 102 staff were hired by the DEWS as of 18 March 2011 (Table 1).

Whilst not hired under the DEWS programme, in each hub and at national level administrators-logisticians, one or more pharmacists who manage medical supplies (about 24 in total), water and sanitation engineers (about 20), and several drivers and support staff also participate heavily in DEWS activities, including field visits to assist with alert investigation and outbreak response. The WHO team leader within each hub also participates intensively in DEWS activities.

DEWS budget

In 2010, the DEWS had an operating budget of USD 10,141,750, or roughly USD 845,145 per month. This total however includes the somewhat separate environmental health programme which, though included in the same budget, is not considered part of DEWS core functions as described above. DEWS staff estimate the core functions accounted for an expenditure of about USD 500,000 per month as of March 2011.

Table 1. Case definitions and alert thresholds for the main DEWS reportable diseases and syndromes, as of 18 March 2011.

Disease	Case Definition and Information	Alert threshold
Suspected Cholera	In an area where the disease is not known to be present: A person aged 5 years or above with severe dehydration or death from acute watery diarrhoea. In an area where there is a Cholera outbreak: Any age person with acute watery diarrhoea <i>To confirm a case of cholera: Isolation of Vibrio cholera O1 or O139 from a diarrhoeal stool sample.</i>	One case
Bloody Diarrhoea	Acute diarrhoea with visible blood in the stool. <i>To confirm a case of epidemic bacillary dysentery: take a stool specimen for culture isolation of Shigella dysenteriae type 1.</i>	Three or more cases in one location
Other Acute Diarrhoea	Acute diarrhoea (passage of 3 or more loose stools in the past 24 hours) with or without dehydration, and which is not due to bloody or suspected cholera.	Twice the average number of cases seen in the previous 3 wks for a given location
Acute Upper Respiratory Tract Infection	Any acute onset of cough, with mild fever, runny nose, sore throat, pharyngitis, laryngitis, otitis, tonsillitis, with normal breathing and without any danger signs.	Twice the average number of cases seen in the previous 3 wks for a given location
Acute Lower Respiratory Tract Infection	Children <5: Any child <5 year old with cough or difficulty in breathing with any one of the following symptoms; fast breathing, unable to drink or breast feed, bluish discoloration of skin, chest indrawing, stridor, fits or convulsions. Patients above 5 years: Any person 5 years and above presenting with: Acute onset of cough, fever, difficulty in breathing and chest pain which increases with breathing.	Twice the average number of cases seen in the previous 3 wks for a given location
Suspected Malaria (uncomplicated)	History of recent fever (may be continuous or irregular in beginning), with one or more of following: chills, headaches, body aches, weakness, anaemia <i>To confirm a case of malaria: positive laboratory test for malaria parasites (blood film (thick or thin smear) or rapid diagnostic test.</i>	1.5 times the average number of cases seen in the previous 3 wks for a given location
Suspected Measles	Fever and maculopapular rash (i.e. non-vesicular) and cough, coryza (i.e. runny nose) or conjunctivitis (i.e. red eyes) or any person in whom a clinical health worker suspects measles infection. <i>To confirm a case of measles: Presence of measles-specific IgM antibodies.</i>	One case
Suspected Meningitis	Sudden onset of fever (>38.5 °C) with any one of the following: neck stiffness, altered consciousness, other meningeal sign or petechial or purpurial rash. In patients aged <12 months, a suspected case of meningitis occurs when fever is accompanied by a bulging fontanelle. <i>To confirm a case of meningococcal meningitis: Suspected case, as defined above, with either positive- CSF antigen detection for Neisseria meningitidis or positive CSF culture or blood with identification of N. meningitidis.</i>	One case
Acute Jaundice Syndrome	An acute illness with discrete onset of symptoms of jaundice, dark urine, anorexia, malaise, extreme fatigue, right upper quadrant tenderness and/or fever and absence of any known precipitating factors.	Three or more cases in one location
Acute Flaccid Paralysis	Any child aged <15 years with recent onset of floppy weakness of any cause including Guillain-Barré syndrome or any acute paralytic illness in a person of any age in whom poliomyelitis is suspected.	One case
Suspected Hemorrhagic Fever	Any person with acute febrile illness of two to seven days duration AND two or more of the following: headache, retro-orbital pain, myalgia, arthralgia, rash, hemorrhagic manifestations and leucopenia.	One case
Unexplained Fever	Fever (body temperature >38.5 °C) for >48 hours and without other known aetiology.	One death or two times the mean number of cases of the previous 3 weeks for a given location

Table 2. Human resources employed by the DEWS, by provincial hub, as of 18 March 2011.

Province - DEWS hub	Number of districts included in DEWS	DEWS coordination staff	Surveillance officers
Azad Jammu and Kashmir	7	0	3
Balochistan - Quetta	20	1 coordinator 1 hospital coordinator 1 data analyst/assistant	13
Federally Administered Tribal Areas	3	1 coordinator	3
Gilgit Baltistan	7	0	3
Islamabad Capital Territory	1	0	1
KP -Peshawar	20	1 coordinator 1 hospital coordinator 2 data analysts/assistants	21
Punjab - Multan	12	1 coordinator 1 hospital coordinator 1 data analyst/assistant	12
Sindh - Hyderabad	14	1 coordinator 1 expatriate epidemiologist 1 hospital coordinator 1 data analyst/assistant	13
Sindh - Sukkur	9	1 expatriate epidemiologist 1 hospital coordinator 1 data analyst/assistant	7
Islamabad headquarters	-	1 expatriate epidemiologist 1 national coordinator 1 hospital coordinator 2 data analysts/assistants 3 administrators/logisticians	0
Total	93	26	76

1.3 Rationale and objectives

The present evaluation of the Pakistan DEWS was carried out with both a national and global scope.

As of March 2011, the DEWS had been running for several years and had seen a rapid expansion over 2010, but a formal evaluation was yet to be conducted. An evaluation was judged useful to take stock of lessons learned to date; identify strong and weak points of the system; and suggest ways forward for maintenance and/or integration of the system within surveillance systems of the Pakistan government. This was particularly relevant in light of the ongoing devolution of Ministry of Health functions to Pakistan's provinces, which as of 2011 are responsible for public health policy setting, health system financing and health services implementation.

In 2009, a technical working group set up by WHO reviewed evidence on the design and implementation of early warning alert and response network systems (EWARN) for disease surveillance in humanitarian emergencies, and agreed on the urgent need for documentation and evaluation of ongoing EWARN systems, so as to build the evidence basis and inform the development of global guidelines, currently under finalisation [3]. Specific issues identified, for which stronger evidence was required, included the relative usefulness of aggregate data collection and immediate alert reporting; the relevance of data on endemic diseases (e.g. ARI); and processes of integration with routine government surveillance.

Based on the above rationale, WHO's Pakistan Country Office, Regional Office for the Eastern Mediterranean (EMRO) and headquarters jointly requested a formal evaluation of the DEWS.

Objectives

The objectives of this evaluation, as per the agreed Terms of Reference were as follows:

1. To describe the DEWS system, in terms of setting, geographical and population catchment area, objectives of the system, duration of operation, diseases/syndromes covered by the system, network of data providers and data flow structure, resources, and other basic features;
2. To identify the optimal approaches to surveillance (passive, active, exhaustive, sentinel), and the effectiveness of the system in terms of early detection and response to epidemic-prone diseases;
3. To determine the minimum information required to detect outbreaks and monitor diseases;
4. To assess the quality of data and its analysis in terms of sensitivity and predictive value positive of thresholds; signals that influence public health actions; and completeness and timeliness of surveillance reporting;
5. To describe the balance of system standardization with flexibility;
6. To assess the usefulness of the system, in terms of effect on operational and health policy decisions;
7. To provide recommendations on how the system may be strengthened, including sustainability issues.

2 Methods

2.1 Overview of evaluation methods

Team composition

The evaluation team was composed of five teams each consisting of two persons (except KP province where the team had three members), with each team dispatched to a different hub, and each team composed of a pharmacist or other staff member of WHO Pakistan permanently based at the hub and an external evaluator (two Pakistani public health specialists and two expatriates).

Timeline

Field work for the evaluation took place between 23 March and 3 April. After three days spent finalising study tools and training staff in Islamabad, teams travelled to the different hubs for 3 to 4 days of data collection. At the end, a one day debriefing was then held in Islamabad. In Quetta hub, only a 1 day visit was feasible.

Themes for the evaluation

We structured the evaluation according to the following themes:

- **Knowledge and participation issues**, including training of RU and DEWS staff; understanding of the DEWS and its function by RU staff; involvement of RU staff through visits and monitoring; and dissemination/feedback of DEWS information;
- **Weekly DEWS reporting**, including completeness of reporting; reliability of aggregate data reports; issues with data compilation and reporting; and usefulness of data collection;
- **Alert and response functions**, including output thus far, ways in which alerts are detected, issues with alert investigation and response, and work on responding to confirmed outbreaks;
- **Relationship of the DEWS with other programmes and systems**, including vertical disease control programmes within and outside WHO, and government counterparts: under this theme we also explored issues of integration of the DEWS with government routine surveillance.

The above themes broadly form the structure of the Results section.

Overview of evaluation activities

We did primary data collection using both quantitative and qualitative approaches in a sample of districts, and, within each selected district, a sample of RUs. The sampling strategy is described below.

Within each district, we:

- Interviewed DEWS staff including the district SO;
- Conducted semi-structured questionnaires within selected RUs;
- Collected information on the mode of detection of alerts generated by the DEWS in the district since the July 2010 floods.

At the province/hub level, we also interviewed the DEWS hub coordinator and provincial Ministry of Health authorities.

At national level, in addition to various informal meetings and conversations with DEWS headquarters staff, we reviewed data on alerts and outbreaks detected, and attempted to evaluate completeness of weekly data collection.

These methods are described in more detail below.

Authorisations and approvals

The evaluation was approved by the Ministry of Health of Pakistan. We also obtained ethics approval for primary data collection from the Ethics Committee of the London School of Hygiene and Tropical Medicine.

2.2 Selection of districts and reporting units

Selection of districts

We considered as our sampling universe provinces affected by recent emergencies (Balochistan; Khyber-Pakhtunkhwa or KP; Punjab; and Sindh); altogether, these provinces account for 75 of the 93 districts covered by the DEWS (Table 1).

Within each province (further split into two provincial hubs in Sindh), we selected three districts to visit from a sampling frame consisting of all districts where DEWS was implemented before or immediately after the July 2010 floods, and that were accessible based on United Nations security restrictions at the time of the evaluation. We also excluded districts where the DEWS had been implemented in 2011, as it was judged that insufficient time had elapsed for a meaningful evaluation to take place in these districts. In Balochistan, all districts were inaccessible due to insecurity, but we sampled and interviewed district SOs during a short visit in the provincial capital Quetta: therefore, in this province we did not exclude insecure districts from the sampling frame.

Within each province, we ranked districts according to the number of alerts produced since September 2010 per district population, which we assumed to be a good proxy indicator of relative DEWS effectiveness at the district level. We then divided the sampling frame into three strata, namely the top, middle and lower third, according to the above proxy indicator. From each stratum, we selected one district through simple random sampling. We did this in order to capture the full extent of variability in DEWS effectiveness across Pakistan.

Overall, we included 15 districts in our evaluation (Table 1 and Figure 1), out of a potential 45 in our sampling frame. One selected district in Sukkur was substituted with another from the same stratum, as its SO position was vacant at the time of the evaluation. Two other districts (one in Punjab, one in Hyderabad) were substituted as they were poorly accessible.

Selection of reporting units

In KP, Punjab and Sindh provinces, within each selected district, public health facilities were classified into Basic Health Units (BHUs), Rural Health Centres (RHCs) and hospitals, which altogether represent the majority of public sector health facilities in Pakistan. Health facilities that provide first aid, very limited care or specialised services were excluded: these included community dispensaries, school health centres, mobile clinics, first aid posts, field hospitals, field health clinics, tuberculosis centres, rural dispensaries, jail hospitals, social security dispensaries and sub-health centres (some of these denominations are specific to provinces, and, apart from dispensaries, all are infrequent; dispensaries are generally not targeted for inclusion in the DEWS).

For each selected district, we chose two BHUs, one RHC and one hospital based on simple random sampling. While this sampling design resulted in potential loss in heterogeneity due to clustering of RUs within only a few districts, it was a compromise between random selection and logistical constraints (visiting a larger sample of districts would have been difficult within the time frame of the evaluation, due to driving distances and security constraints).

Of the selected reporting units, 14 BHUs and one hospital were replaced as they were inaccessible due to insecurity or remoteness or no longer existed. These reporting units were therefore replaced by others, also selected randomly.

Overall, therefore, we aimed to visit 24 BHUs, 12 RHCs and 12 hospitals, for a total of 48 reporting units across KP, Punjab and Sindh provinces. However, in practice due to timing restrictions or facility closure we were able to visit 16 BHUs, 7 RHCs and 12 hospitals (Table 4).

In Balochistan only one RU within Quetta city was visited, as no movement outside Quetta was allowed: this RU was selected conveniently.

Table 3. Districts selected for the evaluation.

Province - DEWS hub	Number of districts eligible for the evaluation (number covered by the DEWS)	Estimated population of eligible districts	Districts selected (estimated population)
Balochistan - Quetta	6 (20)	2 310 000	Jaffarabad (490 000) Naseerabad (280 000) Quetta (870 000)
KP - Peshawar	10 (20)	13 450 000	Charsadda (1 420 000) Haripur (960 000) Lower Dir (1 000 000)
Punjab - Multan	8 (14)	20 080 000	D. G. Khan (2 220 000) Muzaffargarh (3 560 000) Rajanpur (1 490 000)
Sindh - Hyderabad	12 (14)	16 070 000	Hyderabad (3 820 000) Mirpurkhas (1 200 000) Tando Allah Yar (650 000)
Sindh - Sukkur	9 (9)	11 560 000	Jacobabad (980 000) Khairpur (2 040 000) Sukkur (1 200 000)

2.3 Semi-structured questionnaires at reporting units

Target respondents

Within each selected RU, we aimed to interview the medical officer or technician in charge who is the designated focal point for DEWS or surveillance/outbreak control activities; if (s)he was absent, we asked to interview the person most closely filling this role (the assistant, or whoever was present at the time of the visit). Further, if the above person was not the same person who compiles and transmits data to the DEWS, we also asked to interview this second person, if (s)he was available.

If the respondent invited additional people to attend the interview so as to provide supplementary information, we considered these as additional respondents. At each RU, all respondents (if more than one) were interviewed simultaneously in a focus group discussion.

Table 4 provides details of the actual questionnaire respondents and their stated positions.

Table 4. Details of reporting unit questionnaire respondents, by provincial hub.

Province - DEWS hub	Basic Health Units	Rural Health Centres	Hospitals
Balochistan -Quetta	1 BHU 1 medical officer	-	-
KP - Peshawar	5 BHUs 1 medical officer 3 medical technicians 1 junior medical technician	1 RHC 1 senior med. technician	3 hospitals 1 in charge nurse 1 women's medical officer 1 medical officer
Punjab - Multan	5 BHUs 2 dispensers 3 medical officers	2 RHCs 1 senior med. officer 1 medical officer	3 hospitals 1 medical superintendent 1 deputy med. superintendent 1 child specialist
Sindh - Hyderabad	4 BHUs 1 medical officer in charge 1 medical officer in charge + assistant PPHI district support manager + social mobilise 1 medical officer + health technician 1 medical officer + women's medical officer	3 RHCs 1 medical superintendent 1 medical superintendent + senior registered medical officer 1 medical officer in charge + medical officer, Maternal Neonatal and Child Health programme	3 hospitals 1 dental surgeon + medical officer 1 chief registered medical officer 1 medical officer + district government surveillance officer
Sindh - Sukkur	2 BHUs 1 women's medical officer 1 medical officer	2 RHCs 1 medical officer 1 deputy medical superintendent	3 hospitals 1 deputy medical superintendent 1 women's medical officer 1 paediatrician

Questionnaire development

The questionnaire (Annex 3) consisted mainly of open-ended questions, broadly covering the following topics:

- Ways in which alerts and outbreaks are detected at the RU;
- How clinicians recognise cases of suspected cholera and suspected measles (chosen as key epidemic-prone diseases based on which to assess RU's understanding of DEWS case definitions);
- Knowledge and understanding of the DEWS;
- Training received;
- If the community served by the RU experienced any outbreak since the July 2010 floods, a narrative of the most recent outbreak, and the role of different partners in controlling it;
- The process of weekly data compilation and transmission;
- Any other suggestions by the respondent(s) on how to improve the DEWS.

In addition, at the end of the questionnaire we completed a quantitative checklist consisting of the following items:

- Availability of any written case definitions of outbreak-prone diseases on display in the RU;

- Availability of the DEWS case definitions on display in the RU;
- Availability of the recommended DEWS form for data collection;
- Whether the RU received a copy of the last DEWS bulletin;
- The number of cases of ALRI and suspected measles reported to the DEWS during the previous week, if immediately available from a record or copy of the DEWS report.

The proposed questionnaire was discussed with the study team, and, after reaching a final English version (Annex 3), an Urdu translation was done through group consensus. Training lasted one day and covered principles of qualitative interviewing as well as consent taking.

The consent procedure (see below) and questionnaire were tested in a limited pilot phase consisting of two interviews with a BHU and hospital in Islamabad Capital Territory.

Questionnaire administration

Interviews were conducted in consultation rooms or administrative offices of the selected RU. After explaining study procedures (see Information Sheet, Annex 1), we obtained verbal consent (Annex 2) from each respondent (with optional additional consent for audio taping of the interviews and use of direct quotes in the report).

Interviews were done mainly in Urdu, unless respondents were very fluent in English, in which case, where a non-Pakistani team member was present, the latter language was primarily used. In practice, both interviewers and respondents frequently changed language during the interview. Generally, one interviewer asked questions and led the conversation, whilst the other checked that the question list was adhered to, monitored the audio recorder and offered probing questions where needed. Both interviewers attempted to take detailed or verbatim notes of responses in spaces provided below each question within printed versions of the questionnaire.

Items on the quantitative checklist at the end of the interview were personally verified by the interview (i.e. we inspected outpatient consultation rooms to verify whether case definitions were on display, etc.).

Data entry and analysis

Each team transcribed paper notes onto electronic copies, translating Urdu material into English and when necessary supplementing notes with further material from the available audio recordings.

We used a framework approach for the analysis of qualitative data [4]. Accordingly, after preliminary inspection of interview notes, we developed a coding scheme encompassing various themes derived from our conceptual framework as well as interview responses. We then reviewed the interview notes line by line and assigned one or more codes to the text, using NVivo version 9 software (QSR International, Doncaster, Victoria, Australia). During coding, we added more themes as needed to the scheme.

After familiarisation with data under each code, we cut and paste representative quotes and grouped material under different themes or issues, whenever appropriate trying to quantify the number of mentions of each theme as a measure of relative importance.

2.4 Interviews and focus groups with key stakeholders

Target respondents

For district DEWS staff interviews or focus groups, we sought to interview, at a minimum, the district DEWS surveillance officer, and, if available, the environmental health officer and pharmacist deputised to the district.

In addition, at the district government level we sought to interview the district Executive Director of Health (EDOH), if available), as well as the district DEWS focal point, surveillance officer and/or statistical officer.

Lastly, at the hub level we arranged interviews with the DEWS hub coordinator, and with any very senior provincial Ministry of Health staff available at the hub.

Details of the actual questionnaire respondents are provided in Table 5.

Questionnaire development

Questionnaires (Annexes 4 to 7) were developed as above, although no piloting was carried out before data collection, and only an English version was prepared, as it was expected that all respondents would be fluent in English. Only open-ended questions were included in these questionnaires. A different questionnaire was prepared for each type of respondent. Topics explored were as in the RU questionnaire, but with a greater focus on the perceived strengths and weaknesses of the DEWS. Questionnaires for district and provincial government counterparts were more streamlined, and attempted to explore the issue of integration of the DEWS.

Questionnaire administration

Questionnaire administration was broadly as described above for RU questionnaires.

Data entry and analysis

Data entry and analyses were as for RU questionnaires.

2.5 Analysis of weekly reporting data

We did not have access to DEWS aggregate weekly data for any hub, and were therefore unable to carry out an independent assessment of timeliness and completeness of weekly reporting. Furthermore, the system does not collect data on when a given weekly report was received, so that it is impossible to determine whether data from a given RU were received on time or added to the database in subsequent days or weeks.

In order to evaluate completeness, we requested from the DEWS data manager a database of all RUs who ever reported to the DEWS, and whether, for each week from 1 August 2010 to 18 March 2011, a weekly report was received or not. This database was received for the Sukkur, Hyderabad and Peshawar hubs.

Note that for Multan hub (Punjab province), weekly reports are centralised by the government, and data are not directly available to the DEWS team.

Table 5. Details of stakeholder questionnaire respondents, by provincial hub.

Province - DEWS hub	District DEWS staff	Provincial DEWS coordination	District health office staff	Provincial government staff
Balochistan - Quetta	3 districts 1 surveillance officer 1 surveillance officer 1 surveillance officer	DEWS hub coordinator	0 districts	Provincial epidemiologist
KP - Peshawar	3 districts 1 surveillance officer + environmental health engineer + pharmacist + government district surveillance officer 1 surveillance officer + pharmacist 1 surveillance officer + environmental health engineer + pharmacist	DEWS hub coordinator	3 districts 1 EDOH + DHIS coordinator 1 EDOH + deputy EDOH 1 + EDOH + EPI coordinator	DHIS manager
Punjab - Multan	3 districts 1 surveillance officer + pharmacist 1 surveillance officer 1 surveillance officer	DEWS hub coordinator	3 districts 1 statistical assistant 1 EDOH 1 statistical officer (DHIS)	not done (provincial government in Lahore)
Sindh - Hyderabad	3 districts 1 surveillance officer 1 surveillance officer 1 surveillance officer	DEWS hub coordinator Epidemiologist	3 districts 1 district surveillance officer + district public health officer + district vaccination officer 1 EDOH + DEWS focal point + government surveillance officer 1 EDOH + government surveillance officer	director of public health
Sindh - Sukkur	3 districts 1 surveillance officer 1 surveillance officer 1 surveillance officer	DEWS hub coordinator	2 districts 1 EDOH 1 EDOH	Focal point, director general of health

2.6 Alert detection

Country-wide alert log

We reviewed the alert and outbreak log maintained by the DEWS headquarters in Islamabad, for the period from 1 August 2010 (start of the floods) to 18 March 2011. We described the alert output by suspected and confirmed causative agent.

Mode of detection of alerts

In each district sampled, we asked the DEWS surveillance officer to recall, either from his/her written records or from memory, all the alerts, starting from the most recent, generated by the DEWS in the district since 1 August 2010, or the date of appointment of the surveillance officer if later.

For each alert listed, we collected on a register the following variables:

- the date the alert was reported;
- the reportable condition (e.g. suspected measles);
- whether the alert was later confirmed as an outbreak;
- a short narrative (3-4 sentences) of how the alert was first detected;
- whether the surveillance officer found out the alert passively, i.e. by someone informing him/her, or whether (s)he found out the alert actively, i.e. by getting in touch with a health facility or another source, or doing his/her own trends analysis (this classification was checked and revised based on the short narrative above);
- whether the information on the alert came from the surveillance officer's written record or personal recall.

We then classified the mode of detection of each alert as follows:

- **Weekly DEWS data** if the alert was first detected by reviewing DEWS reports, e.g. by applying any DEWS alert threshold;
- **Health system source** if the alert was first detected because of notification by anyone in the formal health system (any health worker including Lady Health Workers, EPI vaccinators, dispensers, and private practitioners);
- **Informal source** if the alert was first detected in any other way (e.g. from media information, community rumour, etc.).

3 Results

3.1 Knowledge and participation issues

Training

About two fifths of RUs sampled reported that they had received some training on DEWS since the July 2010 floods (Table 6), with no obvious differences by type of health facility. Note that a non-quantified proportion also received training before then in districts where the DEWS pre-dates the 2010 floods.

Table 6. Proportion of reporting units sampled that reported some DEWS training since July 2010.

Training since July 2010?	Basic health units	Rural health centres	Hospitals	Total
Some training	6 (35.3%)	4 (50.0%)	5 (41.7%)	15 (40.5%)
No training	10 (58.8%)	4 (50.0%)	7 (58.3%)	21 (56.8%)
Unknown / unclear	1 (5.9%)	0	0	1 (2.7%)
Total	17	8	12	37

Generally training was brief (a few hours to two days), and there were numerous suggestions that it was insufficient ("there is a difference between a briefing and a training" [government]; "just 1 day briefing - no comprehensive training [RHC]").

The need for more training in both long-standing and new RUs was the most mentioned weakness or suggestion for improvement of DEWS activities by all types of respondents, and RU respondents particularly. Expectably, medical officers and general health facility staff were most frequently put forward for training (7 mentions each), but other target groups, including Lady Health Workers, social mobilisers and vaccinators (6), paramedics, nursing staff and pharmacists (4), SOs (4, all suggested by DEWS staff), and EDOH or medical superintendents (2), were proposed. Specific training needs were mainly felt on reporting (4 mentions) and specific diseases (3).

"Refresher training" was the main format suggested (9 mentions), but 4 respondents also mentioned more formal "workshops".

DEWS staff also suggested holding workshops either on or in foreign countries, to learn about DEWS implementation abroad.

Visits and monitoring by DEWS staff

Three fourths of RUs reported having been visited by DEWS staff at least once during the previous month (Table 7). The frequency of visits appeared to be greater in hospitals, most of which are more accessible for SOs.

DEWS staff and RU respondents described various activities that took place during SOs' visits. By far the most frequent activities (25 mentions) were those related to weekly reporting (checking registers, auditing figures, providing forms). There were 13 mentions of general briefings and/or on the job training on the DEWS, six mentions of case definition issues, four mentions of community assessments, and three mentions of alert investigation, with five further mentions of various response-related activities (checking EPI and drug stocks, discussing ARI and diarrhoea centres), and just one mention of providing feedback (a bulletin).

Table 7. Timing of the last visit by DEWS staff to the reporting units sampled in the evaluation.

Timing of last DEWS visit	Basic health units	Rural health centres	Hospitals	Total
During the past week	6 (35.3%)	3 (37.5%)	10 (83.3%)	19 (51.4%)
2-4 weeks ago	6 (35.3%)	2 (25.0%)	1 (8.3%)	9 (24.3%)
More than 1 month ago	2 (11.8%)	2 (25.0%)	1 (8.3%)	5 (13.5%)
Never visited	2 (11.8%)	1 (12.5%)	0	3 (8.1%)
Unknown / unclear	1 (5.9%)	0	0	1 (2.7%)
Total	17	8	12	37

Understanding of the DEWS

Four RU respondents had no explanation for what the DEWS' functions consist of. Among the rest, 18 mentioned reporting alerts or weekly reports to WHO or the EDOH office; 15 mentioned that the DEWS provides information on disease trends or outbreaks; 15 mentioned responding to alerts and outbreaks; and three mentioned training of health staff.

DEWS case definitions were on display at 22/37 (59.5%) RUs visited, though only 5/12 (41.7%) hospitals.

As shown in Table 8, most RU respondents worked with reasonable case definitions of measles: 29/34 responses (85.2%) included a mention of rash, though only six (17.6%) mentioned the specific sign of maculo-papular rash included in the DEWS case definition, and four knew of no case definition. There did not seem to be better knowledge at hospital level than elsewhere.

Suspected cholera case definitions appeared to be less specific, though perhaps more sensitive than the DEWS definition (Table 9). Hospital respondents if anything seemed less precise than BHU or RHC staff, and a few misconceptions were evident (e.g. bloody diarrhoea or fever as a sign, occurrence in a child as opposed to an adult). One DEWS staff respondent suggested that the DEWS helped to clarify the difference between acute watery and normal diarrhoea, but another mentioned that these definitions were often misunderstood.

Serious problems were apparent in distinguishing upper and lower ARI, as confirmed by two DEWS staff respondents, and the very erratic number of ALRI reported by RUs we audited (Table 10). It appeared at least in one RU that ALRI were not counted as they could not be managed on site.

Barriers and facilitators to participation

Frequently mentioned barriers to health facility participation were remoteness and lack of transport (13 mentions); communication problems (9); insecurity (8); lack of training (4); and lack of interest, incentives or ownership by RU staff (6):

[Government] "There is lots of variance especially in the centres which are very far off and doctors are posted only for salaries. They go once or twice a week for just putting their attendance and they have got no importance of sending these reports."

One DEWS staff respondent suggested that hospitals not directly under EDOH administration are particularly problematic ("It's their own kingdom - many departments to negotiate, no single focal point").

The main facilitating factor mentioned was frequent visits and close support by SOs (5):

[DEWS staff]: "When SOs visit, it makes them feel like they are in the system."

Table 8. Case definitions of suspected measles according to reporting unit respondents.

Basic health units	
Rashes, fever, itching in whole body	Coughing, runny nose, temperature and skin rashes
Fever + macula-papular rash + cough/sore throat/coryza/conjunctivitis	Fever, macula-papular rash, running nose and conjunctivitis
High grade fever, maculo-papular rashes, runny nose, conjunctivitis	Rashes, fever, cough, conjunctivitis and will confirm after laboratory
Rash and fever, runny nose	Child with fever, and rashes on the skin
I do not know. I have never seen a case	Child with fever, and rashes on the skin
Temperature, coughs, reddish spots on skin, restlessness, infection in nose and throat. If 2-4 patients come from same community	High temperature, rashes start from head, neck. Also ask the number of day's patient is suffering
There is fever and rash on patient	High grade fever, flu, cough, sneezing, red eyes
Acute onset of fever, maculo-papular rash, runny nose, red eyes & history of contact is there	Fever, sneezing, tearing eyes, watery nose and rashes on skin
Rural health centres	
See clinical features, clinical diagnosis. Ask about vaccination, history of patients. Signs and symptoms are ARI, conjunctivitis, generalised rashes	>38 degrees fever with a history of 3 days + maculo-papular rash (non-vesicular) and/or runny nose / conjunctivitis / cough / red eyes
Do not know case definition	Fever, rashes, cough and running nose
Fever, cough, conjunctivitis, red rashes	My idea is density of fever, reporting rashes, sore throat
High grade fever, viral, rash, koplick spots are there	
Hospitals	
They send blood to the lab for confirmation. Check with a skin specialist. Fever and rash/red spot on skin were mentioned after probing.	Maculo-papular rashes, fever, cough, runny nose, tearing eyes. History of contact with other patient and then typically rashes will be there
Generalised rash, symptoms of RTI, high grade fever	Skin rashes within a week, conjunctivitis, and running nose
Do not know about the case definitions	Fever, and rashes on the skin
Fever, runny nose, tearing eyes, rashes on the skin	Child with fever, and rashes on the skin
Fever-like symptoms, rashes in some established cases, conjunctivitis	Fever, cough, sneezing, redness, high temperature, when temperature rises then rashes appears on whole body
There are two paediatricians at hospital and they do the case diagnosis and report	

Table 9. Case definitions of suspected cholera according to reporting unit respondents.

Basic health units	
Loose motions, excessive vomiting, maybe fever, skin infection	There is diarrhoea with vomiting
Isolation of stools to detect the organism. History of 2/3 loose motions, severe dehydration, sunken eyes, dry mouth	Stool like rice water, dehydration, if we have case like above mentioned symptoms and sudden death then we say it might be cholera
There is vomiting and diarrhoea. In normal conditions of diarrhoea, there is no associated vomiting	Acute watery diarrhoea, with vomiting and dehydration. Incubation period varies from few hours to many days. Confirmation is by laboratory
Acute watery diarrhoea with severe dehydration	If a patient comes with loose motion, dehydration or death occurs due to diarrhoea
In unknown area, severe dehydration, frequent diarrhoea resulting in death in a child 0-5y. Then send stool sample to the office, when diagnosis decided in office	Symptoms of diarrhoea, severe dehydration, sunken eyes, dry tongue, hypotension/ shock and stools like rice. Diarrhoea with sudden death due to dehydration is cholera in people above 5 years of age. Death from diarrhoea is also suspect cholera. Diarrhoea with severe dehydration and history of contact from area where cholera epidemic was reported is standard case definition.
Vomiting, watery stool	Continuous stool, vomiting and dehydration
Watery diarrhoea, vomiting, dehydration	Watery diarrhoea, and dehydration
Severe diarrhoea, unconscious, dehydration and vomiting	Fever and diarrhoea
Rural health centres	
White watery diarrhoea	Acute watery diarrhoea and severe dehydration
Severe diarrhoea with severe dehydration, loose motions, stools like rice water	Any patient with acute watery diarrhoea with severe dehydration
Severe dehydration, loose or fluid stool	Patient reports with rice watery stools
Death due to watery diarrhoea, Watery diarrhoea with severe dehydration	Suspected cholera case also referred to MO and MO further decides about diagnosis of suspected cholera
A person who died with symptoms of water diarrhoea or a patient present with rice water stools without blood and dehydration	Watery diarrhoea, and dehydration
Hospitals	
Severe diarrhoea, profuse, rice watery stool not controlled by antibiotics and any other medicines	We cannot diagnose but we can estimate through watery diarrhoea
Frequent diarrhoea, very lethargic	Watery diarrhoea, and dehydration
Do not know about the case definitions	Watery stools
We will take the history from patients and their contact, if there will be history of diarrhoea or bloody diarrhoea, vomiting, persistent cough and temperature then it will be suspect cholera. Patient with history of watery stools, vomiting, abdominal pain and cramps. If cholera is already present then one case will be suspect cholera	There are two paediatricians at hospital and they do the case diagnosis and report
Diarrhoea with rice water stools	Loose motions 5-10/day, and dehydration

Feedback of DEWS information

DEWS staff mentioned a variety of ways in which they share DEWS findings with partners, including:

- Monthly NGO and cluster coordination meetings;
- Weekly bulletins sent to PPHI and EDOH offices;
- DEWS briefings at local monthly PPHI health facility meetings;
- Less structured communications with individuals and various programmes (e.g. the TB programme).

However, only 3/37 (8.1%) RUs visited reported having received a DEWS bulletin during the previous week.

One government respondent suggested that the DEWS should do more dissemination of its activities in the general public. For sharing with government counterparts, see below (Role of the government).

3.2 Weekly DEWS reporting

Number of reporting units

About two weeks after start of the 2010 floods, 597 fixed and 361 mobile health facilities reported data to the DEWS (Figure 3). The total number of RUs had declined to 560 by mid-November as the floods emergency subsided and mobile (largely NGO-operated) health facilities shut down, but the subsequent expansion of DEWS to new districts resulted in a large increase from November to mid-January 2011. As of the evaluation visit (18 March 2011), 2762 RUs participated in the DEWS.

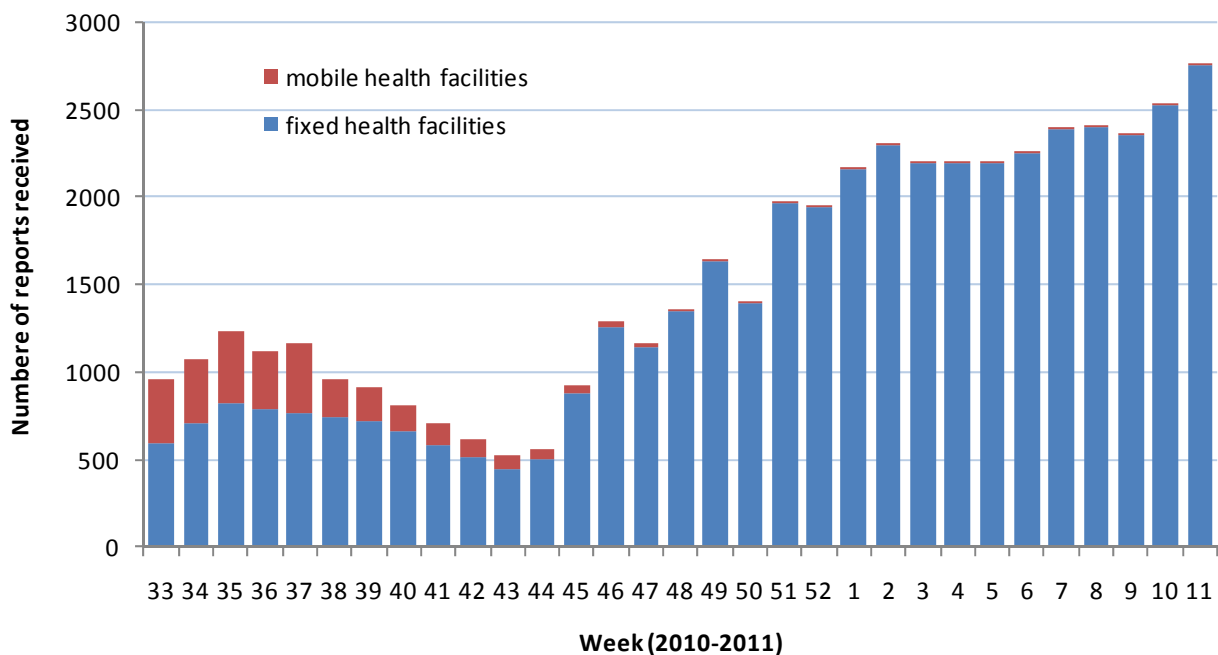


Figure 2. Number of reporting units that sent reports, by week, 16 August 2010 to 17 March 2011. Data taken from the DEWS weekly bulletin for the week 11-17 March 2011.

In Hyderabad hub there was considerable fluctuation in the number of RUs reporting per week over 2010, but in 2011 the number of reports appears more stable (Figure 4). BHUs account for the majority of reports.

A similar pattern was observed in KP Province (Figure 6). Similar data were not available to us from other hubs.

Completeness of reporting

Considering as the denominator all RUs that reported at least once during weeks when the DEWS was implemented in a given district, percent completeness of reporting appeared lower in Hyderabad hub (Figure 5) than in KP Province (Figure 7), where a steady improvement over time is apparent. Moreover, in both hubs percent completeness was higher for BHUs and RHCs than for hospitals; in Hyderabad hub districts, only about 20% of inpatient facilities reported on any given week.

As data on the total number of health facilities in each hub were not available, the true completeness of reporting (i.e. out of *all* potential RUs in any district) could not be computed. However, it should be noted that DEWS standard operating procedures do not recommend establishing weekly reporting at all health facilities in the districts outside of emergency periods:

"During emergencies, DEWS should aim to include all health facilities, hospitals, and health care providers in the emergency areas for daily reporting; the surveillance activities should not be limited to sentinel sites only.

However, for sustainability in the long term, DEWS weekly reports should be from a number of sentinel sites that can all be monitored within one to two weeks because the weekly reports should be verifiable and the alerts generated from the weekly report need to be addressed by the team within 24 hours. It is envisaged that the total number of sentinel sites for DEWS weekly reporting from one district will not exceed 30 sites.

DHQ and THQ hospitals should be included and other facilities with good patient flow and representing each UC of the district. Health facilities that are receiving Essential Medicines from WHO or some other sort of WHO assistance should be DEWS reporting sites as well. " [2]

In addition to measures to improve participation (Section 3.1), four respondents suggested that completeness would improve if the government were to mandate DEWS reporting through an official letter or order, sent to all RUs:

[DEWS staff] "In my opinion, if they are given some directions in black and white, like government order that it is mandatory so that they own it and with clear instructions from WHO to government."

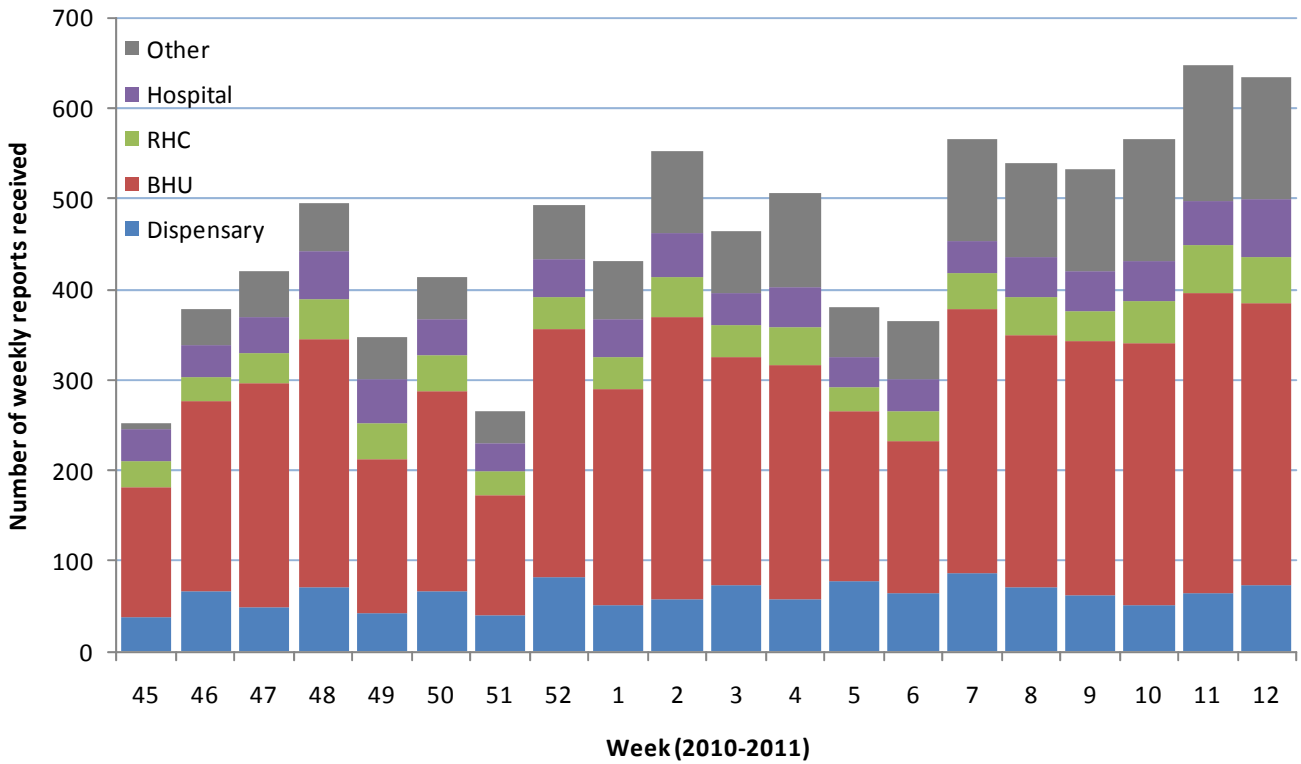


Figure 3. Number of weekly reports received by week and type of reporting unit, Hyderabad hub, Sindh province.

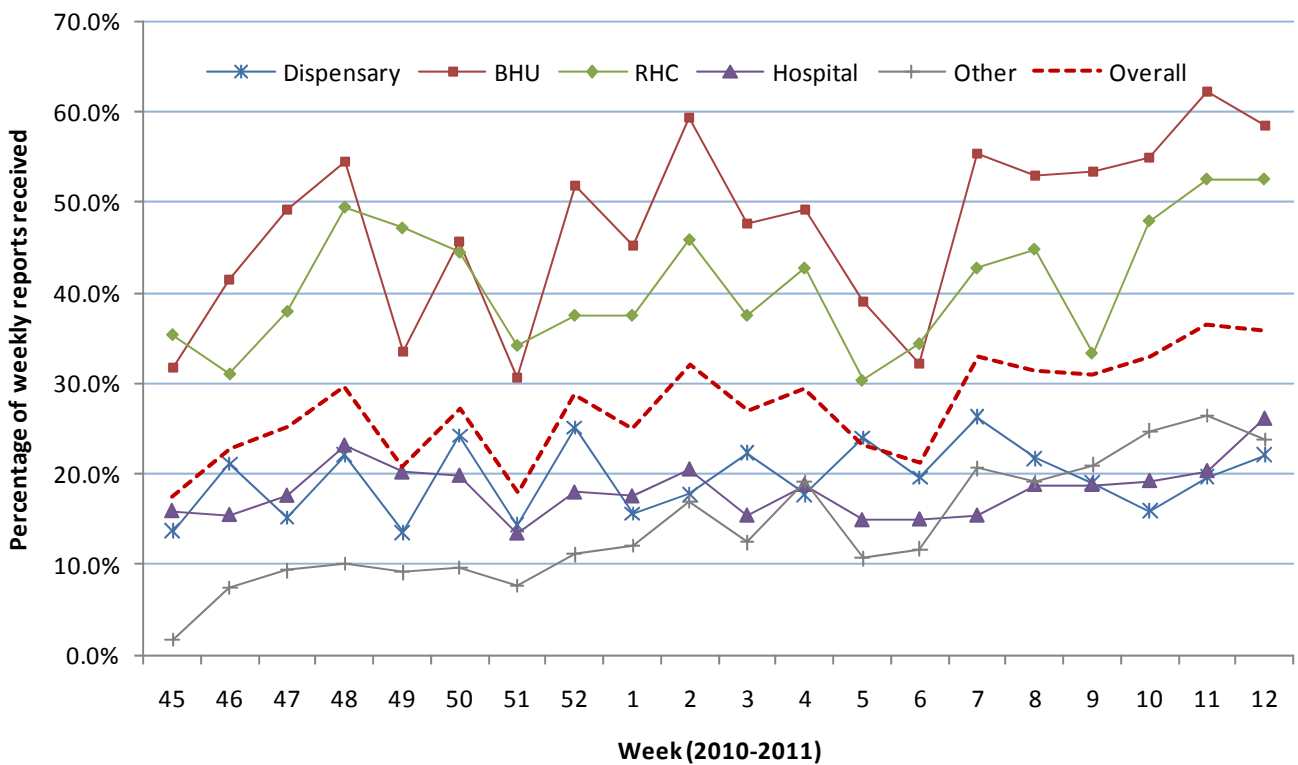


Figure 4. Proportion of reports received by week, overall and by type of reporting unit, Hyderabad hub, Sindh province (out of all reporting units ever reporting).

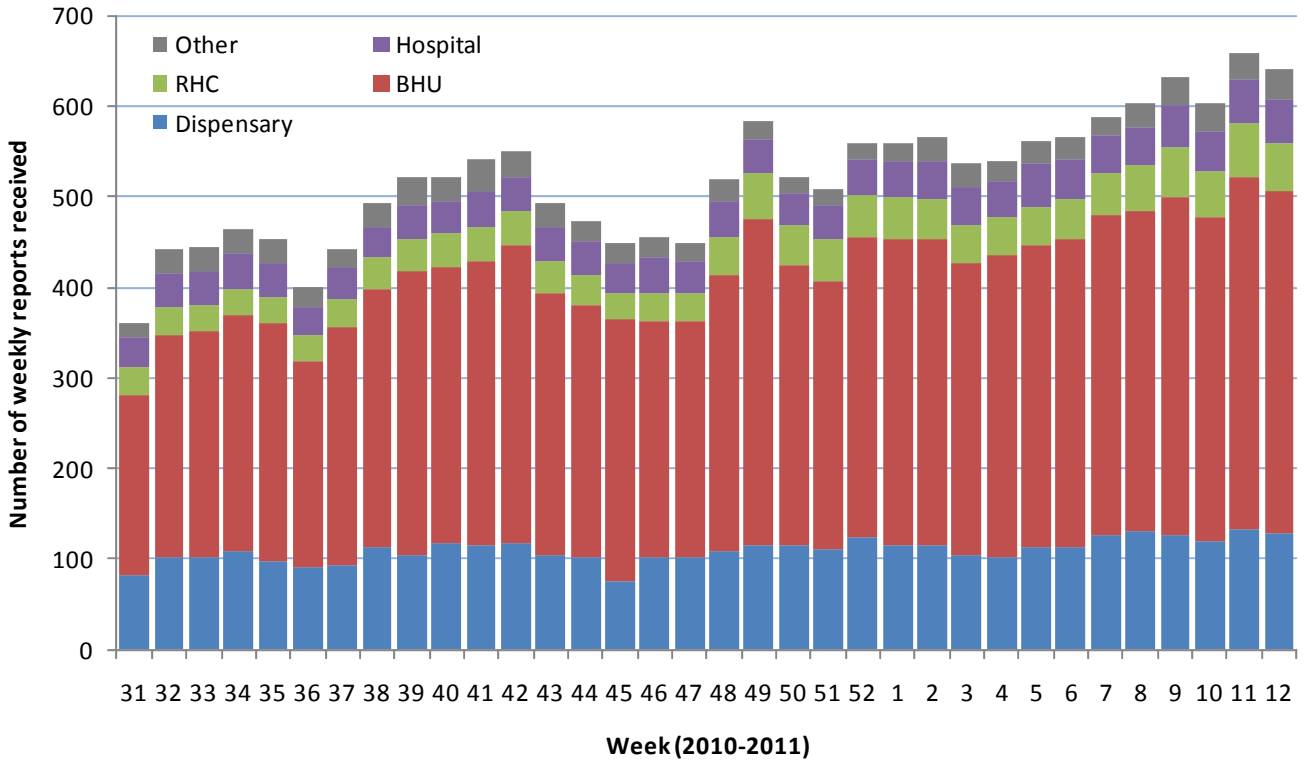


Figure 5. Number of weekly reports received by week and type of reporting unit, Peshawar hub, KP province.

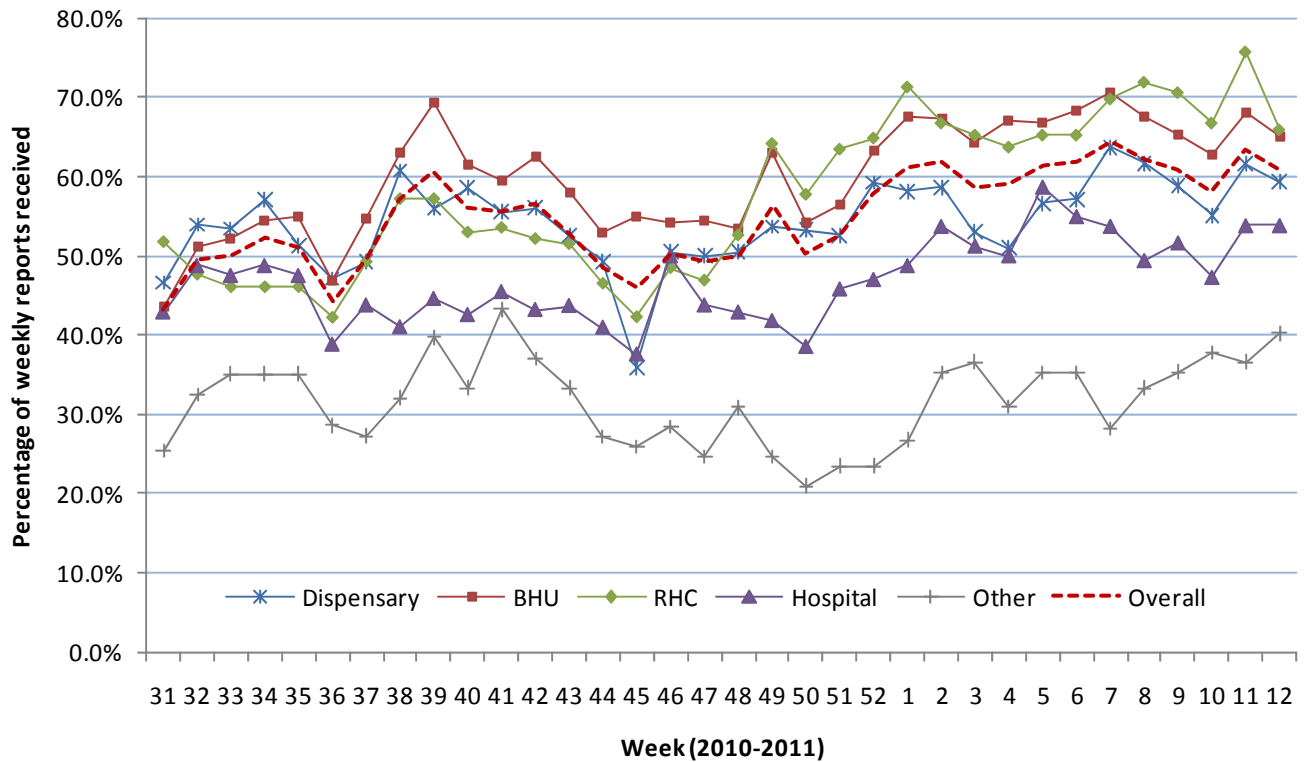


Figure 6. Proportion of reports received by week, overall and by type of reporting unit, Hyderabad hub, Sindh province (out of all reporting units ever reporting).

Data compilation

The weekly DEWS report is compiled for each Friday-Thursday week. It is one of several forms and registers that RU respondents mentioned having to complete on a daily, weekly or monthly basis. These included:

- Central registration patient register;
- OPD register (with different formats and age stratifications according to whether the RU is run by PPHI or the government);
- OPD slips;
- Daily expenses register;
- Abstract register;
- Mother and Child Health register;
- Birth register;
- Family planning register;
- EPI register;
- Field vaccinators register;
- LHW register;
- Stock register;
- Medico-legal forms for individual cases;
- Tuberculosis ward report;
- Monthly HMIS or DHIS report (about 4 pages each);
- Monthly reporting form to PPHI (for PPHI-run facilities only);
- Monthly gynaecology and obstetrics report;
- LHW supervisor's report;
- Weekly polio eradication programme AFP zero reporting form (which contains the number of AFP, suspected measles and neonatal tetanus cases), compiled for each Sunday-Saturday week;
- Weekly EPI programme Vaccine Preventable Disease form (which contains the number of suspected measles, neonatal tetanus and other EPI vaccine diseases; note that this form appeared to be available only in a minority of RUs), compiled for each Sunday-Saturday week.

Standard DEWS weekly reporting forms were available at 34/37 (91.9%) RUs visited. Several DEWS staff and government respondents mentioned the lack of DEWS forms at various health facilities nominally included in the system.

All RUs reported that they compiled weekly DEWS reports based on the OPD registers (for RHCs and BHUs) or the different ward registers (for hospitals), with some using a pro forma to tally the figures. Five respondents suggested various measures to facilitate daily tallying (e.g. adding daily columns to the DEWS form or creating daily pro formas).

Seven respondents requested training on data compilation, while five suggested harmonisation of reportable syndromes in the DEWS and DHIS forms (also see Section 3.4). Four more suggested integrating the DEWS, polio and EPI weekly forms and/or having the same reporting week for all three (Section 3.4).

Data transmission

Respondents described various ways in which weekly reports are transmitted from RUs to the DEWS, including:

- Messengers, who usually carry reports to the EDOH or PPHI office, where the DEWS SO captures them;
- Active visits by the DEWS to each RU;
- Telephone;
- Facsimile;
- Email, mainly used in Multan hub, where many EDOH offices are equipped with computers and internet access;
- SMS: this is particularly widespread in Sukkur and in some districts is the systematic approach used; it is also used in Hyderabad; in each case hub- or district-level solutions have been devised. Opinions of this system were favourable.

With the exception of Multan hub, where transmission was almost exclusively to the EDOH, there was a clear heterogeneity of reporting lines, with some RUs sending reports simultaneously to the government and the DEWS SO. Furthermore, there were various approaches to record-keeping, with some RUs reporting only telephonic data.

Many respondents mentioned the stressful nature of assembling weekly reports on Thursday and Friday. Many government respondents requested computer and internet facilities, as well as incentives, with which to facilitate their data collection and transmission work. Nearly all RU respondents requested better communications equipment and/or financial support for telephone or SMS charges. The financial and time burden of sending messengers to hand deliver the report, shouldered by the facilities themselves, was also frequently mentioned (9 mentions), and many RU respondents requested facilitation (fuel, salaries or human resources) for this activity.

Quality of weekly data

Several respondents mentioned concerns with the quality of reported data. For example:

[Hospital] "Bogus fictitious reports are generated by the doctors."

[DEWS staff] "People have been sending unrealistic reports and wrong as well."

[DEWS staff] "Till now, they [DEWS coordinators] are interested in figures and not quality."

[Government] "We do not check the data but DHIS report, which is in hard copy has at times got so many blunders. So then what is the reliability of this telephonic data."

One DEWS respondent suggested that reliability of data is the biggest challenge for the system. Government respondents were particularly concerned that data reported by SMS or telephone only are impossible to verify and may be very flawed.

We performed a limited audit of suspected measles and ALRI reports. During RU visits, 7/37 DEWS reports of suspected measles cases occurring during the last reporting week were not immediately available; however, the DEWS database in Islamabad did contain suspected measles data for all these facilities (zero cases for all). For 20/37 RUs, a DEWS report from the previous week was available at the facility, and zero cases of suspected measles were reported both locally and on the Islamabad database. In one RU, one suspected measles case appeared on the locally stored DEWS report, but zero cases were reported in the Islamabad database.

ALRI figures were available in the DEWS database for all RUs sampled, although six RUs did not have copies of the DEWS reports locally. There were striking differences between figures reported locally and in the Islamabad database (Table 10): concordant figures were noted for only 7/37 (18.9%) RUs, and absolute differences of < 5 cases for a further 6 (16.2%).

A few DEWS respondents believed that there was considerable confusion with ALRI figures, and mentioned that in the HMIS report only ARI cases are tallied, with no distinction between lower and upper. One respondent suggested that some RUs may simply divide ARI figures arbitrarily into ALRI and upper ARI. Differences in the number of ALRI cases reported (Table 10) were striking, with some small RUs reporting large numbers, and others zero.

Table 10. ALRI cases reported locally and by the DEWS database, week 12, 2011 (18-24 March 2011). For each RU type, each row is one RU.

Basic Health Units		Rural Health Centres		Hospitals	
ALRI cases (DEWS database)	ALRI cases (RU questionnaires)	ALRI cases (DEWS database)	ALRI cases (RU questionnaires)	ALRI cases (DEWS database)	ALRI cases (RU questionnaires)
9	9	7	7	0	0
0	0	27	27	121	99
4	0	0	n/a	397	n/a
83	83	78	118	33	158
14	16	12	n/a	85	102
2	32	30	14	11	n/a
0	117	63	0	0	1
4	45	98	40	14	15
3	n/a			7	8
5	5			19	n/a
0	6			32	50
32	144			145	10
24	12				
1	0				
8	0				
23	11				
5	11				

Perceived burden of data collection

Most BHU and RHC respondents reported that compiling the DEWS report takes 1-2 hours every week (14 answers); eight take less than 1 hour and five take 2-4 hours. The burden in hospitals was greater, with two taking 2-4 hours, three half a day and 3 a whole day or longer.

DEWS staff were split as to whether data collection is burdensome for RUs. Nearly all RU respondents, however, stated that DEWS reporting is manageable and not disruptive. A few (two hospitals and two BHUs) mentioned problems, e.g.

[Hospital] "Yes this affects my time. Patients suffer due to compilation of this report and I have to work in extra hours to compile this report."

[BHU] "Yes, I have to close pharmacy or OPD due to this report."

Perceived usefulness of data on endemic diseases

We asked DEWS staff their opinions on the usefulness of data on ARI and other acute diarrhoea collected by the DEWS. Nearly all respondents suggested that ARI and other diarrhoea data had been useful to (i) plan for resource mobilisation (e.g. drug supply, prepositioning of resources) and (ii) decide on the location of specialised, seasonal ARI and diarrhoea treatment centres, and when to implement either.

Some staff offered anecdotes of instances in which ARI or diarrhoea data were used to generate alerts. For example, nebulizers, oxygen cylinders and drugs were made available to a BHU because of increases in ARI. Communities in which ARI or diarrhea cases doubled were visited and village-level interventions were carried out.

Only one SO provided a contrarian view to the above:

[DEWS staff] "We don't have use for these [ARI] data except that we present data, trends in coordination meetings. In our minds we are focussing on alerts, not scabies or ARI or unexplained fever."

However, the same SO noted that acute diarrhoea

"...is a different case from ARI: here we are looking for a very high number of cases of acute diarrhoea, as sign of something going wrong."

Indeed, we learned of at least one instance in which a cholera outbreak was detected from analysis of other diarrhoea trends.

3.3 Alert and response functions

Detection of alerts and outbreaks

Over an eight month period since the start of the 2010 floods, the DEWS central database reports detection of 940 alerts (about four per day), of which 256 (positive predictive value [PPV] 27.2%), or about one per day, were confirmed as outbreaks (Table 11). Most of the alerts and outbreaks came from the populous provinces.

Acute watery diarrhoea (suspected cholera), measles and haemorrhagic fever constituted the bulk of alerts, but other syndromes not covered by weekly reporting, including diphtheria, H1N1 influenza, suspected meningococcal meningitis and pertussis were frequently reported (Table 12).

Measles virus, *Vibrio cholerae*, dengue virus and H1N1 influenza were the most commonly isolated aetiologic agents. However, in discussions with DEWS staff it seemed obvious that other diseases like pertussis and leishmaniasis caused outbreaks, but were not reported as such in the database due to the lack of or poor sensitivity of laboratory tests.

Table 11. Alerts and outbreaks detected by the DEWS, by hub and confirmed causative agent, 1 August 2010 to 18 March 2011.

Province - DEWS hub	Alerts	Outbreaks	Causative agents (n)
Azad Jammu and Kashmir	3	1	<i>V. cholerae</i> (1)
Balochistan – Quetta	19	10	<i>V. cholerae</i> (3), <i>P. falciparum</i> (2), mixed <i>P. falciparum</i> and <i>P. vivax</i> (3), measles (1), rubella (1)
Federally Administered Tribal Areas	5	0	
Gilgit Baltistan	0	0	
Islamabad Capital Territory	7	2	Measles (1), H1N1 virus (1)
KP – Peshawar	338	135	Hepatitis A (3), <i>V. cholerae</i> (49), <i>Salmonella</i> spp. (1), dengue (19), measles (36), <i>C. diphtheriae</i> (2), H1N1 virus (24), mumps (1)
Punjab – Multan	101	30	<i>V. cholerae</i> (14), <i>S. flexneri</i> (1), dengue (1), mixed <i>P. falciparum</i> and <i>P. vivax</i> (1), measles (3), H1N1 virus (1)
Sindh – Hyderabad	165	24	<i>V. cholerae</i> (4), dengue (1), measles (18), mumps (1)
Sindh – Sukkur	262	52	Poliomyelitis (1), <i>V. cholerae</i> (15), dengue (3), <i>P. vivax</i> (1), measles (29), rubella (1), measles and rubella (1), H1N1 virus (2)
Overall	940	256	

During the floods emergency in August-October 2010, most alerts were attributed to acute watery diarrhoea. Since then, acute watery diarrhoea alerts have diminished, while an increasing number of measles alerts is noted (Figure 7). Other agents, like diphtheria and pertussis, seem to be clustered in time. The mean number of patients per alert decreased considerably since the flood emergency period to about < 5. Taken together, these observations may suggest an increased sensitivity and timeliness of the system in detecting individual cases. One DEWS staff respondent noted that "in these days the number of measles alerts is so great that SOs have not had time to look after other alerts, for example whooping cough".

Many respondents, and government in particular, suggested that the DEWS has an added value in alert detection. For example:

[Government] "There are more alerts than before."

[Government] "Only DEWS is helping in detection and response to outbreaks."

[BHU] "DEWS helps in diagnosis. Increased number of cases are reported."

[RHC] "Proper reporting and better response [would have] been there if DEWS had been implemented earlier."

[BHU] "DEWS is the best way for detecting outbreaks; for example a case of malaria and dengue was reported during summer. We never had plan before. Now due to DEWS we can easily find the outbreaks."

Table 12. Alerts and outbreaks detected by the DEWS, by suspected causative agent, 1 August 2010 to 18 March 2011.

Suspected agent	Alerts	Outbreaks (PPV %)	Causative agents (n)
Acute flaccid paralysis	24	1 (4.2%)	Poliomyelitis
Acute jaundice syndrome	9	3 (33.3%)	Hepatitis A
Acute watery diarrhoea	220	86 (39.1%)	<i>V. cholerae</i>
Bloody diarrhoea	20	2 (10.0%)	<i>Salmonella</i> spp. (1), <i>S. flexneri</i> (1)
Haemorrhagic fever	93	33 (35.5%)	Dengue
Malaria	19	8 (42.1%)	<i>P. falciparum</i> (3), <i>P. vivax</i> (1), mixed (4)
Measles	292	91 (31.2%)	Measles (88), rubella (2), measles and rubella (1)
Others			
Acute respiratory syndrome	14		
Chickenpox	25		
Diphtheria	33	2	<i>C. diphtheriae</i>
Food poisoning	1		
H1N1 influenza 2009	47	28	H1N1 virus
HIV/AIDS	1		
Hypothermia	1		
Leishmaniasis	8		
Meningococcal meningitis	37		
Mumps	9	2	Mumps
Neonatal tetanus	32		
Pertussis	37		
Rabies	2		
Scabies	1		
Tetanus (other)	10		
Typhoid fever	1		
Unexplained fever	4		
Total	940	256 (27.2%)	

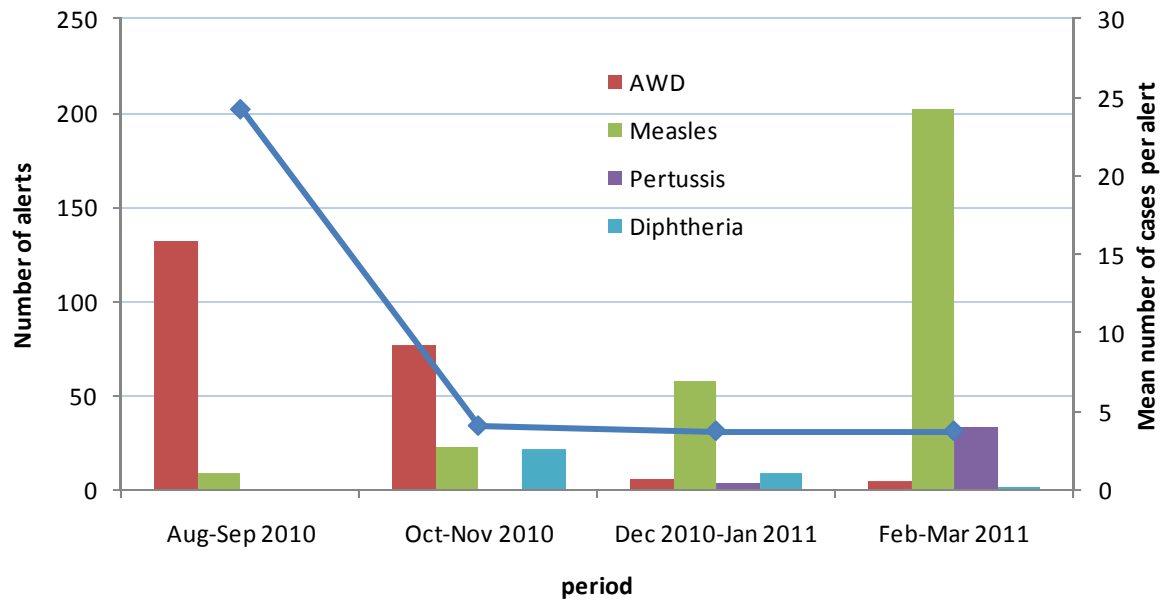


Figure 7. Number of alerts for four selected suspected agents, and mean number of cases per alert, over time.

The main complaint by DEWS staff as regards alert detection was that the software does not enable them to detect alerts from the data (4 mentions). Other difficulties mentioned were lack of interest from health facilities, picking up alerts from private facilities and inaccessibility.

The main suggestions for improved alert detection included:

- Sensitising communities through fliers or media messaging about hygiene promotion and signs and symptoms of the main epidemic-prone diseases;
- Visiting communities regularly;
- Training LHWs and vaccinators (see Section 3.1);
- Frequent visits to RUs by DEWS staff (weekly or monthly), with reminders about case definitions;
- Intensified communication between SOs and RUs, if necessary by providing mobile phones and other communication means;
- Greater coordination with EDOH and other government counterparts, with frequent meetings.

Mode of detection of alerts

Narratives of 184 alerts were available, of which 142 (77.2%) relied on written records or reports kept by the SO, and the remainder on his or her personal memory.

The majority of these alerts (and 36/39 or 92.3% of alerts that were confirmed as outbreaks) were detected through a formal report by a health practitioner either within or outside the DEWS (Figure 3). This took place nearly always through a phone call or SMS, with communication mostly directly from the health facility to the DEWS SO (data not shown). About 11% of alerts and one confirmed outbreak were detected by the SO upon reviewing weekly DEWS reports and applying DEWS alert thresholds. A small number of alerts, of which two outbreaks, were detected through informal sources (community informants or newspapers).

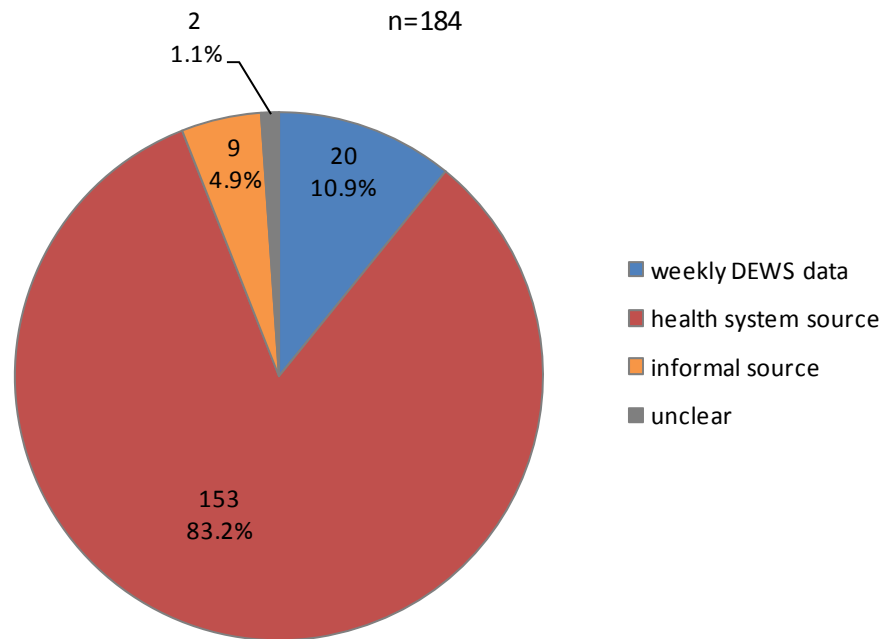


Figure 8. Mode of detection of alerts since the July 2010 floods, according records or personal recall of the surveillance officer.

The DEWS SO actively detected 71/184 (38.6%) alerts and 10/39 (25.6%) confirmed outbreaks, the remainder consisting of passively received information.

When questioned about the ways in which alerts can be detected, DEWS staff mentioned primarily analysis of DEWS reports (through software if available) in order to detect unusual trends or the crossing of thresholds (9 mentions). Fewer mentioned phone or SMS communication with health facilities (6 mentions); the media (5); personal relations (3; "[SOs] get alerts from private facilities through networks they develop, but this is taking time, not easy for one SO" [DEWS staff]); and visits to health facilities (3; "pay all facilities a visit and collect data like alerts because all may not send alerts and just consider sending the numbers only" [DEWS staff]).

When probed about the best way to detect alerts, more DEWS staff suggested notification from health facilities (9 mentions) than analysis of DEWS weekly reports (6). Two suggested the media, and that each hub should systematically review newspapers each morning.

By contrast, RU respondents mainly suggested the observation of unusual cases among OPD or hospitalised patients (28 mentions), Lady Health Workers (LHWs; 9), vaccinators (polio or EPI; 6), and various community informants (9) as ways to detect alerts. Passive surveillance of incoming patients or review of the patient registers were proposed as the best way to detect alerts by 12 respondents, while 8 proposed LHWs, 7 vaccinators and 5 other community informants.

A few RU respondents displayed a very clear understanding of alert reporting procedures:

[BHU] "As received training on DEWS, when we receive alert we inform to WHO. Suspect case is taken as alert, and from previous 3 weeks data coverage is taken and compared, if threshold is higher than the standard then [this is] taken as alert and responded to."

The link between OPD staff and community health workers was also obvious in some interviews:

[BHU] "From the daily outdoor patient register, we check the increasing diseases; if EPI field staff gives the information about some suspected cases in a locality then we start investigation by sending the hospital staff there."

[RHC] "[the best way is from] OPD registers: if any patient with problem related to DEWS pro-forma is coming to OPD, at that moment we ask LHWs from that area to look at the situation of disease in that area, we can send people to that area to give information."

RU respondents stated that they mainly report alerts to the EDOH or other government staff (25 mentions), but some also report directly to WHO staff (11; " Sometimes if something happens that is not usual" [RHC]; " I will report to WHO and then WHO will reply or respond in 24 hours" [BHU]) and PPHI (2; "and for major problems DHO" [BHU]). In Multan hub, priority reporting to EDOH seemed universal.

Alert investigation

DEWS staff from all hubs described a consistent, fairly structured approach to alert investigation, whereby teams are formed (comprising the SO, his or her district government counterpart if available, and the DEWS pharmacist and environmental engineer if appropriate), and dispatched to the health facility affected as soon as possible, and usually within 24-48 hours ("The DEWS react fast, they are coming in half an hour to the ward" [Hospital]). The team travels with supplies for laboratory sample collection and, depending on the syndrome reported, small kits enabling containment interventions (e.g. water purification tools and hygiene promotion materials for suspected cholera; vaccines for suspected measles). On the ground, cases are reviewed with clinicians and line listed, and the community is visited, with contact tracing and active case finding as key activities. We did not have time to review reports prepared by SOs of alerts they responded to, but it was clear that many SOs produced very detailed investigation reports, illustrated by photographs of every step.

The central alert database reported that laboratory samples were collected for 613/940 (65.2%) alerts. Laboratory confirmation was by far the most frequent issue raised by DEWS staff respondents as regards alert investigation (13 mentions). In particular, four issues arose:

- Delays (usually of two weeks) between dispatch of lab samples from districts to the NIH in Islamabad, and receipt of results from NIH; DEWS staff also reported samples being lost or for which no results were ever communicated:

[DEWS staff] "When we send samples of alerts for laboratory tests, the reports are not timely provided. I have sent 6 samples of alerts but have not received a feedback on any one of them."

It was also clear that there was no consistent line of communication between NIH and DEWS field staff, with results being sent to the EDOH, the hub, headquarters or individual SOs, and a lack of data management and sample tracking.

- Lack of sampling kits and supplies at hub or district level. Even where supplies were available, the quantity was low and insufficient to deal with a potential large-scale outbreak.
- Problems with shipment and quality of cold chain, resulting in negative results, e.g. for strongly suspected pertussis cases.
- A discrepancy in guidelines on measles sampling between the DEWS and the EPI programme, with the former recommending sampling of 20% of suspected cases, and the latter 80%.

DEWS staff suggested decentralising laboratory services to the provincial level.

DEWS staff also mentioned obvious structural problems that hamper alert investigation, including insecurity (9 mentions; some reported delays due to having to obtain security clearance before travel) and remoteness of affected communities (8; a few added that rental vehicles used by DEWS are unfit for rural roads).

There were also mentions of reluctance from communities (3; "People resistance is there for example, when we went for sampling of measles cases, we face resistance from community that why you are doing sampling" [Hospital]), and the difficulty of having to monitor a large number of RUs (with consequent failure occasionally to investigate all suspected measles cases). Furthermore, DEWS staff from all hubs mentioned issues with involvement of the government (see Section 3.4).

Outbreak response

We collected numerous narratives of outbreaks in which the DEWS was involved since the July 2010 floods. For brevity, we present in Table 13 representative narratives of six outbreaks in which the DEWS' impact ranged from relatively high (i.e. directly effecting containment) and relatively low (being involved in the detection but having little effect on control).

Generally it appeared that the DEWS played an essential role in detection, contributed heavily to confirmation, and, critically, stimulated the response by engaging with the EDOH and advocating for interventions. There were instances in which the DEWS led the response by delivering drugs and organising activities, but EDOH involvement was prominent in many instances, particularly with regards to reactive vaccination for measles and other EPI diseases.

Government respondents provided various anecdotes, too numerous to list of the DEWS' assistance in outbreak control since the floods. These included:

- Detection of various epidemic-prone syndromes and diseases (diarrhea, cholera, measles, pertussis, jaundice, hepatitis, dengue, leishmaniasis, H1N1 influenza, bloody diarrhea);
- Provision of supplies for outbreak control (cholera kits, bed nets, water and sanitation tools, emergency health kits, rapid diagnostic tests for malaria, etc.);
- Support for reactive vaccination;
- Other containment measures, including for polio;
- Creation of wards and drug supplies for ARI and diarrhoea management.

Respondents were appreciate of the DEWS' support in outbreak control, and no negative opinions were voiced:

[Government] "DEWS in floods working to detect outbreaks helped us to do immediate preventive work in that area."

[Government] "If there were no DEWS support, we would be in trouble because of outbreaks."

[Hospital] "The DEWS is very useful for any outbreak to control in a timely fashion."

[BHU] "DEWS is important to detect outbreak, this is the only way to detect and manage to control outbreak."

[BHU] "DEWS is best at the moment for detecting and responding to outbreaks."

[BHU] "Only DEWS is there."

Notable suggestions by DEWS staff respondents for improved outbreak response included pre-positioning supplies and kits at district level, particularly during cholera season, and better coordination among agencies and more importantly with government.

Table 13. Narratives of six selected outbreaks, classified by the relative impact of the DEWS on their detection and control.

High impact of the DEWS	
<p>Cholera [reported by DEWS staff]. The SO detected an increase in other diarrhoea cases by analysing DEWS weekly reports from a hospital, and, after two investigations, confirmed a cluster of cholera cases. Response began within 24 hours of the first suspected cholera case meeting case definitions, and before lab confirmation. There was an aggressive containment response; DEWS staff and EDOH held a joint meeting, and also met with city government staff and partner agencies. Responses included flocculation and chlorination of water supplies (WHO, Unicef, city government, hygiene promotion (EDOH, Helping Hands for Relief and Development) and sanitation (Oxfam). The outbreak remained circumscribed (< 15 cases).</p>	<p>Measles [reported by DEWS staff and a BHU]. The SO was notified of 11 suspected measles cases by a friend at a health facility. Investigation took place on the same day, and 2 cases were eventually confirmed. The intervention took place within 24 hours and included active case finding, isolation of cases, health education, vitamin A to cases and reactive vaccination of almost 200 children by the EDOH and the SO jointly. The DEWS detected the alert and "sensitised" the EDOH to join the investigation and take action.</p>
Moderate impact of the DEWS	
<p>Acute diarrhoea [reported by a RHC]. After noticing an increasing number of patients with severe diarrhoea, clinicians notified an alert to the SO and the EDOH. Seventy-two cases were noted among attendees of a wedding party. The EDOH provided IV fluids and ORS and facilitated lab sampling, for which however results were delayed. The SO helped to organise investigation and response and provided essential medicines.</p>	<p>Measles [reported by DEWS staff]. A RHC notified the DEWS SO by SMS of suspected measles cases. The SO notified the EDOH, who organised a reactive vaccination campaign. The DEWS had no sampling supplies (these were borrowed from the polio programme) and the government's cold chain was weak. The DEWS provided vitamin A and the polio programme's courier system was used to ship samples.</p>
Low impact of the DEWS	
<p>Cholera [reported by DEWS staff]. An outbreak of cholera was confirmed by international medical teams during the floods emergency, based on DEWS data. The response came from the EDOH, two international NGOs and an Egyptian medical team. There was limited sharing of information from government to the WHO SO.</p>	<p>Malaria [reported by a Hospital]. Hospital staff was alerted by the media and a phone call from a peripheral health facility experiencing cases of malaria. Hospital staff confirmed the cases, provided medicines and reported the outbreak to the Malaria Control Programme. Most of the response and coordination came from the government. WHO helped with training, drugs and "mobilisation".</p>

3.4 Relationship of DEWS with other programmes

Integration with other disease control programmes

Several respondents, mainly DEWS staff or government interviewees, mentioned the need to coordinate DEWS' work with that of other disease control programmes, including the polio eradication programme, the EPI programme and, in Peshawar hub, the Malaria Control Department.

Respondents in all hubs suggested simplifying the weekly reporting processes used by polio (AFP zero reporting form), EPI (Vaccine Preventable Disease form) and DEWS, by adopting the same reporting week and integrating the three into one. Currently all three programmes collect a weekly report; suspected measles is included in all three forms; neonatal tetanus in the polio and EPI form; and AFP in the DEWS and polio form.

The general view was that DEWS and the polio programme work well together. In Hyderabad hub, for example, despite the obvious lack of clear procedures separating the work of polio and DEWS staff, the two programmes meet frequently and have informal arrangements in place to split the field investigation work.

Views were less positive on coordination with the EPI programme. For example,

[DEWS staff] "EPI programme currently does not do active surveillance, before DEWS there was no active EPI surveillance. They want DEWS there but when we try to involve them, they don't want to be involved."

[DEWS staff] "AFP and measles are supposed to be investigated by polio person, but the polio officer is not really investigating measles, relies on government to do so."

Only 3 RUs we visited mentioned the Vaccine Preventable Disease form, which appears to have limited coverage.

Role of the government

Generally government respondents were complimentary of the DEWS' work and suggested cooperation with the DEWS is good ("With DEWS we see only benefits, no loss" [Government]). They also stressed the added benefits of improved government planning and greater capacity through training of clinicians and district managers.

It was clear that, to various extents, districts maintain their own surveillance and response cells, which usually work in partnership with DEWS staff to respond to alerts and outbreaks. However, about half of government respondents pointed to insufficient or late sharing of weekly reports, alert information or weekly bulletins by the DEWS or bypassing of EDOH staff in the reporting line; for example,

[government] "Now SOs are collecting reports from facilities, but if he goes away the system will be paralysed, so we should go through the district for collection of reports."

[government] "Following response to an outbreak, we expect an outbreak response feedback from the coordinating DEWS team but this currently is not made available to the EDOH in a timely manner."

The DEWS appeared to have a more dynamic relationship with PPHI and its RUs than with the government.

Two government respondents also pointed out that the DEWS does not sufficiently involve social mobilisation/awareness teams available at EDOH offices, while other suggestions included involving local political leaders and NGOs so as to build awareness of the DEWS, and providing district offices with resources so as to enable them to face the added work brought on by the DEWS.

By contrast, in 14/20 of the DEWS staff interviews or focus groups problems with cooperation and involvement of the government counterparts were raised; mentions of "low ownership", "low involvement", "lack of support" or "lack of cooperation" were very frequent. For example:

[DEWS staff] "DOH puts all the burden on WHO's shoulder, sometimes everything is available but they don't participate."

[DEWS staff] "Investigation would not have occurred without the DEWS."

[DEWS staff] "District teams think that DEWS alerts and outbreak handling is responsibility of only WHO team and DEWS officer. Government staff does not take responsibility especially in the alert investigation."

[DEWS staff] "Currently they do not feel responsible."

Fear and trust appeared to be common themes in the relationship between DEWS and government:

[DEWS staff] "Government people in some places are afraid to inform DEWS, are fearful that they will be criticised, that they will face questions."

[DEWS staff] "The government is hiding cases because of inefficiency."

[DEWS staff] "Political pressure from EDOH should be removed."

[DEWS staff] "For example, our pharmacists are not allowed to visit district drug stores and our environmental health staff lack cooperation from their government counterparts."

[DEWS staff] "They do not share their data."

[DEWS staff] "EDOH thinks alerts simply cause problems for them because of demand for action that follows."

[DEWS staff] "Sometimes EDOH is angry that an alert has been reported."

[DEWS staff] "People of health department did not want to give us any information and they were so much scared of reporting an alert and they were hiding it."

[DEWS staff] "They are afraid of it getting reported to the higher authorities as in my opinion vaccination is only 50% coverage and they also want to hide measles vaccination coverage."

[DEWS staff]: "There is now a very good level of trust, the government calls DEWS, they have confidence to call."

Integration with government surveillance

Government respondents did not perceive the DEWS as a competitor to the current Health Management Information System (HMIS) or the new District Health Information System (DHIS) being progressively rolled out throughout Pakistan, which collect monthly data and mainly focus on health services management.

Nearly all respondents (DEWS staff and government) were supportive of integrating DEWS within government surveillance and/or DHIS specifically. On the one hand, linking DEWS to DHIS was deemed expedient to ensure greater coverage of the former. On the other hand, the DEWS was deemed to provide a function that the DHIS does not; for example,

[Government] "When we developed HMIS it had a weekly and immediate notification component that did not quite take off; the current DHIS does not have this component and we see DEWS filling this gap. We would like to see DEWS integrated with DHIS as soon as this can be achieved with WHO support."

Respondents offered various suggestions for how to bring integration about, including the following main points:

- One common reporting format, otherwise "they feel that it's a WHO thing" [DEWS staff]; this was a very frequent suggestion, and three respondents proposed that the DHIS form be adopted but made weekly in frequency; one proposed only reporting diseases weekly and the rest of the variables monthly;
- Provision of adequate computing, data management and communication facilities to government surveillance cells;
- Advocacy with the provincial departments of health to allocate a budget for and take ownership of the DEWS:

[DEWS staff] "The problem is the motivation of government: we have to increase the trust level first, have to show how the outbreak was controlled on time; when they realise the importance they will make it a part of their system, but it will take time."

- Harmonisation of syndromes to report (e.g. DHIS does not distinguish upper and lower ARI, but DEWS does);
- Making sure DEWS and government staff sit in the same office and work together on alert response;
- Frequent, structured coordination meetings between DEWS and district and/or provincial health counterparts;
- Holding high level discussions between WHO and provincial health authorities.

Some DEWS staff suggested that integration would detract from the DEWS' strength of alert and response:

[DEWS staff] "DHIS and HMIS have no alert reporting so early warning would be not possible."

[DEWS staff] "Number 1 focus should be [...] a very healthy ongoing DEWS programme. We can integrate it later on."

4 Discussion

4.1 Main findings

Main strengths

The DEWS is currently the only programme available in Pakistan with the capacity to detect and meaningfully respond to epidemics other than polio. As such, it represents an invaluable resource for public health in this very large and emergency-prone country. **We believe that the DEWS must be maintained and strengthened with the support (financial and institutional) of the WHO, the government and donors.**

The DEWS has produced an impressive and arguably under-appreciated output in terms of alerts and outbreaks detected. Whilst we could not document the effectiveness of all responses mounted to these outbreaks, reports and opinions of a variety of respondents were mostly very positive. There is little doubt that the absence of this system would leave Pakistan considerably more exposed to large epidemics and their severe public health toll.

The system has a strong focus on alert and response. Accordingly, investigations are very timely, and this ensures not just that outbreaks are detected and described, but also that they are *contained* - a critical function of any epidemic surveillance system, but one that is lacking in many. The emphasis on timely response and containment also means that WHO can provide surgical operational support (reactive vaccination or water and sanitation in circumscribed communities; case management support for small clusters of cases), without substituting the government - a rational and intelligent strategy that arguably should be replicated elsewhere.

The system provides the above services with comparatively modest inputs. The mean cost of the DEWS per outbreak detected was about USD 15 000, which appears reasonable and cost-beneficial when considering the economic implications of the alternative, i.e. reacting with lesser timeliness to larger outbreaks. The DEWS also produces a variety of economic externalities, chiefly those due to better clinical and public health practice as a result of health worker training, either formal or on the job.

Lastly, we found evidence that the system is supported by highly motivated staff, and, importantly, enjoys esteem and appreciation by government counterparts.

Main weaknesses

The main weakness we identified was the insufficient utilisation of data collected on a weekly basis. Despite constituting the majority of DEWS-related work, weekly reports are mostly not used for their main intended purpose, i.e. detecting outbreaks: this is a result of easily rectifiable deficiencies in automated software analysis. Furthermore, the quality of data may be very questionable, particularly for some syndromes like ALRI. Completeness is not optimal, particularly in hospitals, warranting a more streamlined approach to define RUs in each district.

We also noted inadequate data management at all levels, with insufficient transparency. The system is currently unable to accurately estimate essential monitoring indicators such as completeness and timeliness, and indeed there is no clear, dynamic overview of the number, type and spatial distribution of RUs. Software applications seem outdated and insufficiently secure, with a proliferation of applications and analysis across the different hubs, and an avoidable workload (and risk of data entry and analysis errors) for staff at all levels. Spatial analysis is also not sufficiently utilised.

Laboratory investigation of alerts is ineffective, possibly resulting in alerts and outbreaks missed (particularly for measles and pertussis), lower probability of containing outbreaks, and greater workload for all involved. Given the size of the DEWS, current systems to ship samples, track them, report findings and manage lab data seem inadequate.

In general, there is an insufficient focus on quality assurance. While this is understandable given the rapid expansion of the DEWS and the various emergencies it has had to tackle, moving into the future we believe that better, more systematic procedures need to be implemented to verify that alerts and outbreaks are responded to according to standards, and that weekly reports contain accurate data.

While DEWS staff are motivated, they are also overstretched, "on call seven days a week" [DEWS staff], "exhausted" [DEWS staff], with "hardly time to sleep" [DEWS staff]. Some very populous districts share one SO between them, and the team of environmental health engineers and pharmacists at hub level, as well as the headquarters coordination team, are likewise small compared to the task at hand (epidemic surveillance in the world's sixth biggest country!). Furthermore, the team is severely gender-imbalanced and threatened by impermanence due to very short-duration consultant contracts that may in the long run detract from motivation prevent retention of the best staff. Improving DEWS staffing and working conditions seems unavoidable to ensure quality.

As currently implemented, the system has limited sustainability outside of WHO support. We do not believe however that total sustainability and complete handover to government should be uncompromising aims for the future. We believe instead that WHO has a future role to support and maintain this system, whilst the overall socio-economic and political situation in Pakistan improves. Despite this, strategic thinking and high-level discussions should take place both at WHO and in the government about how to achieve greater integration and sustainability over the next years. This process may proceed at different speeds in various provinces, depending on local capacity.

Below we formulate recommendations to address the above and other issues.

4.2 Limitations of this evaluation

Findings of this evaluation are subject to the following main limitations:

- The sample of districts and RUs visited was biased by exclusion from the sampling frame or post-selection replacement of districts and RUs that were inaccessible, and where it is plausible to assume that the DEWS functions less well. Potential selection bias would have resulted in overly optimistic conclusions about the DEWS. While the extent of this bias is difficult to gauge, we believe that, at a minimum, the numerous examples of success encountered in our evaluation, as well as the apparent saturation of responses concerning the challenges and weak points of the system, provide sufficient material for drawing up comprehensive recommendations.
- Whilst the open-ended nature of questionnaires likely enhanced the richness of responses provided by interviewees, interview administration was sub-optimal due to a number of factors, including: (i) the short time available for training and testing of questionnaires; (ii) the inconsistency of language used for the interview, where expatriates were present (Sukkur and Hyderabad); (iii) varying quality of note-taking during interviews. Furthermore, end of interview notes taken by interviewers that many RU respondents were somewhat uneasy, and may have perceived the evaluators' visit as primarily targeting the quality of their work, rather than the DEWS itself: it is likely that this may have muted some criticisms of the DEWS and thus detracted from the true heterogeneity of view on the system's performance.
- Due to time limitations, we did not interview staff of programmes that do work related to the DEWS (e.g. polio eradication programme, EPI programme), as well as other health stakeholders (e.g. UNICEF, NGOs). These respondents might have increased the diversity of material collected.
- Lack of access to the raw datasets of weekly reports precluded meaningful evaluation of timeliness and completeness across the entire DEWS, and of the usefulness and appropriateness of alerts thresholds in use.

- Our evaluation focussed on the post-flooding emergency period, and does not well reflect the effectiveness of the DEWS during the acute emergency period.

4.3 Recommendations

General

1. Maintain and expand the DEWS:

- 1.1. The DEWS must be maintained for the foreseeable future, and, once the above improvements have been made, should be expanded to cover the remaining areas of Pakistan where it is not yet implemented.
- 1.2. Donors should continue to strongly support the DEWS, as the programme is highly cost-beneficial and delivers concrete, life-saving services, while improving clinical practice and surveillance throughout Pakistan. The current operating budget appears modest and staff and resources are overstretched: a budget increase to moderate workload and enhance quality assurance should be ensured. Pakistan remains prone to crises, and furthermore the DEWS is currently the only system to detect and respond to most outbreaks. Thus, a short-term, reactive approach of only funding DEWS activities when a disaster strikes is unwise and not recommended.
- 1.3. Contracts of DEWS staff at all levels should be extended for at least one year, and additional staff should be added to cover gaps, particularly for data management/analysis and quality assurance, and at hub level for support functions (environmental health, pharmacy). Generally, a single SO should not have to cover more than one average-sized district.

2. Implement stronger quality assurance procedures:

- 2.1. Minimum requirements for ongoing monitoring of quality should be explicitly added to the DEWS standard operating procedures, and to work plans at all levels of implementation.
- 2.2. A full-time quality assurance manager should be added to the DEWS headquarters team, to focus on monitoring and evaluation.
- 2.3. The focus of quality assurance should be on the outputs (i.e. timely response to alerts and outbreaks) rather than the inputs or processes.
- 2.4. Hub DEWS coordinators or, preferably, a third person responsible for countrywide quality assurance (see above), should routinely verify SOs' alert and response work, by comparing the alert register with alerts objectively raised through weekly data analysis (as a way to partly assess completeness of SOs' response), and, for a sample of alerts, verifying through ground visits whether actions reported did indeed take place.
- 2.5. Similarly, there should be regular, structured spot checks (e.g. every semester) of each RU: these should focus the reliability of weekly data reported in each reporting RU, by comparing reports with the patient registers used to compile them for a randomly selected week; and on adherence to case definitions. In hospitals, spot checks should be more frequent (e.g. monthly).
- 2.6. The proportion of "other" diagnoses should be monitored as a proxy indicator of how well RU staff adhere to the case definitions.

Knowledge and participation issues

3. Increase knowledge and participation at health facility level:

- 3.1. SOs should perform regular visits to RUs, including those that do not provide weekly reports. Visits should occur on at least a monthly basis, and should cover mainly case definitions and alert detection and reporting.
- 3.2. Refresher or de novo training sessions for RU staff should be organised in 2011. Training should mainly cover case definitions, particularly of the most important epidemic-prone diseases (e.g. suspected cholera, suspected measles) or diseases that are difficult to classify (e.g. ALRI, other diarrhoea); awareness of outbreak alerts in routine work; and alert reporting procedures.
- 3.3. The Provincial Department of Health responsible for each hub should consider issuing official regulations mandating health facility participation in the DEWS, as a way to increase reporting.

4. Increase dissemination and feedback:

- 4.1. Use SMS networks to send out information to RUs about new alerts in the district: this can be done through mass messaging.
- 4.2. Regular visits to RUs should also be used as opportunities to feed back information, e.g. by sharing copies of the DEWS bulletin.
- 4.3. Use the weekly bulletin and other media (including newspapers and radio) to more effectively advertise DEWS success stories (e.g. early detection and containment of specific cholera or measles outbreaks).
- 4.4. Organise at least one yearly DEWS scientific workshop in Islamabad, featuring Ministry of Health representatives, academics, NGOs and other external partners: the workshop should be an opportunity for DEWS staff to learn from examples of best practices, presented by peers, and for government and other agencies to find out more about the work the DEWS is performing.

Weekly reporting

5. Streamline the selection of reporting units:

- 5.1. A more systematic approach to selecting RUs for weekly reporting should be developed; a suggested approach follows. All hospitals in each participating district should be included in weekly reporting if possible. No facilities below the BHU level should be included unless a specific area is only covered by dispensaries. A tiered process should be implemented: firstly, a selection of about 20-30 facilities per district with good geographic spread should be made (PPHI-operated facilities appear to be of good quality and cater to vulnerable sectors of the population: they could be prioritised for inclusion); the completeness and timeliness proportions in this selection of RUs should be monitored, and, if they are acceptable over several weeks (e.g. >80%), a second tier of 20-30 facilities could be included; and so on. Exhaustive coverage should only be attempted in well-resourced districts and after developing a system of SMS-based data transmission (see below).
- 5.2. Once included in the DEWS, meta-data for each RU should be collected and maintained in the DEWS database, including the name, level (e.g. BHU) and coordinates (latitude, longitude), essential for spatial analysis.

6. Simplify data collection:

- 6.1. Age stratification should be removed, consistent with the DHIS monthly report.

- 6.2. The following diseases and syndromes should be removed from the list to be reported on a weekly basis: suspected malaria, skin disease, eye infection, dog bite; in KPK, where the list appears longer, other syndromes should be removed (e.g. hypertension, asthma, diabetes, injury, neonatal conditions).
- 6.3. For malaria, the number of patients tested and the number of test-confirmed cases should continue to be reported.
- 6.4. Suspected pertussis (whooping cough) should be added to the list, as its global burden remains high and is under-recognised.
- 6.5. A revised DEWS weekly reporting form should be introduced, that is as similar as possible (e.g. in the layout and order of items) to the DHIS monthly report.

7. Streamline reporting and transmission processes:

- 7.1. The reporting week should be changed to match that for AFP zero reporting, i.e. Sunday to Saturday. The week numbers should also be harmonised.
- 7.2. Wherever mobile phone coverage is robust, SMS-based weekly reporting to a toll-free or collect-call number should be introduced, as done in parts of Sukkur and Hyderabad hubs. This should be done in concert with phone companies. Ideally, the SMS should feed directly into a DEWS database accessible by all levels of the DEWS, without the requirement for SOs to manually enter and transmit data.
- 7.3. Where mobile phone coverage is not good, a variety of other systems, including verbal landline reporting, fax or paper form transmission by messengers, should be maintained, as per current practice.
- 7.4. A paper pro forma containing the weekly data transmitted (i.e. the DEWS form) should be kept at RU level.

8. Improve data management:

- 8.1. A new, integrated software application should be commissioned to aid with all aspects of data management for the DEWS. The application should be able to automatically process data received (e.g. from SMS), identify abnormal values and generate queries for rectification, apply alert thresholds, generate a suite of possible reports/epidemiological bulletins, maintain the alert and outbreak log (see below), and perform basic spatial analysis (e.g. distribution of measles alerts). This should be done urgently, as currently data are often not used meaningfully, and as data management is currently reducing SOs' effectiveness at alert and response.
- 8.2. The data management team should be strengthened, with at least one person working full-time on this part of the work in each major hub.

Alert and response functions

9. Enhance detection of alerts:

- 9.1. Communication from health system sources is by far the main mode of alert detection, and should be enhanced by stressing the immediate alert criteria and procedures through training and briefing of as many clinicians as possible in each district. The alert function can and should be instituted even in health facilities that do not provide weekly reports, and should be considered the basic level of functionality of a facility participating in the DEWS. Communication should be facilitated by instituting toll-free hotline numbers (see below).

- 9.2. Lady Health Workers and EPI vaccinators should be involved more formally in alert detection. These health staff should be trained on simple procedures for recognising suspected cases of the main epidemic diseases of interest (a reasonable list might be: cholera, bloody diarrhoea, measles, AFP, pertussis, any cluster of severe disease or death), and reporting the alert to the DEWS.
- 9.3. Weekly data must be used more meaningfully for alert detection, through improved, weekly automated software analysis of data (see above). A new software application should perform the following alert-related tasks: (i) facilitate alert and outbreak logging and management, from detection to investigation to interventions; (ii) generate a weekly list of alerts at the level of each RU and/or at the district level, by applying the alert thresholds; (iii) map alerts geographically, thereby providing further evidence of epidemic onset.

10. Improve and decentralise laboratory investigation of alerts:

- 10.1. Adequate supplies of tests and sample collection materials should always be ensured at the district level, with support from the hub and headquarters.
- 10.2. A focal point with sufficient time availability should be designated at Islamabad level to track shipments of samples to NIH, actively follow-up results, communicate lab results to hubs and districts and maintain a database of DEWS laboratory investigations. All communications between districts and NIH as regards lab samples should be mediated by this focal point.
- 10.3. The DEWS should actively negotiate at high level with the NIH in order to ensure that DEWS samples are given priority over other NIH investigations (AFP samples excepted), thereby reducing sample processing times.
- 10.4. The DEWS could consider introducing rapid tests for cholera and measles at district level, although the status of WHO recommendations on these tests needs to be verified. Lab samples from suspected cholera or measles cases should continue to be collected and sent to NIH for final confirmation and strain characterisation.
- 10.5. SOs should not wait to initiate outbreak response for either suspected measles or suspected cholera until laboratory results become available: it is likely that the clinical/syndromic diagnosis of both is quite specific, and therefore outbreak response should start as per DEWS SOPs when either is reported.

DEWS and other programmes

11. Work more closely with other disease control programmes:

- 11.1. The polio eradication programme and the DEWS should continue to work in parallel so as to maximise sensitivity of AFP surveillance during the (hopefully) final eradication years, but, at the level of each hub, monthly joint briefings should be held between the two programmes, and ways to minimise overlap at the local level should be explored.
- 11.2. Weekly data collection on the number of measles and other EPI diseases by the EPI programme should be phased out, and only DEWS and DHIS should collect data on these diseases. Furthermore, the DEWS should be mandated with alert and response responsibilities for EPI diseases, while the EPI programme should focus on strengthening routine vaccination coverage. The two programmes should hold regular joint meetings in order to compare data and benefit from respective knowledge.
- 11.3. The DEWS should have regular meetings with other disease control programmes (e.g. malaria, hepatitis) to discuss ways of streamlining and integrating any parallel data collection systems.

12. Work towards integration with and handover to the government:

- 12.1. The alert and response function of the DEWS should be maintained, but should eventually (e.g. 4-5 years from now) become a component of the DHIS, with some level of ongoing support from WHO.
- 12.2. The above integration should not be done at the expense of quality and effectiveness, and should be viewed as a gradual process, not conditioned by strict country-wide deadlines (some provinces, like Punjab, may be ready to assume full responsibility for DEWS earlier; some activities may be handed over sooner than others).
- 12.3. So as to work towards the above, provincial Departments of Health should mandate greater involvement of their staff in the DEWS, in particular in alert and response activities.
- 12.4. The proportion of alert investigations which are jointly carried out by the DEWS and government (district) surveillance officers should be monitored as an indicator of DEWS quality in the different hubs.
- 12.5. The weekly reporting function should be reviewed in 1-2 years, and its usefulness at enhancing alert detection should be evaluated.
- 12.6. Departments of Health and of Finance of all provinces should work together to define a financing and implementation plan for handover of the DEWS from WHO; WHO should assist this process by defining the minimum requirements for financial support, staffing, logistics, data management and other implementation aspects that the DEWS requires to fulfil its functions.

5 References

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3. **Early warning surveillance and response in emergencies: WHO technical workshop, December 2009**. *Wkly Epidemiol Rec* 2010, **85**(14/15):129-136.
4. Green J, Browne J (eds.): **Principles of social research**. London: Open University Press; 2005.

6 Annexes

Annex 1: Information sheet for reporting unit respondents

World Health Organization

London School of Hygiene and Tropical Medicine

In case of any questions, please contact the investigators:

Dr Francesco Checchi

E-mail francesco.checchi@lshtm.ac.uk

Tel. 0308 555 9644

Dr Peter Mala

Tel. 0301 855 1470

E-mail ptrmala@yahoo.com

You can also reach us through the district WHO DEWS surveillance officer.



Study title: Evaluation of the Disease Early Warning System (DEWS) Information Sheet for Interview Participants

About the study

You are being asked to participate in an evaluation of the disease surveillance system (DEWS) in Pakistan. The evaluation is conducted by the London School of Hygiene and Tropical Medicine and the World Health Organization, with the agreement of the Ministry of Health. The objectives of this evaluation are to:

1. Describe how the surveillance system works.
2. Assess how well the system has been able to detect possible outbreaks and respond to these alerts.
3. Provide recommendations on how the system may be strengthened.

As part of the evaluation, we are interviewing a number of people throughout Pakistan who are involved in the system in various ways, including staff at some randomly selected health facilities in this district.

Study procedures

If you accept to take part in the evaluation, the interview will last about forty minutes. If you agree, we will tape record the interview. Otherwise, we will just take notes.

The interview is based on a questionnaire, which explores the following topics:

- Participation and involvement in the surveillance system;
- Opinions about its usefulness;
- Problems encountered as part of the surveillance activities;
- Positive and negative examples in which the surveillance system has had an effect on activities;

- Recommendations for improvement of the surveillance system.

Consent and confidentiality

If you provide verbal consent, it means that you understand what this evaluation is about and what will be asked of you. It also means that all of your questions have been answered and you agree to participate. At anytime you can withdraw your consent. Your participation is voluntary, and will not affect services provided to this health facility in any way.

With your permission, we will use direct quotes from your interview, without mentioning your name or the name of this facility. If you would prefer not to be quoted, we will just use material from your interview, without presenting direct quotes.

The information you provide will only be seen by the interviewers and the study investigators, and will be stored in WHO Islamabad office and in London for 10 years, then destroyed.

Annex 2: Consent form for reporting unit respondents



Study title: Evaluation of the Disease Early Warning System (DEWS)

Consent Form

Date:/...../..... [dd / mm / yyyy]

Province:

Hub:

Reporting unit:

The respondent has read the information sheet concerning this study and understands what is required of him or her to take part in the study. His or her questions concerning this study have been answered. He or she understands that at any time he or she may withdraw from the study without providing a reason. By signing below you certify that he or she has agreed to take part in this study.

Please read the following options carefully and tick ONE option:

	The respondent agrees that material from his or her interview may be quoted, although his or her name will remain anonymous.
	The respondent does not agree that any material from his or her interview may be quoted, but researchers may use information from his or her interview to inform their analysis.

Name of interviewer 1:

Signature of interviewer 1:

Name of interviewer 2:

Signature of interviewer 2:

Annex 3: Semi-structured questionnaire for reporting units



Evaluation of the Disease Early Warning System in flood-affected areas of Pakistan March-April 2011

QUESTIONNAIRE FOR REPORTING UNITS

Questionnaire unique code:	Date (Western calendar): dd / mm / yyyy	
Full name of interviewer:		
Province/Hub:	District:	Locality:
Name of health facility:		
Type of health facility: __BHU __RHC __Hospital __other (specify):		
Position of respondent 1 (focal point medical officer or technician):		
Position of respondent 2 (data compiler if applicable):		

Open-ended questions for respondent

Role of the respondent

What is your position at this health facility?

Could you tell me about all the different things that you do as part of your work?

How outbreaks are detected

Can you tell me by which different means you can detect outbreaks in your area?

PROBE: What do you think staff at this clinic can do to find out whether an outbreak has started?

What do you think is the most effective way for staff at this health facility to quickly find out whether an outbreak has started?

If you suspected that an outbreak had started in this community, what would you do?

PROBE: Whom would you inform?

In your clinical work, how do you recognise a case of suspected measles?

In order to recognise a suspected measles case, do you use a standard case definition?

[if yes:] What is the case definition exactly?

In your clinical work, how do you recognise a case of suspected cholera?

In order to recognise a suspected cholera case, do you use a standard case definition?

[if yes:] What is the case definition exactly?

Knowledge and understanding of the DEWS

Could you tell me about the different programmes and structures that exist in this district to detect and respond to outbreaks?

[if respondent does not mention the DEWS:] Do you know about the DEWS, or Disease Early Warning System?

[if yes:] As far as you understand, how would you describe the different functions of the DEWS?

PROBE: What specific actions is the DEWS supposed to undertake?

Training on outbreak detection and response

Could you describe any training that you or other colleagues working at this facility have received on DEWS or other programmes to detect outbreaks?

[If at least one training was mentioned:]

Did any of this training take place since the July 2010 floods?

What did this training consist of?

Which agency provided the training?

Has a DEWS surveillance officer come to visit your facility since the July 2010 floods?

[if yes:] When was the last visit?

What activities took place during the visit?

Outbreak detection and control story

Was this community affected by any outbreak since the July 2010 floods?

[if yes, for the most recent outbreak:]

What disease caused the outbreak?

How exactly did staff at this clinic first find out that an outbreak was happening?

PROBE: What led to the initial alert?

What responses were taken to control the outbreak in this community?

What support, if any, did your health facility get from the government to control this outbreak?

What support, if any, did your health facility get from other agencies to control this outbreak?

What in your opinion were the strong points of the response to this outbreak?

What in your opinion were the weak points of the response to this outbreak?

Were there any ways in which the DEWS helped to detect and respond to this outbreak?

Were there any ways in which the DEWS could have done a better job of detecting or responding to this outbreak?

Process of data compilation and transmission

Can you describe for me all the different forms and registers in which staff at this facility are supposed to record data on patients seen?

[for each form or register:]

How often is this register supposed to be compiled?

To whom should the register be sent?

[if the health facility is reporting to the DEWS:]

Can you describe the data sources you use to compile the DEWS form?

PROBE: How does the information in these source registers get compiled into the DEWS form?

Approximately how much time does it take people at this health facility every week to compile and transmit all these forms and registers?

PROBE: You can give me an approximate figure in hours.

PROBE: Is it more than half a working day? More than a working day?

How do you feel about the amount of time that people at this health facility spend on data compilation and transmission?

PROBE: Would you say it's appropriate? Too much? Too little?

PROBE: What effect if any does the time spent compiling data have on your other activities?

PROBE: For example, in some countries clinicians state that they sometimes have to rush through their clinical work in order to make time for compiling data.

Do you have any suggestions for how your work on data compilation and transmission could be improved?

Suggestions by the respondent

Do you have any other suggestions for how the detection of and response to outbreaks could be improved in this community?

What additional support if any would you and your colleagues need to be more effective at detecting or responding to outbreaks?

Quantitative check-list

[verify personally the following check-list:]

Does facility have any written case definitions of outbreak-prone diseases on display?	<input type="checkbox"/> Yes <input type="checkbox"/> Unclear	<input type="checkbox"/> No
Does facility have a copy of the DEWS case definitions on display?	<input type="checkbox"/> Yes <input type="checkbox"/> Unclear	<input type="checkbox"/> No
Does facility record data on the recommended DEWS form?	<input type="checkbox"/> Yes <input type="checkbox"/> Unclear	<input type="checkbox"/> No
Did the health facility receive a paper or email copy of the last DEWS bulletin?	<input type="checkbox"/> Yes <input type="checkbox"/> Unclear	<input type="checkbox"/> No
Ask how many cases of Acute Lower Respiratory Infection were seen last week:		
Is the number immediately available from a report? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unclear		
If immediately available, record number of cases: _____		
Ask how many cases of Suspected Measles were seen last week:		
Is the number immediately available from a report? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unclear		
If immediately available, record number of cases: _____		

Additional observations by the interviewer

Note here any other observations or impressions from your visit or interview that may be useful to interpret this questionnaire. For example, was the respondent in a hurry to finish the interview? Was (s)he at ease or feeling uneasy? Did the responses appear truthful? What are the general conditions at the health facility?

Annex 4: Topic guide for district surveillance officer interviews



Evaluation of the Disease Early Warning System in flood-affected areas of Pakistan March-April 2011

TOPIC GUIDE FOR DEWS DISTRICT COORDINATOR INTERVIEWS

Date (Western calendar): d d / m m / y y y y		
Full name of interviewer:		
Province:	Hub:	District:
Name of respondent 1:		
Position of respondent 1 (should be DEWS surveillance officer):		
Name of respondent 2:		
Position of respondent 2 (should be environmental health):		
Name of respondent 3:		
Position of respondent 3 (should be pharmacist):		
Name of respondent 4:		
Position of respondent 4 (should be government DEWS focal point):		

Role of respondents

Could you describe to me what you see as your professional role?

Respondent 1:

Respondent 2:

Respondent 3:

Respondent 4:

What is a typical working day like for you?

Respondent 1:

Respondent 2:

Respondent 3:

Respondent 4:

Overall perception of the DEWS

What do you think are the strong points of the DEWS?

What do you think are the weak points of the DEWS?

Participation of health facilities in DEWS

We understand that not all health facilities in this district may participate in the DEWS, and that not all may send reports every week. What things make it easy for health facilities to participate in the DEWS?

What things make it difficult for health facilities to participate in the DEWS?

Ways to detect outbreaks

How do you detect alerts and outbreaks here at the district level?

PROBE: What software or other tools do you use to manage data and apply alert thresholds?

What challenges do you face in detecting alerts and outbreak here at the district level?

PROBE: Can you provide specific examples?

Alerts or outbreaks may be detected in different ways. For example, analysis of trends in the data reported may reveal unexpected increases in incidence. Alternatively, a health facility may notify a worrisome observation, for example a cluster of cases or deaths. Alerts or outbreaks may also be detected via rumours or information received from the community or the media. Based on your experience, which of the above ways of detecting alerts or outbreaks is most effective?

Issues with data collection and reporting

What do you think about the burden of data collection for reporting units in this district?

What in your opinion might facilitate DEWS data collection?

What are the main challenges for transmission of data from reporting units through the chain up to national level?

PROBE: What is the most difficult step in this chain of transmission?

PROBE: What is the least difficult step in this chain of transmission?

What solutions if any have been found to facilitate data transmission?

What in your opinion would facilitate data transmission?

Issues with alert investigation

Could you describe for me how you generally go about investigating an alert in this district?

What challenges do DEWS staff in this district face in investigating alerts?

PROBE: What are the challenges in this district as regards laboratory testing of samples?

PROBE: Can you provide specific examples?

What in your opinion might make alert investigation more effective in this district?

Issues with outbreak response

Could you describe for me how you generally respond to an outbreak in this district?

What challenges do DEWS staff in this district face in responding to outbreaks?

PROBE: Can you provide specific examples?

What in your opinion might make outbreak response more effective in this district?

Outbreak detection and control story

Was this district affected by any outbreak since the July 2010 floods?

[if yes, for the most recent outbreak:]

What disease caused the outbreak?

How exactly did the DEWS team at the district first find out that an outbreak was happening?

PROBE: What led to the initial alert?

What responses were taken to control the outbreak in this district?

What support, if any, did the district get from the government to control this outbreak?

What support, if any, did the district get from other agencies to control this outbreak?

What in your opinion were the strong points of the response to this outbreak?

What in your opinion were the weak points of the response to this outbreak?

Were there any ways in which the DEWS helped to detect and respond to this outbreak?

Were there any ways in which the DEWS could have done a better job of detecting or responding to this outbreak?

Usefulness of DEWS

The DEWS collects data on common diseases, including acute respiratory infection (ARI), acute diarrhoea and scabies. Can you narrate specific instances in which data on ARI generated by the DEWS resulted in actions on the ground?

Can you narrate specific instances in which data on acute diarrhoea generated by the DEWS resulted in actions on the ground?

What do you think about the usefulness of data on ARI or acute diarrhoea?

Sharing of DEWS information

How do you share information generated by the DEWS at the district level?

PROBE: With whom do you share DEWS information at the district level?

Training activities

Can you describe any training activities undertaken by the DEWS in this district since the July 2010 floods?

PROBE: Who was trained?

PROBE: How long did the training last for?

PROBE: What subjects did the training cover?

How do you monitor DEWS related work taking place at the reporting units?

Integration with routine surveillance systems of the Ministry of Health

What would be some ways in which the DEWS could be integrated more with other WHO programmes?

What are your views on the feasibility of integrating DEWS with routine surveillance systems such as DHIS and HMIS?

What might facilitate integrating DEWS with routine surveillance systems such as DHIS and HMIS in this district?

Additional suggestions on DEWS

In addition to what we have already mentioned, in your opinion what modifications or additional activities might enhance the effectiveness of the DEWS?

In addition to what we have already mentioned, what additional support if any would you and your colleagues need to be more effective at detecting or responding to outbreaks through the DEWS?

Annex 5: Topic guide for district health office interviews or focus groups



Evaluation of the Disease Early Warning System in flood-affected areas of Pakistan March-April 2011

TOPIC GUIDE FOR DISTRICT EDO INTERVIEWS

Date (Western calendar): dd / mm / yyyy		
Full name of interviewer:		
Province:	Hub:	District:
Name of respondent 1:		
Position of respondent 1:		
Name of respondent 2:		
Position of respondent 2:		

Role of district health office in disease control

Could you describe to me how the District Health Office carries out detection and response to outbreaks in this district?

PROBE: What different programmes are in place to detect and respond to outbreaks?

Overall perception of the DEWS

What do you think are the strong points of the DEWS?

What do you think are the weak points of the DEWS?

Usefulness of DEWS

Can you share some examples in which government authorities in this district have used DEWS information?

PROBE: Can you share any experience since the floods?

Can you mention any examples in which the DEWS has not had positive effects on your work?

Sharing of DEWS information

How do you feel about the sharing of DEWS information in the district?

Feelings about integration of DEWS

What do you think about the role of the DEWS within surveillance over the long-term?

PROBE: How do feel that DEWS can be integrated into surveillance systems of the province?

Additional suggestions on DEWS

What are your other suggestions to make the DEWS more effective?

Annex 6: Topic guide for hub DEWS coordinator interviews



Evaluation of the Disease Early Warning System in flood-affected areas of Pakistan March-April 2011

TOPIC GUIDE FOR DEWS HUB COORDINATOR INTERVIEWS

Date (Western calendar): d d / m m / y y y y	
Full name of interviewer:	
Province:	Hub:
Name of respondent:	
Position of respondent:	

Role of respondent

Could you describe to me what you see as your professional role?

What is a typical working day like for you?

Overall perception of the DEWS

What do you think are the strong points of the DEWS?

What do you think are the weak points of the DEWS?

Participation of health facilities in DEWS

We understand that not all health facilities in this hub may participate in the DEWS, and that not all may send reports every week. What things make it easy for health facilities to participate in the DEWS?

What things make it difficult for health facilities to participate in the DEWS?

Ways to detect outbreaks

How do you detect alerts and outbreaks here at the hub level?

PROBE: What software or other tools do you use to manage data and apply alert thresholds?

What challenges do you face in detecting alerts and outbreak here at the hub level?

PROBE: Can you provide specific examples?

Alerts or outbreaks may be detected in different ways. For example, analysis of trends in the data reported may reveal unexpected increases in incidence. Alternatively, a health facility may notify a worrisome observation, for example a cluster of cases or deaths. Alerts or outbreaks may also be detected via rumours or information received from the community or the media. Based on your experience, which of the above ways of detecting alerts or outbreaks is most effective?

Issues with data collection and reporting

What do you think about the burden of data collection for reporting units in this hub?

What in your opinion might facilitate DEWS data collection?

What are the main challenges for transmission of data from reporting units through the chain up to national level?

PROBE: What is the most difficult step in this chain of transmission?

PROBE: What is the least difficult step in this chain of transmission?

What solutions if any have been found to facilitate data transmission?

What in your opinion would facilitate data transmission?

Issues with alert investigation

Could you describe for me how you generally go about investigating an alert in this hub?

What challenges do DEWS staff in this hub face in investigating alerts?

PROBE: What are the challenges in this hub as regards laboratory testing of samples?

PROBE: Can you provide specific examples?

What in your opinion might make alert investigation more effective in this hub?

Issues with outbreak response

Could you describe for me how you generally respond to an outbreak in this hub?

What challenges do DEWS staff in this hub face in responding to outbreaks?

PROBE: Can you provide specific examples?

What in your opinion might make outbreak response more effective in this hub?

Usefulness of DEWS

The DEWS collects data on common diseases, including acute respiratory infection (ARI), acute diarrhoea and scabies. Can you narrate specific instances in which data on ARI generated by the DEWS resulted in actions on the ground?

Can you narrate specific instances in which data on acute diarrhoea generated by the DEWS resulted in actions on the ground?

What do you think about the usefulness of data on ARI or acute diarrhoea?

Training activities

Can you describe any training activities undertaken by the DEWS in the districts belonging to this reporting hub since the July 2010 floods?

PROBE: Who was trained?

PROBE: How long did the training last for?

PROBE: What subjects did the training cover?

Integration with routine surveillance systems of the Ministry of Health

What would be some ways in which the DEWS could be integrated more with other WHO programmes?

What are your views on the feasibility of integrating DEWS with routine surveillance systems such as DHIS and HMIS?

What might facilitate integrating DEWS with routine surveillance systems such as DHIS and HMIS in the province?

Additional suggestions on DEWS

In addition to what we have already mentioned, in your opinion what modifications or additional activities might enhance the effectiveness of the DEWS?

In addition to what we have already mentioned, what additional support if any would you and your colleagues need to be more effective at detecting or responding to outbreaks through the DEWS?

Annex 7: Topic guide for provincial health authority interviews



Evaluation of the Disease Early Warning System in flood-affected areas of Pakistan March-April 2011

TOPIC GUIDE FOR PROVINCIAL GOVERNMENT INTERVIEWS

Date (Western calendar): d d / m m / y y y y
Full name of interviewer:
Province:
Name of respondent 1:
Position of respondent 1:
Name of respondent 2:
Position of respondent 2 (if available):

Role of provincial government in disease control

Could you describe to me how the Provincial Government carries out detection and response to outbreaks?

PROBE: What different programmes are in place to detect and respond to outbreaks?

Overall perception of the DEWS

What do you think are the strong points of the DEWS?

What do you think are the weak points of the DEWS?

Usefulness of DEWS

Can you share some examples in which provincial government authorities have used DEWS information?

PROBE: Can you share any experience since the floods?

Can you mention any examples in which the DEWS has not had positive effects on your work?

Sharing of DEWS information

How do you feel about the sharing of DEWS information in the province?

Feelings about integration of DEWS

What do you think about the role of the DEWS within surveillance over the long-term?

PROBE: How do feel that DEWS can be integrated into surveillance systems of the province?

Additional suggestions on DEWS

What are your other suggestions to make the DEWS more effective?

Annex 8: Standard DEWS weekly reporting form



**Annex 1
Pakistan Flood Response 2010
DEWS Reporting Form
At Health Facility level**



Form #:

Reporting Period	From: <input type="text"/> / <input type="text"/> / <input type="text"/>	Province	<input type="text"/>
	To: <input type="text"/> / <input type="text"/> / <input type="text"/>	District	<input type="text"/>
Submitted by	<input type="text"/>	Tahsil/Taluka	<input type="text"/>
Submission date	<input type="text"/>	Village/settlement	<input type="text"/>
Contact number	<input type="text"/>	Health Facility Name	<input type="text"/>
Organization name	<input type="text"/>	Health Facility Code	<input type="text"/>
Catchment Population	<input type="text"/>	Health Facility Type	<input type="text"/>

Disease	Cases		Deaths	
	< 5 yrs	≥ 5 yrs	< 5 yrs	≥5 yrs
AWD/Suspected Cholera				
Bloody Diarrhea				
Other acute Diarrhea				
Acute Upper Respiratory Infection				
Acute Lower Respiratory Infection				
Suspected Malaria				
Suspected Measles				
Suspected Meningitis				
Acute Jaundice Syndrome				
Acute Flaccid Paralysis				
Suspected Haemorrhagic fever				
Unexplained Fever >38.5°C				
Skin Disease				
Snake Bite				
Eye infection				
Others				
TOTAL				

For confirmed Malaria (if test performed) please report:	Cases	
	< 5 yrs	≥ 5 yrs
Total number of sample tested:	<input type="text"/>	<input type="text"/>
Number positive:	P. Falciparum	<input type="text"/>
	P. Vivax	<input type="text"/>
	Mixed	<input type="text"/>

Annex 9: Details of alerts and outbreaks detected by the DEWS

Table 14. Details of alerts and outbreaks detected by the DEWS, 1 August 2010 to 18 March 2011.

Hub	Alerts	Outbreaks	Causative agents (n)
Azad Jammu and Kashmir	3	1	
Acute watery diarrhoea	2	1	<i>V. cholerae</i>
Haemorrhagic fever	1		
Balochistan – Quetta	19	10	
Acute flaccid paralysis	1		
Acute jaundice syndrome	3		
Acute watery diarrhoea	13	3	<i>V. cholerae</i>
Bloody diarrhoea	1		
Haemorrhagic fever	1		
Malaria	6	5	<i>P. falciparum</i> (2), mixed <i>P. falciparum</i> and <i>P. vivax</i> (3)
Measles	12	2	Measles (1), Rubella (1)
Others	19	n/a	
Federally Administered Tribal Areas	5	0	
Measles	1		
Others	4	n/a	
Gilgit Baltistan	0	0	
[no alerts]			
Islamabad Capital Territory	7	2	
Measles	4	1	Measles
Others	3	1	H1N1 virus
KP – Peshawar	338	135	
Acute flaccid paralysis	3		
Acute jaundice syndrome	5	3	Hepatitis A
Acute watery diarrhoea	98	49	<i>V. cholerae</i>
Bloody diarrhoea	6	1	<i>Salmonella</i> spp.
Haemorrhagic fever	50	19	Dengue
Malaria	3		
Measles	80	36	Measles
Others	93	27	<i>C. diphtheria</i> (2), H1N1 virus (24), mumps (1)
Punjab – Multan	101	30	
Acute flaccid paralysis	10		
Acute jaundice syndrome	1		
Acute watery diarrhoea	42	14	<i>V. cholerae</i>
Bloody diarrhoea	8	1	<i>S. flexneri</i>
Haemorrhagic fever	18	10	Dengue
Malaria	1	1	mixed <i>P. falciparum</i> and <i>P. vivax</i>
Measles	13	3	Measles
Others	8	1	H1N1 virus
Sindh – Hyderabad	165	24	
Acute flaccid paralysis	2		
Acute watery diarrhoea	24	4	<i>V. cholerae</i>
Bloody diarrhoea	5		
Haemorrhagic fever	2	1	Dengue
Measles	95	18	Measles
Others	37	1	Mumps

Sindh – Sukkur	262	52	
Acute flaccid paralysis	8	1	Poliomyelitis
Acute watery diarrhoea	38	15	<i>V. cholerae</i>
Haemorrhagic fever	21	3	Dengue
Malaria	9	1	<i>P. vivax</i>
Measles	87	30	Measles (29), rubella (1), measles and rubella (1)
Others	99	2	H1N1 virus