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Original Article

Assessment of the Integrated Communicable Disease Surveillance and Response System in Thamar Governorate, Yemen

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Abstract

Background: The Integrated Communicable Disease Surveillance and Response (IDSR) system facilitates detection, monitoring and the effective response to public health threats.
Objectives: This study aimed to assess the IDSR system core and support functions in Thamar Governorate, Yemen.
Methods: The study utilized a cross-sectional design. All health workers working in the IDSR system were interviewed (n = 212). The study included governorate, district and health facility levels of IDSR system. A specifically designed structured interview instrument was adapted from the WHO generic questionnaires. The questionnaire included two sections: assessment of core activities of the IDSR system (structure, case confirmation, data reporting, data analysis, outbreak investigation, epidemic preparedness, epidemic responses, feedback) and assessment of support functions of the IDSR system (supervision, training, coordination, logistics and resources).
Results: Regarding case confirmation function, none of the health facilities had the capacity of specimen transport to a higher-level laboratory. Follow-up of specimen results, keeping of specimen results reports, and completion of specimen results reports were present in only 28.4%, 17.7%, and 17% of health facilities, respectively. Regarding data reporting function, a lack of recommended IDSR forms was reported in 46.1% of the health facilities and delayed submission of urgent notification for more than 24 hours was reported in 46.8% of health facilities. Regarding epidemic preparedness and response function, respondents at all health facilities revealed complete deficiency of emergency stocks of drugs and supplies, lack of budget line for epidemic response, and absence of community public health measures.
Conclusion: There was a deficiency in case confirmation, data reporting, and epidemic preparedness and response activities of the core functions of IDSR system in all health facilities. The IDSR system demonstrated unacceptable performance at the health facility level, which represents the periphery of the system.

Keywords: Surveillance, assessment, IDSR, Yemen, core activities, support functions

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INTRODUCTION

Surveillance involves the continuous, standardized collection, analysis, and interpretation of health-related data to be used in health plans, implement interventions, assess policies, and evaluate practices related to public health. [(1)] National public health surveillance systems of the African countries faced severe defects and weaknesses. Consequently, Integrated Disease Surveillance strategy was developed by Regional Office for Africa (AFRO) of World Health Organization (WHO) in 1998 following major outbreaks of communicable diseases in the African region. Its aim was to enhance disease surveillance, detection, and timely response to threats. In order to emphasize the link between the surveillance and response, WHO changed the name of the strategy in 2002 to Integrated Communicable Disease Surveillance and Response (IDSR).[(2, 3)] The system uses the resources rationally and efficiently to integrate related surveillance activities. It connects national, district, health facility, and community levels. The IDSR strategy includes indicator-based and event-based surveillance which are considered essential components of an Early Warning Alert and Response (EWAR) system. [(2)] Event-based surveillance depends on capturing events that had

inherent risk to public health to detect small outbreaks, while indicator-based surveillance monitors indicators to assess disease trends over time. [2] Activities of IDSR are included in multiple functions in a coordinated and integrated way. These same core functions that are used for surveillance include case detection and confirmation, data reporting and analysis, outbreak investigation, epidemic response and action, feedback and evaluation. [2] The strategy of IDSR was implemented in forty-four African countries by 2017 which represented 94% of Africa. [3]

A systematic review detected the challenges facing effective IDSR implementation in the African countries. Data reporting and data analysis challenges were evident in 83% and 26% of the studies, respectively. Obstacles in priority disease detection and notifications were reported in 57% of studies, while 49% of studies revealed challenges in feedback and information dissemination. Epidemic preparedness and response faced problems in 43% of studies, while challenges affecting human resources and staff training were identified in 45% of studies. [4] Data reporting issues included inaccurate and incomplete data, underreporting and delay, and lack of reporting firms. Deficiencies in various resources were also commonly reported, such as lack of financial capabilities, insufficient staff, and poor transportation. Moreover, the systematic review demonstrated deficient preparedness plan documentation, defects in detection of priority diseases, and insufficient knowledge of case definitions and surveillance procedures. [4]

Yemen is one of the developing countries that experienced a protracted period of civil turmoil, including many ongoing conflicts. A severe humanitarian crisis had developed as a result of an armed conflict that escalated in 2015. People were compelled to live in temporary settlements where several families lived in cramped quarters with poor sanitation, contaminated water, insufficient food, and inadequate access to essential social and health services. This led to increased risk for outbreaks of potentially fatal communicable diseases that raise morbidity and mortality. In case of disasters, it is essential to detect and respond rapidly to epidemics. [5, 6] The Electronic Diseases Early Warning System (eDEWS) was established in 2013 as a way to support the routine disease surveillance, and to identify alerts and take rapid action. This system utilized facility-based indicators and electronic platform.[7] Research carried out to assess the performance of eDEWS revealed usefulness, resilience of the system, and high rate of report completeness. However, challenges existed in quality of data and response timeliness. [8]

In Yemen, IDSR system was initiated in 2014. It was implemented in all the governorates, covering 333 districts and 2196 health facilities, supported by Ministry of Health in Yemen and WHO/Eastern Mediterranean Region. The system uses electronic software and tools linking data reporting, data collection, and analysis and feedback database for notification of thirty communicable diseases. In Thamar governorate, the IDSR system is working under numerous challenges such as lack of funding and political circumstances that affect its implementation and effectiveness. This study aimed to assess the core and support functions of the IDSR system in Thamar Governorate, Yemen. Findings of this study will help in strengthening the IDSR system and improving its performance.

METHODS

Thamar Governorate in Yemen provides healthcare services to a population of 2056,000. The study was conducted at three levels providing services related to Integrated Communicable Disease Surveillance and Response (IDSR) system in Thamar governorate; central level (governorate level), twelve districts (district level), and 141 health facilities (health facility level). The twelve districts included 141 health facilities (108 governmental and 33 private).

A cross-sectional design was used. All health workers (key informants) working in the IDSR system were included (n=212). Key informants were divided into focal persons of IDSR at health facilities (n = 141), one in each health facility; rapid response team members (RRT) of IDSR at the 12 health districts (n = 60) (five members in each district); and all health managers of IDSR at the governorate level (n = 11).

A specifically designed structured interview questionnaire was adapted from the generic questionnaires of the WHO protocol for the assessment of national communicable disease surveillance and response systems, [9] the WHO framework for monitoring and evaluating surveillance and response systems for communicable diseases, [1] and reviewing a previous study that was conducted in Sudan and used validated Arabic-translated versions. [10] Data was collected through interviewing key informants at the different levels of the IDSR system. The interview questionnaire assessed the implementation of the IDSR system by measuring input, process, and output indicators that are in the two dimensions of core activities and support functions. The interview questionnaire included two sections: assessment of core activities of the IDSR system (structure, case confirmation, data reporting, data analysis, outbreak investigation, epidemic preparedness, epidemic responses, feedback) and assessment of support functions of the IDSR system (supervision, training, coordination, logistics and resources).

Structure function indicators included the availability of the IDSR guideline manual for

surveillance and the availability of a mandatory surveillance system. Case confirmation function indicators included the presence of standardized case definition for priority diseases, the capacity of specimen transport to a higher-level lab, availability of guidelines for specimen collection, handling, and transportation to the next level, follow-up of specimen results, keeping of specimen results reports, completion of specimen results reports, and the problems facing specimen collection and transportation at different levels of the IDSR system. Data reporting function consisted of preparing reports and notifications to the higher level at different levels of the IDSR system (availability of recommended IDSR forms at any time during the past year, ease of using the reporting form, time consumption in completing the form, length to prepare the report and send to the higher level, reporting methods, number of reports or notifications in the previous month compared to the expected number, training for preparation of reports or notifications, forwarding of urgent notifications about notifiable diseases, delaying submission of an urgent notification for more than 24 hours, presence of zero reporting and use case investigation sheet for the recommended notifiable diseases). In addition, data reporting function indicators covered the accuracy and completeness of the reports at the different levels of the IDSR system (commenting on the accuracy and completeness of reports or notifications received from the lower levels, using a standard format from the central level for producing the reports or notifications, and keeping copies of reports or notifications for the past 12 months, keeping the reports or notification copies in good condition).

The data analysis function indicators included the data describing age, sex, place, time, and the presence of definition of action threshold for priority diseases. Outbreak investigation function indicators involved the number of suspected outbreaks in the past year, methods of discovering the epidemic, investigating an outbreak in the last year, looking for risk factors in the investigated outbreaks, and using the data resulting from investigated outbreaks for action. Epidemic preparedness function indicators incorporated the availability of a written epidemic preparedness and response plan, epidemic preparedness and response plan ability to define the priority group for intervention, availability of emergency stocks of drugs and supplies at all times in the past year, experiencing shortage of drugs supplies during the most recent epidemic (or outbreak), existence of a written case management protocol for at least 1 priority disease, availability of budget line for epidemic response, availability of public health education materials readiness for epidemic prone diseases, availability of community public health measures (travel, mass gathering, school closure, etc.), availability of pandemic vaccination strategy, availability of RRT for epidemic, on job raining of RRT for epidemic. Epidemic response function indicators covered responses within 48 hours of notification of the most recently reported outbreak, monitoring of mass vaccination and campaign coverage evaluations, performance of mass vaccination campaigns, calculation of vaccination coverage, and evaluation of preparedness and response activities by RRTs of IDSR during the past year.

Feedback function indicators consisted of the routine production of the IDSR feedback reports, distributing copies to staff at all levels, receiving IDSR feedback reports from a higher level, producing feedback reports according to the national standard guidelines, receiving reports from a higher level during the past year on a regular basis, and thinking that a feedback report from a higher level is beneficial. Supervision function indicators included the availability of regular supervision visits from the higher levels and lower levels, reviewing IDSR activities by the supervisors during the visits, providing feedback on the performance of the IDSR system by the supervisors during the visits, and checking the implementation of previous recommendations by supervisors during follow-up visits. Training function included receiving training and post-basic training of IDSR program. The coordination function indicator involved the availability of the IDSR system coordinating body at every level. The logistics function indicators incorporated the availability of a good financing system, well-functioning communication methods, appropriate transportation methods, and health education material. Resources function indicators consisted of the availability of enough and well-trained staff at all levels, motivation of the staff, the need of focal IDSR personnel, thinking whether special incentives for all IDSR personnel would influence positively the quality of the IDSR system, the availability of budget in the IDSR system, whether the IDSR system needs to be more flexible in adopting changes, the simplicity and usefulness of the IDSR system, and the availability of equipment and supplies.

A pilot study was conducted over one week including nine key informants in three districts Jahran, Thamar city and Jabal Asharq of Thamar governorate. The purpose of the pilot study was to test the data collection tool and to identify potential issues or difficulties that may arise, as well as to determine the most effective strategy for addressing them. No modifications were performed on data collection instrument after the pilot study as questions were clear and understandable. Collection of data took place in Thamar governorate during 2018-2019. The collected data was revised and analyzed using the Statistical

Package for Social Sciences program (SPSS) software, version 21. Frequencies and percentages were used to describe categorical data. Indicators were compared to the WHO-recommended gold standard IDSR performance target of 80% for all surveillance levels.[2]

Ethical considerations

Approval of the study was obtained from the Ethics Committee of High Institute of Public Health (IRB number: 00013692) and Yemeni Ministry of Public Health and Population and the Office of Public Health and Population in Thamar Governorate. The researchers complied with the International Guidelines for Research Ethics. Informed consent was obtained from the study participants following an explanation of the purpose and benefits of the research. Anonymity and confidentiality of the data were assured and maintained.

RESULTS

Structure and case confirmation

Regarding IDSR structure, there was no IDSR guidelines manual for surveillance at governmental, district, and health facility levels. However, there was mandatory surveillance for diseases at all levels. All Thamar governorate-level health managers and district-level RRT reported availability of all case confirmation activities at the two levels (capacity of specimen transport to a higher-level laboratory, availability of guidelines for specimen collection, handling and transportation to the next level, follow-up of specimen results, keeping of specimen results reports), except for "completion of specimen results reports," which was reported to be deficient by 15% of RRT. There was a deficiency in case confirmation activities in all health facilities, and the indicators did not meet the recommended standard of 80%. None of the health facilities had the capacity of specimen transport to a higher-level laboratory. Availability of guidelines for specimen collection, handling, and transportation was present in 86.5% of health facilities. Follow-up of specimen results, keeping of specimen results reports, and completion of specimen results reports were present in only 28.4%, 17.7%, and 17% of health facilities, respectively (Table1).

Multiple problems and challenges were encountered during the case confirmation activities. All Thamar's managers and almost all districts' RRT stated that there was a deficiency of the following: sample collection equipment, containers to save samples, culture medium for diagnosis of cholera outbreaks, laboratory services, and there was difficulty in reaching next levels because of distance and roughness of the road. On the other hand, difficulty in reaching the next level was the most frequent problem facing health facilities (100%), followed by a lack of sample collection equipment (58.2%), and a lack of containers to save samples came next (53.2%). There were variable differences in the existence of standardized case definitions for the priority diseases at the district level and even more deficiencies at the health facility level. The existence of standardized case definitions of all diseases was confirmed at the governorate level, while at the district level, case definitions were complete in acute flaccid paralysis, suspected measles, tetanus, and rabies, followed by suspected leishmania (95%), AIDS (88.3%), then suspected meningitis (86.7%), suspected cholera (85.0%), mumps (81.7%), and malaria (80.0%). The majority of health facilities had standardized case definitions for suspected meningitis (95.7%), acute hemorrhagic fever (95%), and acute viral hepatitis (95%). Few health facilities had standardized case definitions for dysentery (16.3%), suspected cholera (26.2%), lower respiratory tract infections (30.5%), acute dysentery (31.2%), and suspected measles (31.9%) (Table 1).

Data reporting and data analysis

All health managers at the governorate level, 91.7% of RRT at the district level, and 46.1% of focal persons at the health facility level reported a lack of recommended IDSR forms. The main reason for the lack of forms is the non-availability at the national level. The forms were easy to use at all levels, but they were time-consuming, as indicated by all managers at the governorate level, all RRT at the district level, and only 7.1% of focal persons at the health facility level. This was obvious as more than half of the participants from the governorate and district levels (54.5% and 51.7%, respectively) spent 3 hours to prepare the report and send it to higher levels, while it only took 1 hour for health workers at the health facilities. The main reporting method was a specific electronic application on the mobile at all IDSR levels. Greater proportions of health workers at health facilities and RRTs at districts fulfilled the required number of reports and notifications in the last month (86.4% and 78.3%, respectively). All managers, RRTs, and focal persons received training on the preparation of reports or notifications. All focal persons in health facilities forwarded urgent notifications about notifiable diseases, although there was delayed submission of urgent notification for more than 24 hours in 46.8% of health facilities. It is noted that all health managers at the governorate level commented on the accuracy and completeness of reports or notifications received from lower levels, while only one-fifth of RRTs in districts commented on the accuracy and completeness of reports from lower levels. All districts and facilities used a standard format from the central level for producing the reports or notifications. Keeping copies of reports or notifications in the past 12 months was

evident at the governorate level, 68.7% of the health facility level, and only 25% of the district level. Regarding data reporting activities, the following indicators did not meet the recommended WHO threshold of 80% at the health district level: availability of forms, duration to complete and prepare the forms, submission of urgent notifications on time, commenting on the accuracy and completeness of reports, and keeping complete copies of reports and notifications in good condition in the previous 12 months. On the other hand, the following indicators did not meet the recommended WHO threshold of 80% at the health facility level: availability of the forms, submission of urgent notifications on time, and keeping complete copies of reports and notifications (Table 2).

Concerning the data analysis activities, the data was described by age, sex, place, and time according to 100% of the governorate's managers and RRTs districts, while this was not applicable at the health facility level. The governorate performed trend analysis for acute flaccid paralysis, diphtheria, and H1N1 diseases. On the other hand, the presence of a definition of action threshold for priority diseases was evident at the governorate level, followed by only one quarter of participants at the district level. Indicators related to data analysis were not met at the health district level (table 2).

Table 1: Structure and case confirmation core activities at different levels of the IDSR system (Thamar, Yemen, 2018-2019)

IDSR core activity	Governorate level (n=11)		District level (n=60)		Health facility level (n=141)		Target
	No.	%	No.	%	No.	%	
Structure							
Availability of IDSR guidelines manual	0	0.0	0	0.0	0	0.0	80%
Availability of mandatory surveillance of diseases	11	100	60	100	141	100	80%
Case confirmation							
Capacity of specimen transport to higher level laboratory	11	100	60	100	0	0.0	80%
Availability of guidelines for specimen collection, handling and transportation to the next level	11	100	60	100	122	86.5	80%
Follow up of specimen results	11	100	60	100	40	28.4	80%
Keeping reports of specimen results	11	100	60	100	25	17.7	80%
Completion of reports of specimen results	11	100	51	85	24	17.0	80%
Problems and challenges facing case confirmation							
Lack of equipment for sample collection	11	100	55	91.7	82	58.2	-
Lack of containers to save samples	11	100	60	100	75	53.2	-
Lack of culture media for diagnosis of cholera outbreaks during this period	11	100	60	100	15	10.6	-
Lack of laboratory services at this level	11	100	60	100	9	6.4	-
Difficulty in reaching next levels because of long distance and roughness of the roads	11	100	60	100	141	100	-
Standardized case definitions for the priority diseases							80%
Upper Respiratory tract Infections	11	100	36	60	96	68.1	
Lower Respiratory tract Infections	11	100	23	38.3	43	30.5	
Influenza Like illness	11	100	9	15	58	41.1	
Severe Acute Respiratory Infections	11	100	29	48.3	91	64.5	
Whooping Cough	11	100	40	66.7	104	73.8	
Diphtheria	11	100	47	78.3	109	77.3	
Suspected cholera	11	100	51	85	37	26.2	
Dysentery	11	100	15	25	23	16.3	
Acute Dysentery	11	100	9	15	44	31.2	
Typhoid	11	100	18	30	141	55.0	
Acute Flaccid Paralysis	11	100	60	100	130	92.2	
Suspected Measles	11	100	60	100	45	31.9	
Acute Viral Hepatitis	11	100	13	21.7	134	95.0	
Tetanus	11	100	60	100	133	94.3	
Mumps	11	100	49	81.7	128	90.8	
Suspected Dengue Fever	11	100	16	26.7	101	71.6	
Acute Hemorrhagic Fever	11	100	32	53.3	134	95.0	
Suspected Meningitis	11	100	52	86.7	135	95.7	
Malaria	11	100	48	80.0	128	90.8	
Suspected leishmanial	11	100	57	95.0	74	52.5	
Suspected Schistosomiasis	11	100	47	78.3	124	87.9	
Rabies	11	100	60	100	117	83.0	
HIV / AIDS	11	100	53	88.3	100	70.9	
TB	11	100	23	66.3	66	61.8	
Chicken pox	11	100	44	73.3	56	39.7	
Scabies	11	100	35	58.3	47	33.3	
Brucellosis	11	100	23	38.3	54	38.3	
Guinea worm	11	100	36	60.0	96	68.1	

Table 2: Data reporting and data analysis core activities at different levels of the IDSR system (Thamar, Yemen, 2018-2019)

IDSR core activity	Governorate level (n=11)		District level (n=60)		Health facility level (n=141)		Target
	No.	%	No.	%	No.	%	
Data reporting							
Availability of recommended IDSR program forms at any time during the last year	0.0	0.0	5	8.3	76	53.9	80
Use of reporting forms is easy	11	100	60	100	141	100	80
Completing the forms is not time consuming	0	0.0	0	0.0	131	92.9	80
Length to prepare and submit the reports to higher levels							
1 hour	3	27.3	0	0.0	141	100	80
2 hours	0	0.0	14	23.3	0	0.0	-
3 hours	6	54.5	31	51.7	0	0.0	-
4 hours	2	18.2	15	25	0	0.0	-
Reporting method: **reporting electronically through specific mobile applications**	11	100	60	100	141	100	-
Fulfillment of the expected number of reports or notifications in the last month*	11	100	47	78.3	121	86.4	80
Training on preparation of reports and notifications	11	100	60	100	141	100	80
Forwarding of urgent notifications about notifiable diseases	-	NA	60	100	141	100	80
Submission of urgent notification within 24 hours	-	NA	55	91.7	75	53.2	80
Presence of zero reporting (submitting a report even if there are no reportable cases)	11	100	60	100	141	100	80
Using case- based investigation sheet for the recommended notifiable diseases	-	NA	60	100	134	95	80
Commenting on the accuracy and completeness of reports or notifications received from lower levels	11	100	12	20	-	NA	80
Using standard format from the central level for producing the reports or notifications	-	NA	60	100	141	100	80
Keeping complete copies of reports and notifications for the past 12 months	11	100	15	25	97	68.7	80
Keeping copies of reports and notifications in a good condition	11	100	12	20	104	73.7	80
Data analysis							
Describing data by age/sex/place/time	11	100	60	100	-	NA	80
Performing trend analysis (acute flaccid paralysis/diphtheria/H1N1)	11	100	0	0.0	-	NA	80
Presence of definition of action threshold for priority diseases	11	100	15	25	-	NA	80

*one report for governorate/ 15 reports for district/ 4 reports for health facility

Outbreak investigation, epidemic preparedness and epidemic response

Assessment of outbreak investigation at the different levels of the IDSR system revealed that more than half of participants at the health facility and district levels (54.6% and 58.3%, respectively) detected two suspected outbreaks in the past year. While all managers at the governorate level detected 3 suspected outbreaks in the past year. The suspected outbreaks were for cholera, measles, rubella, and diphtheria diseases at all levels. All health workers at governorate and district levels and three-quarters of health workers at health facility levels discovered epidemics using clinical diagnosis. It is noted that only 17% of health facilities diagnosed epidemics using laboratory services and 7.8% used rapid tests. The governorate and health district levels achieved the 80% target level in the indicators related to outbreak investigation (Table 3).

Regarding epidemic preparedness, the complete absence of epidemic preparedness was evident at the health facility level, while the district level lacked most items of epidemic preparedness. The results revealed that a written plan of epidemic preparedness and response was available at the governorate level, while it was deficient at the district level. In addition, the plan of epidemic preparedness and response was not able to define the priority group for intervention at the governorate and district levels. Complete deficiency of emergency stocks of drugs and supplies, lack of budget line for epidemic response, and absence of community public health measures were obvious at all levels. All IDSR levels experienced shortages of drug supplies during the most recent epidemics. According to more than half of managers at the governorate level (63.3%) and less than half of RRTs at the district level (40%), a written case management protocol existed for only 3 diseases (cholera, measles, diphtheria). All managers at the governorate level mentioned that there was public education material for acute flaccid paralysis, measles, cholera, and diphtheria, while all RRTs and focal persons at the district and health facility levels denied the presence of any public education materials for epidemic-prone diseases. Epidemic vaccination strategy was available at the governorate level, and RRTs were available and trained (Table 3).

Assessment of epidemic response indicated that all

managers and RTTs responded within 48 hours of notification of the most recent outbreak and met the 80% target. All health facilities delayed response to the most recent outbreak. The majority of focal persons at health facilities (76.6%), all managers, and RTTs monitored mass vaccination and evaluated campaign coverage, performed mass vaccination campaigns, and calculated vaccination coverage. The governorate and districts evaluated the preparedness and response activities during the past year (Table 3).

Table 3: Outbreak investigation, epidemic preparedness, and response core activities at different levels of the IDSR system (Thamar, Yemen, 2018-2019)

IDSR core activity	Governorate level (n=11)		District level (n=60)		Health facility level (n=141)		Target
	No.	%	No.	%	No.	%	
Outbreak investigation							
Number of suspected outbreaks in the past year (cholera, measles and rubella, diphtheria)							
0					3	2.2	
1					28	19.8	
2			35	58.3	77	54.6	
3	11	100	25	41.7	33	23.4	
Method of discovering the epidemic							
• Clinical diagnosis by health workers	11	100	60	100	106	75.2	
• Diagnosis by rapid test	11	100	60	100	11	7.8	
• Diagnosis by the laboratory tests	11	100	60	100	24	17	
Investigating an outbreak in the last year	11	100	60	100	-	NA	80
Looking for risk factors in the investigated outbreaks	11	100	60	100	-	NA	80
Using the data resulting from investigated outbreaks for action	11	100	60	100	-	NA	80
Epidemic preparedness							
Availability of written plan for epidemic preparedness and response	11	100	0	0.0	-	NA	80
Ability of plan for epidemic preparedness and response to define the priority group for intervention	0	0.0	0	0.0	-	NA	80
Availability of emergency stocks of drugs and supplies at all times in the past year	0	0.0	0	0.0	0	0.0	80
Availability of drugs and supplies during the most recent epidemic/outbreak	0	0.0	0	0.0	0	0.0	80
Existence of a written case management protocol for at least 1 priority disease	7	63.3	24	40	-	NA	80
Availability of budget line for epidemic response	0	0.0	0	0.0	0	0.0	80
Availability of public health education material readiness for epidemic prone diseases	11	100	0	0.0	0	0.0	80
Availability of community public health measures*	0	0.0	0	0.0	0	0.0	80
Availability of epidemic vaccination strategy	11	100	-	NA	-	NA	80
Availability of **RRT** for epidemics	11	100	60	100	-	NA	80
On job training of RRT for epidemics	11	100	60	100	-	NA	80
Epidemic response							
Response within 48 hours of notification of the most recent outbreak	11	100	60	100	0	0.0	80
Performance of mass vaccination and calculation of vaccination coverage	11	100	60	100	108	76.6	80
Monitoring of mass vaccination and campaign coverage evaluation	11	100	60	100	108	76.6	80
Evaluation of preparedness and response activities by RRTs of IDSR during the previous year	11	100	60	100	-	NA	80

*For example: travel, mass gathering, school closure RRT= Rapid Response Team

Feedback core activity and IDSR support functions

The district level showed unsatisfactory performance of the feedback function. The highest percentage of managers at the governorate level (72.7%) wrote IDSR feedback reports routinely and distributed copies to staff at all levels. On the other hand, RRTs at the district level did not produce any feedback reports nor distribute them to higher and lower levels. All levels reported a lack of guidelines for the feedback function. All levels of the IDSR system thought that receiving feedback reports from higher levels was beneficial (Table 4).

Three quarters of RRTs and only one quarter of focal persons received regular supervisory visits from higher levels. According to the majority of participants at all levels, IDSR system activities were reviewed by supervisors, IDSR data was reviewed and discussed during such visits, and feedback was provided. Training and coordination functions were satisfactory at all levels. The logistics function was completely lacking and did not attain the target level of 80%. The complete absence of the following items was evident at all levels: financing system, transportation methods, and health education materials (Table 4).

More than half of focal persons at the health facility level stated that they had enough staff, while

all managers at the governorate level and all RRTs at the district level stated that there were not enough staff at their levels. The presence of well-trained staff was reported at all levels. However, health facilities did not attain the target of 80%. Motivation of the staff was illustrated at the district level (58.3%), followed by the governorate level (36.4%), and health facilities' staff were the least motivated (31.2%). All levels did not achieve the target of 80% regarding the motivation indicator. All participants at all levels did not have sound budgets in the IDSR system. It was noted that all the resources were deficient at the district and facility levels except for the telephone service. Staff site offices, computers, printers, stationery supplies, calculators, and vehicles were deficient in all districts and health facilities. On the contrary, almost all logistics and resources were available and functioning at the governorate level. However, only two managers had vehicles for transportation. The majority of health facilities thought that the IDSR system is simple (91.5%), while all managers and RRTs thought the opposite (Table 4).

Table 4: Feedback core activity and support functions at different levels of the IDSR system (Thamar, Yemen, 2018-2019)

IDSR function	Governorate level (n=11)		District level (n=60)		Health facility level (n=141)		Target
	No.	%	No.	%	No.	%	
Feedback							
Routine production of IDSR feedback reports	8	72.7	0	0.0	-	NA	80
Distributing copies to staff at the same level/higher level/lower level	8	72.7	0	0.0	-	NA	80
Receiving IDSR feedback reports from higher level during the last year on regular basis	11	100	60	100	141	100	80
Producing feedback according to national standard guidelines*	-	NA	-	NA	-	NA	80
Feedback reports from higher levels were beneficial	11	100	60	100	141	100	80
Supervision							
Receiving regular supervision visits from the higher level	11	100	45	75	34	24.1	80
Performing regular supervision visits to the lower level	11	100	60	100	-	NA	80
Reviewing IDSR system activities and data by supervisor during the visits	11	100	60	100	133	94.3	80
Providing feedback by supervisor on performance of IDSR during the visits	11	100	60	100	133	94.3	80
Checking the implementation of previous recommendations by supervisor during any follow up visits	11	100	60	100	131	92.9	80
Training							
Availability of initial IDSR training	11	100	60	100	141	100	80
Availability of additional post-basic training	11	100	57	95	113	80.1	80
Coordination							
Presence of IDSR system coordinating body at every level	11	100	60	100	139	98.6	80
Logistic function							
Presence of good financing system	0	0.0	0	0.0	0	0.0	80
Presence of well-functioning communication method	11	100	60	100	139	98.6	80
Presence of appropriate transportation methods	0	0.0	0	0.0	0	0.0	80
Presence of health education materials	0	0.0	0	0.0	0	0.0	80
Resource function							
Availability of enough staff at this level	0	0.0	0	0.0	75	53.2	80
Availability of well-trained staff	11	100	60	100	79	56	80
Motivation of staff	4	36.4	35	58.3	44	31.2	80
There is a need for IDSR focal personnel	11	100	60	100	72	51.1	-
Incentives for IDSR staff would influence positively the quality of IDSR	11	100	60	100	141	100	-
Availability of financially sound budget	0	0.0	0	0.0	0	0.0	80
IDSR system needs to be more flexible in adopting change	11	100	60	100	137	97.2	-
IDSR is too simple system	0	0.0	0	0.0	129	91.5	80
IDSR is highly useful system	11	100	60	100	141	100	80
Availability of well-functioning site offices for staff	11	100	0	0.0	0	0.0	80
Availability of well-functioning computers	11	100	0	0.0	0	0.0	80
Availability of well-functioning printers	11	100	0	0.0	0	0.0	80
Availability of well-functioning stationery supplies	11	100	0	0.0	0	0.0	80
Availability of well-functioning calculators	11	100	0	0.0	0	0.0	80
Availability of well-functioning telephone service	11	100	60	100	141	100	80
Availability of well-functioning vehicles for transportation	02	18	0	0.0	0	0.0	80

*There is absence of national standard guidelines

DISCUSSION

The study assessed the performance of the IDSR system core and support functions based on specific measurable indicators. WHO suggested an 80% level for comparison of IDSR indicators. The results of the current study revealed that the IDSR guideline manual for surveillance was not available at all levels (Table 1). This structural indicator failed to reach the performance target of 80% established by WHO. On

the other hand, the existence of standardized case definitions of all priority diseases was confirmed in 100% of diseases at the governorate level, while at the district level, case definitions were only complete in four diseases: acute flaccid paralysis, suspected measles, tetanus, and rabies. The variability in case definitions of different priority diseases was obvious at the district and health facility levels, as the expected target of 80% was not met for two-thirds of the priority diseases (Table 1). Deficiencies of guidelines and case definitions can be attributed to lack of resources and insufficient communication. Several studies demonstrated inconsistent results to the current study. A study conducted in Northeast Nigeria found that all the studied states and local government regions had the national IDSR technical guidelines, but there was no indication that the guidelines were being used. [11] A study carried out in Kenya showed that 48% of respondents stated that manuals for disease surveillance were present at the facility level. Standard case definitions were available at all the county and sub-county levels, while 83% of health facilities reported availability of them. [12] A study conducted in Eastern Ghana revealed the availability of IDSR technical guidelines, and that the majority of respondents had case definitions at the health facilities. [13] Another study conducted in Tanzania reveals availability of case definitions in 57% of primary healthcare facilities. [14] Findings of a study carried out in Yemen demonstrated that 91% of respondents at the health facilities reported absence of written case definition for malaria in the Integrated Malaria Surveillance System (IMM), while 91% of respondents stated that there was a standard case definition of malaria for the Early Disease Electronic Warning System (eDWAS). [15] One Saudi Arabian study demonstrated the absence of standard case definitions in 59% of primary healthcare centers. [16] The availability of surveillance guidelines and standard case definitions supports the case detection and confirmation activities. Poor detection and diagnosis of cases at health facilities may be attributed to deficiencies in standard case definitions, which act as a guide in priority disease investigation. [15, 16]

As regards case confirmation, results indicated a deficiency of equipment and containers to save samples, culture media needed to diagnose diseases, and laboratory services in the governorate, districts, and health facilities (Table 1). Findings of the current study were contradictory to other studies. In Saudi Arabia, functioning laboratories with full capacities were available in 100% of the primary healthcare centers.[16] A study conducted in Kenya found that functional laboratories were available at all the county, sub-county, and health facility levels. The county level (100%), the majority of sub-county level (84%), and less than half of health facility level (41%) had the capacity to collect and store specimens. [12] A study carried out in Kurdistan, Iraq, revealed the presence of working laboratories in all health facilities, with 93.2% of facilities having the ability to store samples. [17] A study conducted in North Ghana demonstrated similar results to the current study, indicating that the majority of respondents stated that deficient laboratory capacity, false results, and improper diagnosis of laboratory functions were obstacles of health facilities concerning case identification. [18] A study in Tanzania revealed a lack of packaging materials needed to transport samples to laboratories.[14]

The present study revealed that the capacity of specimen transport to a higher-level laboratory was completely absent at the health facility level. This was far beyond achieving the indicator target of 80% (Table 1). This can be explained by the nonavailability of any vehicles at the health facility level (Table 4). Difficulty in reaching the next levels because of the distance and roughness of the road was also mentioned as one of the challenges facing all IDSR health workers (Table 1). This was comparable to a study carried out in Northern Ghana that demonstrated a lack of funds for specimen transportation to reference laboratories, as well as a lack of staff, and no one was in charge of transporting specimens to laboratories. [18] A study in Sudan, showed a different result from the present study, as the capacity of transferring specimens was 100% at the lower levels. [10] Also, the same study conducted revealed deficient standard guidelines for specimen collection at all levels, which totally disagrees with the current study. [10] In Kurdistan, Iraq, almost 68.8% of health facilities transported specimens to specialized laboratories on time. [17] Another two indicators of case confirmation in the current study did not achieve the expected target of 80% at the health facility level: follow-up of specimen results (28.4%) and keeping reports of specimens (17.7%), while they were achieved at the governorate and district levels (Table 1). A study conducted in Sudan revealed that follow-up of specimen results was zero at the locality level, 10.5% in the health area, and not applicable in health facilities, and that specimen results were not kept at all levels. [10] Another study in Iraq demonstrated that nearly three-quarters of health facilities (74.3%) kept reports of specimens' results. [17]

Data reporting and analysis

All the IDSR levels reported a lack of the recommended forms (Table2). Several studies identified similar results to the current study. In Tanzania, a study showed a lack of necessary forms: "registers, weekly and monthly reporting forms, case investigation forms." [19] In addition, studies in Northern Ghana, Zambia, Nigeria, and Kenya reported a shortage of forms as one of the difficulties facing

reporting. [11, 12, 18, 20] Nevertheless, other studies reported contrasting results to the current study. A study conducted in Sudan showed availability of reporting forms at all levels. [10] Moreover, an Iraqi study revealed availability of recommended forms, and only 13.5% of health facilities reported deficiency due to problems of late arrival from districts or photocopying. [17] A recent study in the Eastern area of Ghana demonstrated that the majority of health workers at the health facilities had reporting forms for priority diseases (95.7%), for weekly reporting (90.8%), and for monthly reporting (93.7%). [13] The present study showed that all participants sent reports to the high level by specific electronic application on mobile (Table 2). This agrees with studies in Ethiopia and Ghana. [18, 21] Another study reported the use of Epi Info software at districts and various methods at health facilities "paper-based formats, social media, telephone, or email". [17] Also, another study in Eastern Ghana reported the use of both paper-based and electronic methods for reporting. [13] The current study revealed lengthy time to complete the forms at the districts and governorate levels, as more than half of managers and RRTs took three hours to complete the forms. As for health facilities, completing the forms was not time-consuming and took one hour, and this was similar to a study carried out in Iraq.[17]

Although the health facilities exceeded the 80% recommended target of reporting the expected number of reports, still they fell behind regarding submission of urgent notification on time. Only 53.2% of health facilities submitted urgent notification within 24 hours (Table 2). In Congo, data completeness as measured by number of weekly reports with every reportable disease was 100% at the provincial and health zone levels and 86% at the health facility level.[22] A study carried out in Saudi Arabia indicated that submission of the weekly and monthly reports was in only 17% of health facilities.[16] In contrast to the current study, all health facilities reported timely submission of 82.4% of urgent notifications to the next levels in a study conducted in Iraq.[17]

In the present study, keeping complete copies of reports or notifications in the previous 12 months was deficient at the health facilities and districts, and the target level of 80% was not achieved. Similar results were observed in other studies. An Indian study discovered missing copies of forms during the data accuracy verification process. [23] This was explained by poor resources. Since there were no extra fees for photocopies or printouts, the staff was hesitant to keep office copies of the forms that were turned in. [23] Also, inadequate and insufficient documentation was one of the challenges facing the African region in data management. [24]

As regards data analysis activities, the governorate and districts performed data analysis, while this was not applicable at the health facilities (Table 2). This disagrees with a study conducted in Ethiopia that showed that all health facilities had data analysis by age and sex distribution. [21] Another study conducted in Northern Ghana showed that 50% of health workers indicated that disease surveillance data was analyzed at the health facility level.[18] Also, a study conducted in Eastern Ghana found the majority of health workers analyzed data. [13] All RRTs in districts in the present study reported not performing disease trend analysis (Table 2), and this indicator did not achieve its target of 80%. This disagrees with a study conducted in India that showed 82% of districts performed trend analysis for regular data. [23] Inadequate data analysis at districts was reported in one Tanzanian study. [19] Another Tanzanian study indicated rarely applied data analysis at the district and facility levels. [14] The current study reported absence of definition of action thresholds for priority diseases at most districts (75%) and all health facilities. This result contradicts the result of a study in Zanzibar, Tanzania, where action thresholds for priority diseases were available in all districts and 60% of facilities. [14] Lack of data analysis in the present study can be explained by lack of time, non-availability of enough trained staff, and poor motivation (Table 4).

Outbreak investigation, epidemic preparedness, and response

As regards outbreak investigation activities, the governorate identified three suspected outbreaks for cholera, measles/German measles, and diphtheria. The current study showed that looking for risk factors in investigated outbreaks and using the resulting data for action were performed at all the governorate and district levels, which exceeded the 80% target (Table 3).

The present study revealed weakness of epidemic preparedness function at all levels. This was detected by an absolute deficiency of the five related indicators: no definition of the priority group for the interventions in the epidemic preparedness plan, complete lack of emergency stocks and supplies in the past year, non-availability of drugs during the most recent epidemic, no budget for epidemic response, no public health education material for epidemic-prone diseases, and absence of community public health measures. The current study revealed the existence of a written plan for preparing and responding to epidemics at the governorate level, while it was deficient at the district and health facility levels (Table 3). Several studies documented comparable results to the current study. A study conducted in Sudan showed the absence of a written plan for epidemic preparedness and a lack of emergency drugs. [10] A study in Saudi Arabia reported a complete absence of a written plan for outbreak response in the forty-two primary healthcare centers.

[16] Another study in Iraq demonstrated a lack of an epidemic preparedness plan, except for cholera at the district level in 2018. A shortage of medicines and supplies was reported in 39% of health facilities during the recent epidemic, and half of health units (51%) possessed public educational materials available for epidemics. [17] On the other hand, other studies revealed contrasting results to the present study. The Indian study indicated that 88% of districts had emergency stocks of drugs and supplies at all times in the past year; only 18% of districts demonstrated a lack of drugs and supplies in the recent epidemic, and budget access was available for epidemic response in 71% of districts, and it was determined to be sufficient by 50% of them. [23] Respondents in a study in Kenya reported having sufficient supplies for outbreak response at the sub-county (63%) and county (100%) levels.[12] A study in North Kivo, Congo, revealed that 44% of all health zones had emergency preparedness plan, 80% had a working committee for public health emergencies, 40% had emergency supplies for three months, and only 3% of health facilities had isolation ward.[22] In Tanzania, a study demonstrated the presence of an epidemic response budget line in all the 10 districts. Nevertheless, the epidemic preparedness plan was only present in 60% of the districts.[14]

More than half of managers (63.3%) at the governorate level and less than half of RRTs at the district level (40%) stated that written case management protocol existed for only 3 diseases: cholera, measles, and diphtheria. This was not applicable at the health facilities (Table 3). A study conducted in India showed that the majority of the districts (62%) and facilities (80%) had access to a written standard case management protocol. [23] In Saudi Arabia, a manual for standard case management was provided in 41% of primary healthcare centers.[16] A study in Zanzibar, Tanzania, demonstrated that 60% of the health facilities had a written standard case management protocol for epidemic-prone diseases.[14]

The current study showed that epidemic vaccination strategy was only available at the governorate level (Table 3). In Khartoum state, Sudan, a study revealed the presence of a vaccination strategy in both the locality and all health areas. [10] The current study showed that RRTs for epidemics were available and trained in all districts. (Table 3). This agrees with a study conducted in Nigeria, declaring that RRTs were present in 63% of the local governorate areas. [11] All five surveyed health zones and the province in North Kivu, Congo, had RRTs, but only 41% of RRTs in health zones were functioning. [22] Other study in Zanzibar, Tanzania, reported that all the 10 districts had RRTs. [14] In Sudan, RRTs were completely deficient in the locality and health areas of Khartoum state. [10]

Results of the current study showed that the governorate and districts responded within 48 hours of notification of the most recently reported outbreak, while all health facilities did not respond (Table 3). A study conducted in India revealed similar results. It showed that 77% of districts responded to suspected outbreaks within 48 hours. [23] The indicators of performance of mass vaccination campaigns, calculation of vaccination coverage, and monitoring of mass vaccination achieved their targets of 80% at the governorate, district, and nearly health facility levels (Table 3). Similar results were reported in Sudan. [10]

As regards the feedback function, a complete absence of production of routine feedback reports was observed at the districts and the facilities. On the other hand, all levels received IDSR feedback reports from their higher level, and all levels thought these reports were beneficial (Table 4). According to a Tanzanian study, out of the eight regions, three received inputs on new policies and guidelines, one region received aggregated data, four regions received input on the quality of IDSR reports, and two regions received help with IDSR task execution. [19] A study conducted in Kenya reported 37% of facilities receiving feedback on reports during the preceding year from their higher level. [12] A study carried out in Sudan revealed different results from the current study, indicating that only 10% of the health facilities, 63.2% of the health areas, and 14.3% of the locality thought feedback reports were useful. [10] The findings of an Iraqi study were that all districts and 31.1% of health facilities received feedback regularly, and 54.1% of health facilities found it beneficial. [17] Other study conducted in North Kivu, Congo, demonstrated that the national level provided feedback to the provincial level on 92% of their surveillance data, while the provincial level provided feedback to 97% of the health zones over the past 6 months. [22] A Saudi Arabian study revealed that only 14% of primary healthcare centers received feedback from higher levels. [16] Feedback is mandatory to monitor the performance of IDSR. Also, it helps to alert health workers about the difficulties and obstacles of routine activities of disease surveillance at health facilities. Lack of feedback leads to an ineffective IDSR system, which hinders the prevention and control of infectious diseases. [13]

Support functions of IDSR system

The support functions of IDSR included supervision, training, coordination, logistics, and resources. In the present study, three quarters of health facilities did not receive supervisory visits from the higher level (75.9%), and the target of 80% was not met regarding this indicator. Most districts (75%) received supervision regularly from the higher level. When asked about performing supervision visits to the lower

levels, there were contradictory results, as all governorate managers and RRTs in the districts reported performing regular supervision (Table 4). Several studies revealed contrasting results to the current study. In North Ghana, most respondents stated that facilities had received supervisory visits (83.3%), but the visits were irregular. [18] One study in Kenya stated that the subnational level provided regular visits to 81% of facilities. [12] A study in Zanzibar, Tanzania, indicated that the majority of public and private health facilities had at least one supervision visit by the district level in the previous 6 months, while only 40% of districts received supervision by the national level. [14] About three quarters of health facilities (73%) and all districts had received supervisory visits from higher levels in Iraq, [17] while 81% of primary health care facilities received supervision in the previous 6 months in Jedda, Saudi Arabia.[16] Common attributes of irregular and insufficient supervision were highlighted in multiple studies. The reasons included having many responsibilities at the district, increased workload of the staff, shortage of staff, deficient funds, lack of transportation methods, and transportation difficulties. [12, 14, 23] In the current study, almost all levels agreed that IDSR activities were reviewed by supervisors during the visits (Table 4). This disagrees with a study conducted in Sudan that showed that the review of the surveillance system activities during the supervisory visit was 28.6 at the locality level and 15.8 at the health area level. [10] A study in Kenya revealed that 62% of respondents in facilities stated that activities of surveillance were reviewed at the community level in the latest supervision. [12]

As regards the training, the present study achieved the target of 80% of this indicator at all levels for initial training in the IDSR system and for post-basic training. However, 44% of focal persons in health facilities reported non-availability of well-trained staff, and the target of 80% was not achieved regarding this indicator (Table 4). Other studies reported lower results than the current study. A study conducted in Kenya showed that basic training on surveillance of diseases was received by 83% of respondents in facilities, while post-basic training was received by 20% of respondents. [12] A study in Congo demonstrated that the IDSR training was provided to focal point staff in 65% of health facilities. However, IDSR training was provided to 13% of staff at each facility. [22] A study conducted in Zambia indicated that 63.6% of the study participants at health facilities did not receive any training regarding IDSR guidelines in the past year. [20] A study on malaria surveillance in Yemen demonstrated that 71% of Early Disease Electronic Warning System (eDEWS) respondents were trained on malaria surveillance, while 68% of Integrated Malaria Surveillance System (IMSS) respondents were not trained.[15] Another study carried out in Yemen indicated similar results to the current study. At health facilities, training was provided to all focal persons on how to fill electronic forms on mobile or computer as part of data collection and entry of eDEWS. [8] In Iraq, one training course was at least provided to all staff at the districts, and 63.5% of staff at the health facilities were trained and received refresher training during the last year. [17] A study in Saudi Arabia revealed training of physicians and medical directors in 57% of primary healthcare centers in the previous 6 months.[16]

As regards the logistics, it was noted that there was a complete deficiency of a good program financing system, a deficiency of appropriate transportation methods, and a complete absence of recommended health education materials at all levels (Table 4). These deficiencies explain the ineffectiveness in the performance of IDSR in certain activities. Poor performance of health facilities regarding case confirmation function was because of difficulties faced during transportation of specimens to laboratories. Furthermore, health facilities lacked equipment, containers to collect and save specimens, and culture media needed to diagnose diseases. Delayed epidemic response of health facilities after 48 hours of the most recent outbreaks and irregular supervision from higher levels can be partly attributed to road difficulties and poor transportation methods. Moreover, poor performance of the IDSR system in epidemic preparedness was mainly because of the poor and inadequate budget and lack of funds to support the activities, supply the needed drugs, and restock emergency medicines and supplies, and lack of the funds needed to plan and apply public health measures in case of epidemics. In addition, epidemic preparedness and response were hindered by the absence of health education material on epidemic-prone diseases. Inadequate funding and deficient resources of the IDSR system were reported in several studies.[11, 12,17,18, 25]

A well-functioning communication method was almost completely available at all levels. (Table 4). However, the results showed that reporting was done through a specific electronic application on mobile, which is the only efficient communication method (Table 2). Nearly all health workers mentioned that coordination of IDSR is adequate (Table 4). This disagrees with a study conducted in Zambia that showed that half of participants (52%) stated the presence of inadequate coordination and communication between all levels of the IDSR system. [20] Coordination committees' reports were present in 40% of districts and 17% of facilities in one Indian study.[23] The present study showed that the majority of focal persons at the health facility level stated that the IDSR system is too simple (91.5%) (Table 4). This

was similar to a study conducted in Zambia.[20] All levels of the IDSR system agreed that the system is useful. A study conducted in Zambia reported that less than half of respondents (45.5%) stated that the system is helpful in surveillance and planning activities. [20]

As regards resources, non-availability of enough staff was obvious at all levels, and the recommended 80% target was not achieved. Furthermore, the target of 80% of the indicator of staff motivation was not met, and most working staff at all levels were not motivated (Table 4). Lack of motivation can be attributed to deficiency of incentives, shortage of staff, and difficulty in using the system (Table 4). This is similar to a study conducted in Ghana that showed inadequate staff for surveillance. [18] A study carried out in Saudi Arabia reported that 66% of key informants at primary healthcare centers were not satisfied with the surveillance system. [16] A study conducted in India revealed that transfer of staff and turnover may lead to vacant positions that affect the progress of IDRS system. [23] Challenges in the revitalized program of the IDSR in Uganda were insufficient number and high turnover rate of trained health workers. [25]

The results of the current study revealed that motorcycles were not available at all levels except for two managers at the governorate level. This disagrees with a study conducted in Ethiopia that showed 29% of respondents having motorcycles and cars and 93% having bicycles. [21] Also, a study in Eastern Ghana revealed that over half of health workers had methods of transportation to carry out surveillance activities. [13] It was found in a Saudi Arabian study that none of the primary healthcare centers had a vehicle. [16] The current study showed that the computers, printers, and calculators were not available at the health facility and district levels. This disagrees with a study conducted in Ethiopia that showed that 29% of health facilities had computers and printers. [21] In Saudi Arabia, printers and computers were provided in all primary healthcare centers. [16] A study in Kenya found that 69% of facilities had calculators, 40% of facilities had computers, 25% of facilities had printers, and 23% of facilities had photocopiers.[12]

Limitation of the study

A limitation of this study is the evaluation of the IDSR system in only one governorate, which is Thamar governorate. It is recommended to evaluate the IDSR system at the national level and include all governorates in further research.

CONCLUSION AND RECOMMENDATIONS

The IDSR system in Thamar demonstrated unacceptable performance in all the core activities and support functions at the health facility level. Moreover, the epidemic preparedness and support functions of the IDSR at all levels exerted unacceptable performance, especially in districts and health facilities.

Strengthening the IDSR system in the Thamar Governorate is required. It is recommended that the functions of the system be monitored and evaluated regularly to assess deficiencies and drawbacks. Understanding the challenges of different functions will help to strengthen and improve the system. To strengthen core functions, it is recommended to provide an IDSR surveillance manual that includes case definitions for all health workers at all levels of the system. Focusing on health facilities is an appropriate way to improve system performance. Transportation methods should be readily available to facilitate the transportation of specimens to higher levels to confirm the diagnosis. All epidemic preparedness and response activities should be enhanced. A complete copy of reports and notifications should be kept in good condition. Data analysis activities should be conducted at the health facility level. The IDSR system in Thamar also needs to strengthen its support functions. It is suggested to allocate an adequate number of well-trained and motivated staff, assign a sufficient budget, and establish funding sources for the system. Deficiencies in IDSR reporting forms, drugs, and equipment must be addressed.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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