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Evaluation of measles surveillance systems in Afghanistan-2010

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Measles is a leading cause of death among children under five years world-wide. In Afghanistan, measles claimed 35,000 lives in 2001. Despite reported measles vaccination coverage of 75%, the number of outbreaks was increasing in 2008. The systems involved in measles surveillance in Afghanistan include: Health Management Information System (HMIS), Disease Early Warning System (DEWS), and the Expanded Program on Immunization (EPI). These three systems were evaluated to identify their strengths and weaknesses and formulate recommendations. A qualitative study based on the CDC updated guidelines for evaluating public health surveillance systems was conducted. A detailed checklist was developed and used during the interview with the candidates to collect information about the system attributes. Data were collected from representatives of all mapped stakeholders through face-to-face interviews, telephone, and email. System attributes were assessed and scored for description and comparison on a Likert scale from 1 to 10. The average of scores was obtained to determine the overall ranking. World Health Organization (WHO) estimates for measles cases in the county (2008) was used to calculate sensitivity and predictive values. HMIS scored well for acceptability, cost effectiveness, representativeness, but had poor timeliness and flexibility. The sensitivity of EPI, HIMS and DEWS were 40, 34 and 20%, respectively and predictive value positive (PVP) of the system EPI, HMIS, DEWS were 69, 61 and 22%, respectively. EPI scored well for data quality, representativeness, and stability, but poorly in flexibility, timeliness and cost effectiveness. DEWS had good data quality, timeliness and flexibility, but weak stability. None of the systems has up to the mark attributes, and none of these systems can provide all necessary information to the health system alone. Systems are fragmented and serve different objectives. Lack of integration limits utilization of generated data for policy and planning. Measles surveillance through EPI should be strengthened and integrated with DEWS and HMIS to enhance cases detection and timely response.

Key words: Measles, measles surveillance evaluation, surveillance system, Afghanistan.

INTRODUCTION

Modern public health needs information to decide and act. Surveillance is the system which collects information for public health action. In other words, public health surveillance is the ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding health-related event used to reduce morbidity

and mortality by improving public health (Centers for Disease Control and Prevention [CDC], 2001). Design, objectives, purpose, mode of operandi of each surveillance systems is different. Hence, to ensure quality of data provided by surveillance system, effectiveness, efficiency and usefulness of the surveillance system, should be evaluated periodically.

Measles is a highly contagious self-limiting viral disease (Okonko et al., 2009) that can lead to fatal complications. It is transmitted via droplets from the nose, mouth or throat of infected persons. Initial symptoms, which usually appear 8 to 12 days after infection, include high fever, runny nose, bloodshot eyes, and tiny white spots on the inside of the mouth. Several days later, a rash develops, starting on the face and upper neck and gradually spreading downwards (WHO Health Topics, 2014).

There is no specific treatment for measles (PubMed Health, 2012) and most people recover within 2 to 3 weeks. However, particularly in malnourished children and people with reduced immunity; measles can cause serious complications, including blindness, encephalitis, severe diarrhea, ear infection and pneumonia. Measles can be prevented by immunization (WHO Health Topics, 2014). Measles is a widespread killer, ranked number fifth in 2012. Globally, 139,300 deaths were reported due to measles only in 2012 (WHO Media Center, 2013). A highly effective vaccine has been available since the 1960s. Despite this, measles remains the leading cause of vaccine-preventable deaths in the world, accounting for over 40% of the 1.4 million annual deaths due to vaccine-preventable diseases (UNICEF-WHO, 2005).

The fourth Millennium Development Goal (MDG 4) is to reduce the under-five mortality rate by two-thirds between 1990 and 2015. As per World Health Organization, globally 344,276 reported cases of measles and 139,300 deaths were reported in 2010 (WHO Immunization Surveillance assessment and monitoring, 2012), which was equal to 430 deaths per day due to measles. However, numbers of deaths due to measles has significantly reduced but as per 2010 data 18 children are dying per hour from measles, a vaccine preventable disease (WHO Media Center, 2013). Number of deaths dropped by 74% since 2000, number of cases and deaths significantly decreased since the revolution of the vaccine discovery in 1960s. More than 95% of measles deaths occur in countries with low gross domestic product (GDP) and weak health systems (WHO Media Center, 2013). World Health Statistics (2012) report reads that only 65% of the countries reached measles vaccination coverage of equal or more than 90% (WHO Global Health Observatory (GHO), 2012).

Inequalities in access to vaccines within countries mean that death and disability from measles is concentrated primarily among the poorest, most marginalized and remote people. Failure to deliver at least one dose of measles vaccine to all infants remains the primary reason for high measles mortality.

Measles killed 30,000 to 35,000 of Afghan children annually till 2003 (MMWR, 2003; Gaafar et al., 2003); number of cases of measles reduced to 3,013 in 2011 (WHO RD Report, 2011), 2787 in 2012 (WHO Vaccine-Preventable Diseases: Monitoring System, 2013) and 1,822 deaths reported in 2008 (Black et al., 2010).

In order to reduce the number of measles cases, Ministry of Health Afghanistan with support of national and international partners conducted successive rounds of measles catch-up and follow-up immunization campaigns in the year 2001 to 2002 (for children of 6 months to 12 years old) and 2003 (for children of 9 months to 5 years old), in 2006 to 2007 (for children of 9 to 59 months) and in 2009 (for children of 9 to 36 months). Also in November 2012, WHO reported that a significant reduction in the number of cases of measles, after four months from vaccination of six million children aged 9 months to 10 years in Afghanistan (Measles and Rubella Initiatives, 2012).

Current data claims that still two percent of under five years children deaths are attributed to measles in Afghanistan, with a similar report of one percent at the regional and global level. The country has the third highest number of measles cases per hundred thousand population at the regional level, after Iraq and Qatar (WHO World Health Statistics, 2012a). Case fatality of measles in developing countries is between 3 and 5%, but in some localities it may reach 10 to 30% (Heyman, 2008).

A timely surveillance and rapid case detection for measles followed by rapid outbreak response is key for control and elimination of measles and reducing number of cases, complications and related mortality (WHO Position, 2009). Disease Early Warning System (DEWS) in Afghanistan, established in December 2006, detected 17 outbreaks of measles in 2007, 42 outbreaks of measles in 2008, 54 outbreaks of measles in 2009, 131 outbreaks of measles in 2010 (Ministry of Public Health Afghanistan, Diseases Early Warning System Annaul report, 2011, 2012), 147 outbreaks of measles in 2011 and 213 outbreaks of measles in 2012(Ministry of Public Health Afghanistan, Diseases Early Warning System Annaul Report 2012, 2013). DEWS data shows that the number of outbreaks of measles increased by more than100% from 2009 to 2010. Forty two per cent (N=190) of all outbreaks detected in 2009 were measles, and most of these outbreaks occurred in the provinces with high reported coverage of measles vaccination.

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Objectives

The objectives of this study were to conduct in depth review of the existing measles surveillance systems in Afghanistan; highlight the strengths and weaknesses of these surveillance systems; and provide constructive recommendations based on the findings for improvement of measles surveillance systems in Afghanistan.

METHODOLOGY

This is a qualitative study based on CDC's updated guidelines for Evaluating Public Health Surveillance Systems conducted (CDC, 2001). The guideline includes some main steps: engage the stakeholders in evaluation; describe the surveillance system to be evaluated; focus on the evaluation design; gather credible evidence regarding the performance of the surveillance system; justify and state conclusions and make recommendations; ensure the use of evaluation findings and share lessons learned.

The team has conducted mapping of all measles elimination partners at the country level. The team has met or communicate with the stakeholders individually/study subjects and the structured checklist was applied.

Field work of this evaluation started mid-November 2009 and was completed by the beginning of January 2010.

This evaluation was conducted at the national and provincial levels. Stakeholders for each of the surveillance systems were mapped and contacted.

Measles related documents, reports, policies and strategies of Ministry of Public Health (MOPH) and other stakeholders at the national, regional and global levels were reviewed.

The team located and found main stakeholders of measles surveillance system, contact information and addresses obtained and they were contacted through relevant means and channels. Major stakeholders of measles were: World Health Organization (WHO): Provide technical and financial support; United Nation's Children Fund (UNICEF): Provide financial support to measles immunization; Expanded Program on Immunization (EPI): Main planner and implementer of immunization activities and overall responsible/owner of measles surveillance activities at the national and provincial level; Disease Early Warning System (DEWS): Responsible for outbreak detection and response with the assistance of EPI and Control of Communicable Disease Department; Health Information Management System (HMIS); Policy and Planning Directorate of MOPH; Central Public Health Laboratory (CPHL); Non-Governmental Organizations (NGO): Implementers of basic package of health services and essential package of health services.

All measles reporting sites were located at the public health facilities and limited number of medical doctors-mainly paediatricians are working as AFP and measles focal point. Stakeholders were contacted and discussions were carried-out by telephone, email and also in-person.

Team ranked all attributes on a Likert scale of 1 to 10, while 1 to 5 were considered to be poor performance on that specific attribute, 6 to 7 fair and more than 7 considered as good performance. An average was obtained to see that the system is ranked higher.

Existing measles surveillance systems and description

At the time of study, there are three measles surveillance systems in the country: Health Management Information System (HMIS); Expanded Program for Immunization (EPI); and Disease Early Warning System (DEWS).

This information were sourced from registration book of health facilities; in addition to the fact that DEWS and EPI collect the case counts which are reported during outbreaks and develop line lists.

Health management information system is a passive surveillance system, with coverage of 82% designed to collect service information from health facilities throughout the country, the system is based in the Ministry of Health Facilities fully integrated in the health system of the country. Medical doctors at the outpatient department are responsible for tallying of the cases. Monthly aggregated report, along with other morbidities and mortality reports are shared with the provincial level. HMIS has provincial and regional offices which are linked to their central office. Monthly reports are transmitted from health facilities to district levels and from district level to provincial levels. Aggregated data is shared from provincial level to national level on quarterly basis which is analyzed and disseminated at the end of fourth month at the national level.

HMIS collected information are used at strategic level. The system has a direct support from Ministry of Health and Management Science for Health (MSH). Data flow charts of HMIS are as shown in Figure 1.

Expanded Program on Immunization's measles surveillance system is a case based active and passive surveillance system and they detect all cases and outbreaks. Their goal is to reduce the number of cases of measles to one case per million populations by 2015. This rate was 63 per million in 2011; the system is kept in EPI office in MOPH strongly supported by World Health Organization. Focal points at the health facility level notify the upper level as soon as the suspected case is recorded. Monthly aggregated report is shared with the EPI office at the provincial level, which will be transmitted to regional and national level during the coming month. Outbreak investigation and response is triggered based on the district data at the district level. Collected information were used at the strategic and operational levels. Figure 2 shows the data flow chart of the EPI Measles surveillance data.

Disease Early Warning System is a sentinel based surveillance system. The mixture of active and pass surveillance systems, established in 2006 had more than 200 sentinel sites at the time of the study. Their coverage was 10% of governmental health facilities at the time of the study. The system had full technical support of WHO and financial support of USAID. Measles is reported immediately by focal points and the focal points collect the blood specimen and send it to provincial level. Aggregated reports are shared with the provincial and regional level end of the week and national level produce the weekly report at the beginning of the coming week. Collected information were used at the strategic and operational levels. Figure 3 shows the data flow chart of DEWS.

RESULTS

System attributes

Simplicity

All systems use the registration book of the health facilities as the source of information; DEWS and EPI also use outbreak line-list for data collection. Registration at the health facility level takes very short time; records are not digital and retrieval of these records at the health facility level is very difficult. Aggregate reports are transmitted to the higher level monthly in HIMS and EPI surveillance systems and weekly in the DEWS. Health care workers provide the same aggregated data to

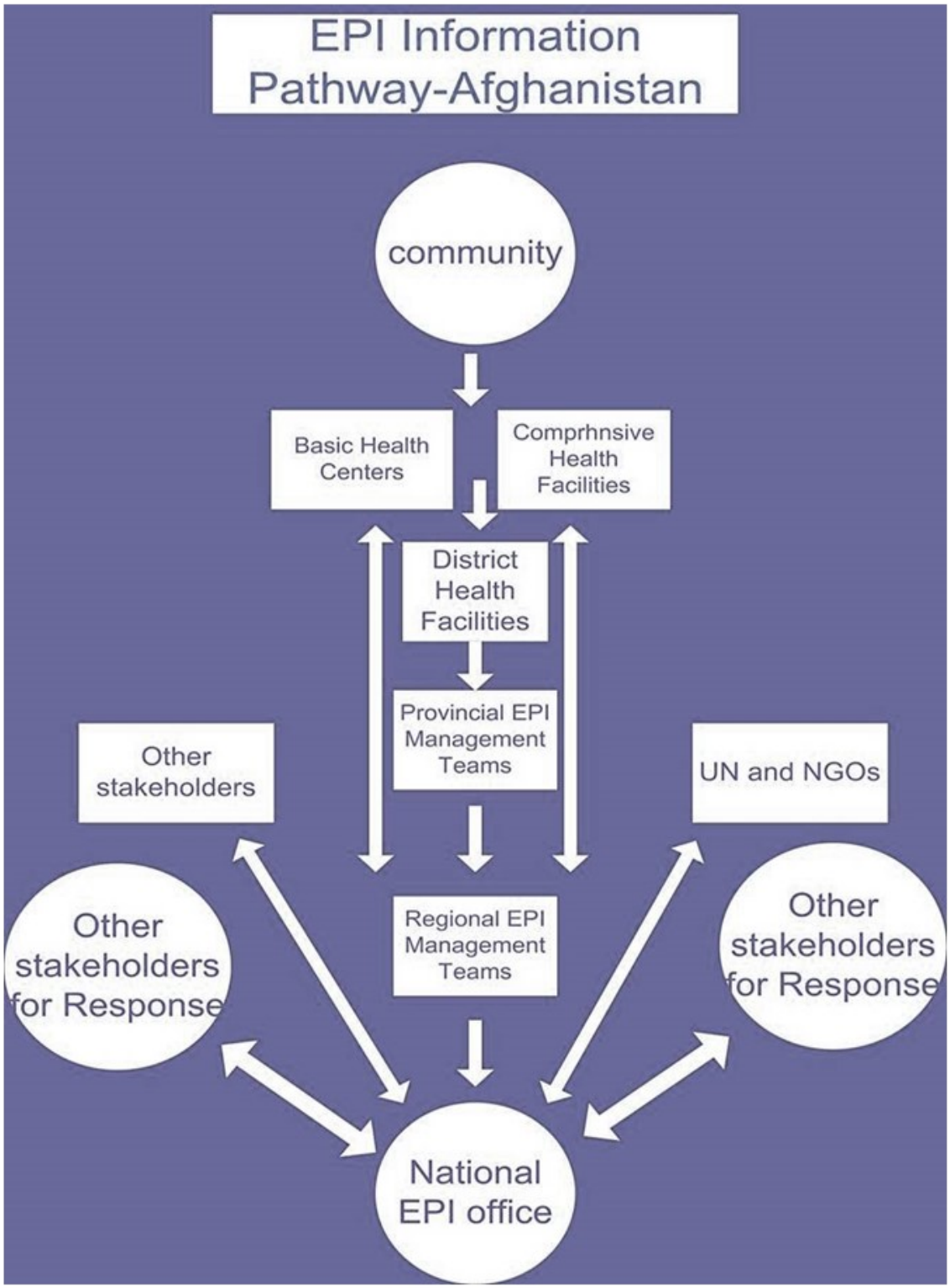

Figure 1. Flow chart of HMIS data.

different surveillance systems while EPI and DEWS use their focal points to collect blood specimens and arrange response at the health facility/district level.

1. Flexibility: HMIS and EPI surveillance systems are very rigid and needs at least six months to bring necessary changes and the DEWS takes a week.

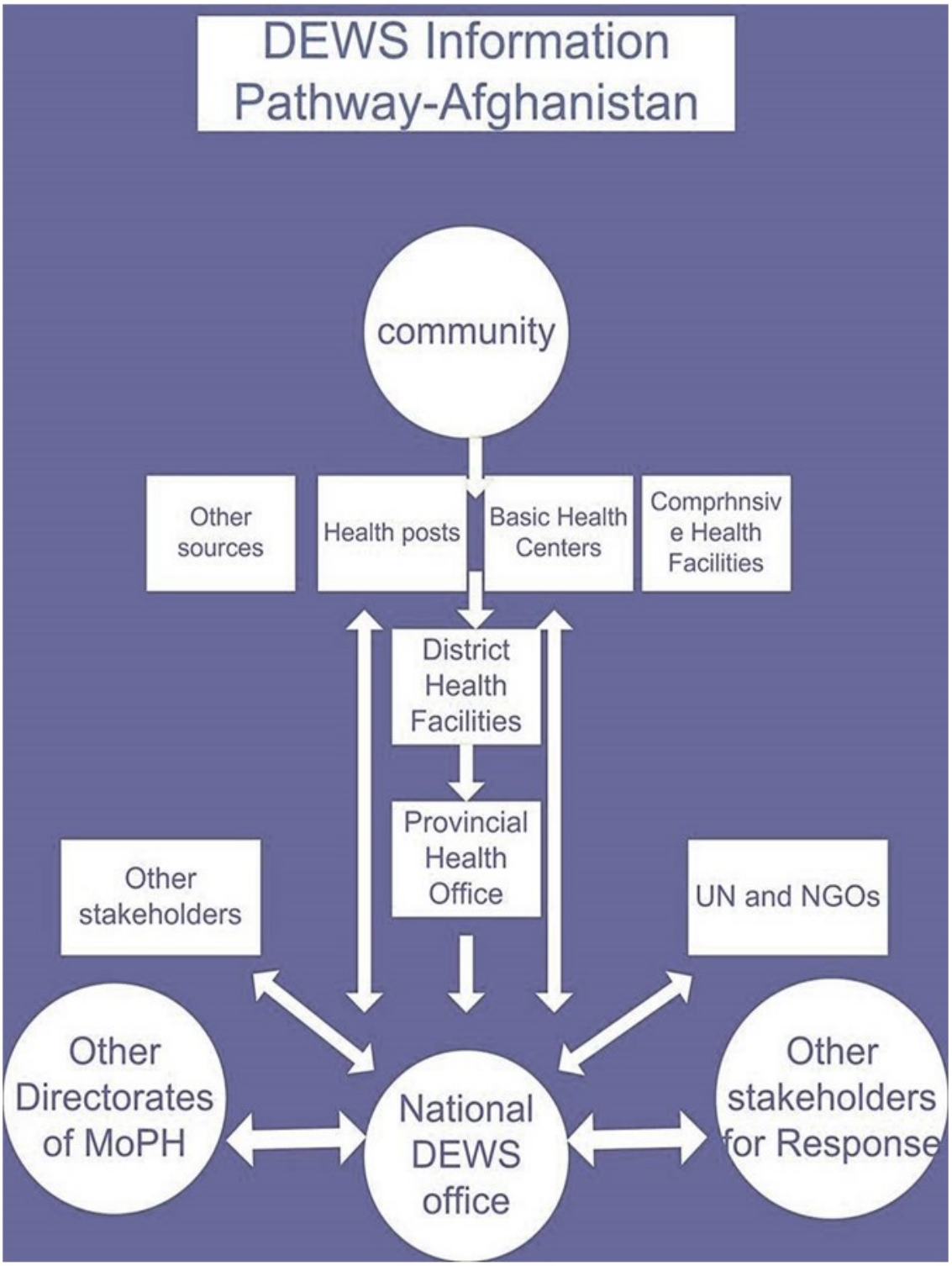

Figure 2. Flow chart of the EPI measles surveillance data.

2. Data quality: Completeness is 95% in HMIS and EPI systems and 97% in DEWS. EPI has a problem with denominator of their data, which is a national level issue. Reported values at the national and throughout the systems are matching with the provincial reported figures; use of case definition is the best throughout the systems

Figure 3. Data flow chart of DEWS.

data management starts from health care facility, forms are all readable and clearly charted and graphed at the health facility level. Hence, the data quality is very good throughout the systems.

3. Acceptability: All systems are well accepted in the government settings. Reporting to HMIS and EPI headquarters are official obligation; however, all system pays an extra incentive to the focal points, while DEWS pays the highest incentive.

4. Sensitivity: Measles surveillance systems in Afghanistan use the WHO standard case definition for measles, in which a clinical case is (A) any person with fever and maculopapular rash (that is, non vesicular), and cough, coryza (that is, runny nose) or conjunctivitis (that is, red eyes); or (B) any person in whom a clinical health worker suspects measles infection and a confirmed case of measles which is a WHO certified laboratory, confirmed the presence of measles specific IgM antibodies in the blood specimen of the case.

HIMS is not directly linked for central public health laboratory, while the other two are directly linked. As per available data in 2008, HMIS reported 13 cases of suspected measles against each laboratory confirmed case of measles, while this ratio reduced to 4.5:1 in 2009. DEWS and EPI are sharing the same source of information from health facilities and laboratory. DEWS is covering 10% of the total governmental health facilities at the national level and EPI measles surveillance is covering all government health facilities, while DEWS reported equal to 58% of the measles cases reported by

HMIS. DEWS reports measles cases recorded in the health facility and outbreak cases. In order to calculate the sensitivity, one needs the total expected number of cases as well. As this information is not available at the national level and the incidence and prevalence rates which are reported are based on the number of detected cases at the national level, the team used prevalence of measles in 2008 at the EMR region and also Nepal (outside the region) and standardized for rate. Afghanistan obtained calculations were cross checked using the standardized expected rate of measles in Afghanistan. The sensitivity of each system based on the available data is HMIS 20, DEWS 34 and EPI 40%.

(A) Sensitivity of EPI measles surveillance system: Sensitivity of the EPI measles surveillance system is calculated using the prescribed formula of the updated guideline for evaluation of surveillance systems which is A/A+C, where A is true positive cases and C is false negative cases and A+C is the total number of positive cases (true and false). EPI measles surveillance detected 1023, laboratory confirmed cases among a total 2524 cases so the sensitivity rate is calculated as:
Sensitivity (%)=1023/2524×100=40.
(B) Sensitivity of HMIS measles surveillance system: Sensitivity of the HMIS measles surveillance was calculate as per the aforementioned formula, where 1,023 confirmed measles cases reported amongst 5,232 suspected, probable and confirmed cases: Sensitivity (%)=1023/5232×100=20.
(C) Sensitivity of DEWS measles surveillance system, 2008 data: The same formula was applied, DEWS reported 1165 confirmed measles cases, 3380 were suspected, probable and confirmed in year 2008, so the sensitivity is SE (%)=1165/3380×100=34.

5. Predictive value positive (PVP): In 2008, HMIS reported 5232 suspected cases, DEWS detected 3380 suspected cases and EPI reported 2529 suspected cases of measles. 1165 specimens collected from routine EPI and outbreak investigation tested positive for measles in the same year.
In order to calculate the PVP, one needs the total expected number of cases at the national level, as this information is not available at the national level and the incidence and prevalence rates which are reported are based on the number of detected cases at the national level; the team used prevalence of measles in 2008 at the EMR region and also Nepal (outside the region) and standardized the rate for Afghanistan. The information obtained from this standardization was cross checked with expected rate of measles in Afghanistan. The PVP of EPI is 69%, DEWS is 61% and HMIS is 58%.

(A) PVP of EPI measles surveillance system is calculated as per the guideline. PVP is represented by A/(A+B), where A is true positive cases and B is false positive cases. In 2008, EPI report 1023 laboratory positive cases, where 1475 cases (suspected, probable and confirmed) were detected.
PVP (%) =1023/1475×100= 69

(B) PVP of HMIS measles surveillance system is calculated as PVP for the HMIS measles surveillance system as the aforementioned formula. Total number true for positive cases (Laboratory Confirmed Cases) reported in 2008 were, 1023 cases, over 1762 detected cases in the same year.
PVP (%)=1023/1762×100=58

(C) PVP of DEWS measles surveillance system is calculated as PVP of the DEWS measles surveillance calculated as per the prescribed formula of the guideline. The same detected 1165 were true for positive cases (Laboratory Confirmed Cases) in the year 2008 with over 1904 all detected cases (suspected, probable and Confirmed), so the PVP is 61%.
PVP =1165/1904×100= 61%

(D) Representativeness: HIMS covers 82% of all governmental health facilities at the time of study. Studies reveal that only 30% of all cases are consulted in the government health facility and the rest is absorbed by private health sector (Ministry of Public Health Afghanistan AHS, 2006, 2006). DEWS at the time of study covered around 10% of the total health facilities at the national level. Representativeness in terms of person and time cannot be calculated as the population for catchment area of each health facility is not available. While each type of health facility is established to serve certain number of population. Available health facilities that provide reports to HMIS office covers 82% of the population at the time of study, so it is estimated that 82% of population are covered under HMIS, while this coverage is 10% for DEWS.

(E) Timeliness: Source of routine data for all systems is registration book of health facilities. The data is collected on tally sheets from the clinics on daily basis. The collected information is compiled and then transferred to provincial level offices of each system. Frequency of this data transmission for DEWS and EPI is weekly and for the HMIS is at the end of each month. National office of DEWS received the information at the end of the week, EPI end of month and HMIS at the end of quarter. Timely transmission of reports to central level is 80% (total number of reports received divided by total number of expected reports multiplied by 100) in HMIS and almost 100% for DEWS and EPI.

(F) Stability: The most stable surveillance system for measles is HMIS. They enjoy being part of the organogram of ministry. The system receives regular funding from government of Afghanistan and also HMIS measles surveillance system receives external financial and technical support from USAID and MSH. EPI

Table 2. Ranking of surveillance attributes.

Attribute	HMIS	EPI	DEWS
Acceptability	9	8	8
cost effectiveness	8	6	7
Data quality	8	9	9
Flexibility	5	5	9
PVP	5	7	6
Representativeness	9	9	7
Sensitivity	5	8	7
Simplicity	6	8	8
Stability	8	9	5
Timeliness	3	5	9
Average	6.6	7.3	7.5

surveillance system is part of the organogram of the Ministry of Public Health. The system has enough financial and technical resources through WHO, GAVI and global fund, plus all necessary equipment and infrastructure to manage and run the system. DEWS is a newly established system, they were not part of MOPH organogram, while they have access to operating fund and infrastructure through WHO.

(G) Usefulness: HMIS is the only routine data collection system that provides information to MOPH and other stakeholders for long term planning evaluation of Basic Package of Health Services implementers' performance and to justify the requested fund for implementation of MOPH activities from donors. DEWS produce actionable information on a weekly basis. Good to mention that there is no clear demarcation between DEWS and EPI surveillance at the grass root level, all focal points and surveillance workers are working together to detect and respond to the cases and outbreaks of measles, so the use of information obtained is the same at the grass root level. Summary of surveillance comments are as shown in Table 1.

Conclusion

Health system management needs three types of information from surveillance systems, operational information, strategic information and tactical information, each category of information for different level of management. The three surveillance systems that were evaluated cannot produce all these information about measles at the same time; however, HMIS can provide strategic and tactical information for the mid to high level managers of MOPH. DEWS and EPI can provide operational or actionable information to the low to mid-level managers of MOPH.

When the purpose and objectives of each surveillance system were compared with the required attributes and their strengths, with the type of the data provided in short or long terms, the systems serve their purposes. HMIS as a system that tend to produce longer term data should have better attributes of data quality, acceptability, PVP, representativeness and stability. While EPI with an objective to detect all cases of measles should have superior attributes of sensitivity, PVP, acceptability and timeliness. The DEWS with an overall goal of outbreak detection should have better attributes of flexibility, timeliness, stability, sensitivity and PVP. HMIS is good in data quality, acceptability, representativeness and stability, while EPI is good in sensitivity and acceptability and DEWS is good in flexibility and timeliness. PVP is poor in HMIS and fair in EPI and DEWS systems. EPI is poor in timeliness and DEWS is poor in stability. Table 2 shows the surveillance components ranking.

As per available information and documents collaboration between these three measles, surveillance systems are very limited at the national level; however, DEWS and EPI are closely working together at the district and provincial levels, and for reverse cold chain they are using the same infrastructure. Also, level of collaboration between HMIS and National Public Health Laboratory (CPHL) is very low, while DEWS and EPI has a better collaboration with CPHL, which is mainly due to the need of outbreak detection and case based surveillance.

Main strength of the Measles Surveillance Systems (DEWS and EPI) is that they are designed to detect and respond to the outbreak. They are using the same platform for outbreak detection and response, and these surveillance systems are linked with action, meaning investigation and response to the outbreaks. There are some functional integrations at the district level and the terms and responsibilities of each system is clear, while there are some functional overlaps at the national level and two different units are handling the same issues. Also both surveillance systems have an active surveillance component, while working separately as per the organogram and policies of the Ministry of Public Health; this increases the cost of the outbreak investigation and increase the time of response coordination.

These three surveillance systems for measles are working on three different objectives and report to three different general directorates, while the overall objective or goal of the program for ministry and people of Afghanistan is the same, measles elimination.

Data management and data integration between these three systems were almost not performed, which causes differences in the level of measles vaccination coverage, number of cases and outbreaks.

Measles is a notifiable disease under HMIS; health care workers should report the disease to Ministry of Health in the first 48 h after detection. Most of the health care workers do not have a direct link with the ministry of public health and they are following the usual chain of communication to notify relevant unit of ministry of health;

Table 1. Summary of surveillance components.

Component	HMIS	DEWS	EPI
Population under surveillance	82% of all health facilities, which cover 82% of population of Afghanistan	10% of the health facilities	Coverage is at the level of HMIS because all sites based in the government health facilities
Time period of data collection	Quarterly	Weekly	Monthly
Data collection	Count	Count and line list	Counts and line list
Reporting source of data	Registration book of health facilities	Registration book of health facilities and outbreak line list	Registration books of health facilities
Data management	Health facilities, provincial, national	Health facilities, provincial, national	Health facilities, Provincial, National
Data analysis	Health facilities, provincial, national	Health facilities, provincial, national	Health facilities, Provincial, National
Information dissemination	National	Health facilities, provincial, national	Provincial
Patient privacy, data confidentiality	Patient names and other personal identifiers remain in the registration book of health facilities and the counts are shared with the concerned people.	Detailed information kept in database, identifiers not shared except team for treatment of cases	-
Compliance with record management system	NA	NA	NA

which is time consuming. Sometimes, health care professionals use their mobiles to contact people at the central level or they forward the information to the provincial health directorate and from there they send the information to ministry of health through Radio CODAN System, which is a wireless radio system. Hence, this is a lengthy process. Also HMIS is not directly linked with the national laboratory to obtain information about result of the specimens collected by other systems and they are not collecting information about the confirmed cases of measles.

Sensitive case definition for the suspected cases used in surveillance system, causes a wide range of PVP among surveillance systems.

All of the HMIS reporting sites are government health facilities; also the same is right in case of EPI and DEWS surveillance systems. So these systems do not capture number of measles cases that are recorded in the private health sector. Studies revealed that only 30% of all the cases are absorbed in the public health sector and the rest are taken care of by providing the health sector.

Based on these findings, the evaluation team recommended the following point:

(1) Measles surveillance cell: Establish or assign one coordinating office, owner for the measles surveillance systems at the national level. This unit should compile all the relevant data, reconcile with those relevant and share with all stakeholders. Finally, this unit should transcribe the data into actionable information and make sure the information is pushed through to decision makers.

(2) Functional integration: These surveillance systems should work much closer with each other at the national and provincial levels. Ministry of health should develop an operational platform for all of these surveillance activities which can be strongly linked with confirmatory entities and also build the capacity for investigation and response to outbreaks of measles. Functional integration of these systems will reduce the cost of these surveillance systems by distribution of task, information dissemination throughout the systems and all levels, increase data quality, timeliness of information and provide stronger tool for decision makers at all levels on the other functional integration will increase their chance for sustainability and reduce the chance for fragmentation.

(3) Central database e-reporting system: Establish a central database or e-reporting for measles case that let the health care providers and surveillance officers to obtain information about suspected, probable and confirmed cases of measles, can facilitate information sharing horizontally and vertically.

(4) Ministry of health should include private sector in the health information management systems of the ministry; as a major part of information is not

coming to ministry of health.

Limitation

Priority of the stakeholders for other diseases and outbreaks, such as H1N1, this study was conducted at the time that H1N1/2009 was the first priority to the country.

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