ACQUAINT PUBLICATIONS
Journal of Community Medicine and Public Health Reports ISSN: 2692-9899
Research Article Volume 3 Issue 04

Evaluation of Surveillance and Response System of Healthcare-Associated Infections and Outbreaks, Regional Level, Saudi Arabia, 2019

Jaber Sharaheeli[1], Bader Alibrahim[1*], Ghada Mohammed BinSaleh[2], Eman Elsayed Abd-Ellatif[3]

[1]Epidemiology and Public Health, Field Epidemiology Training Program, Riyadh, SAU

[2]General directorate of infection prevention and control / Ministry of health

[3]Department of Public Health and community medicine, Faculty of Medicine, Mansoura University, Egypt.

[*]**Corresponding Author:** Bader Alibrahim, Epidemiology and Public Health, Field Epidemiology Training Program, Riyadh, SAU

Received date: 31 May 2022; **Accepted date:** 14 June 2022; **Published date:** 21 June 2022

Citation: Sharaheeli J, Alibrahim B, BinSaleh GH, Abd-Ellatif EE (2022) Evaluation of Surveillance and Response System of Healthcare-Associated Infections and Outbreaks, Regional Level, Saudi Arabia, 2019. J Comm Med and Pub Health Rep 3(04): https://doi.org/10.38207/JCMPHR/2022/JUL03040453

Abstract

Background: HAI is a disease occurred due to healthcare and is associated with a great deal of morbidity, mortality, and increased financial burden.

Objective: To assess the capacity of surveillance and response systems of HAIs and HAIOs in regions in Saudi Arabia.

Methodology: A cross-sectional study was conducted at the regional level in Saudi Arabia. The WHO model for surveillance questionnaire was modified and filled from the regional level.

Results: 78.57 % of regions had surveillance manuals. Only 24.4 % of reports were sent. 54.54 % of the outbreaks were reported, and 63.64 % were investigated. Half of the regions did not have a budget or funds. Half of the areas had a shortage in the staff. The main level visited only 35.7 % of the regions.

Conclusion: The surveillance system at the regional level needs improvement in its core and support functions.

Introduction

Surveillance is an ongoing, systematic process of data collection, analysis, interpretation, and dissemination for action. **[1]**

Surveillance is essential in infection prevention and control programs in healthcare facilities to protect the patient and the healthcare worker, visitors, and others in a timely, efficient, and cost-effective manner whenever possible. **[2,3]**

Surveillance can be either passive or active. Passive management depends on health care providers, although the problems are mainly identified by those other than infection control professionals using data generated in the ordinary course of patient care. It is the least desirable approach in healthcare-associated infections (HAIs). **[4]**

Although many diseases are notifiable, compliance is often poor. Active surveillance means that underreporting is a significant drawback for data analysis and interpretation.

Outbreaks are unique events that need urgent investigations andpublic health interventions. Outbreaks investigations improve the knowledge of the natural history of diseases, pathogens, the vehicles of illness, and the standard or novel errors that contribute to outbreaks. Finally, outbreaks involving fewer common microorganisms or those with more extended incubation periods are less likely to be confirmed, whereas pathogens that usually cause mild illness will be underrepresented. Outbreak reports are frequently deficient because of late notification, unavailability of clinical specimens, unsuitability of laboratories or methods to detect and identify the pathogen, insufficient resources, and trained staff to conduct investigations, lack of cooperation between the different disciplines, or failure of investigators to write the final report. **[5]**

Saudi Arabia's ministry of health developed manuals for surveillance and preventive measures of healthcare-associated infection and communicable diseases. **[6,7]** (Appendices 1,2).

Healthcare-associated infection is defined as an infection acquired in a healthcare facility by a patient who was admitted for a reason other than that infection, and it was not present or incubating at the time of admission and appearing before or after discharge, including occupational infections among the staff of the facility. **[8,9]**

Healthcare-associated infections can occur within 48 hours of hospital admission, 3 days of discharge, or 30 days of an operation.**[10]**

One to 10 patients admitted to the hospital experienced HAIs. HAIs are associated with a great deal of morbidity, mortality, and increased financial burden. **[10]**

Research question:

Are the surveillance and response systems of HAIs and HAIOs at the regional level able to perform their core and support functions?

Hypothesis:

The surveillance and response systems of HAIs and HAIOs in the regions are not effective, not sensitive, inconsistent, and not timely systems.

Goal:

To have robust and standardized surveillance and response systems of HAIs and HAIOs in the regions.

Objectives:

General objective:

To assess the capacity of surveillance and response systems of HAIs and HAIOs, in the regions, in Saudi Arabia.

Specific objectives:

- To employ standardized assessment tools to obtain information about the capabilities (in terms of core and supportfunctions) of surveillance and response systems of HAIs and HAIOs at the regional level.
- Identify weaknesses (absence of core and support functions) in the regions' surveillance and response systems of HAIs and HAIOs**.**
- To develop an action plan to strengthen the capacity of surveillance and response systems of HAIs and HAIOs at the regional level based on the assessment findings.

Methodology:

Study design: A cross-sectional study.

Study population: Infection control coordinators in health directorates in Saudi Arabia.

Sample calculation:

The study covered all populations after applying inclusion and exclusion criteria.

No statistical tests were needed to calculate sample size (n) because of the small number available.

Inclusion Criteria:

The questionnaire was filled out by someone who has worked for at least a year and above. Language, gender, and nationality were not barriers in the study.

Exclusion Criteria: Anyone working for less than a year was omitted because he may not have received formal training.

Data collection:

Self-administered questionnaires were the techniques to collect data. The principal investigator explained the questions to the participants when needed via a telephone call. The questionnaires were administered in English by email to the coordinators. These tools are based on the Protocol for the Assessment of National Communicable Disease Surveillance and Response Systems, which was developed for WHO. The protocol was recommended by whom to help the national teams in their evaluation of surveillance and response systems for communicable diseases, including HAIs. **[11]**

The WHO designed three levels of generic questionnaires: central, district (intermediate), and health facility (service). This study used only a regional-level questionnaire—the WHO-designed questionnaires and observational lists. No observational assessment was carried out. The questionnaire was modified according to the local setting in the forms of systems used in Saudi Arabia.

The performance indicators and metrics used in the tools are suitable for an infection control program in Saudi Arabia. These indicators are selected based on their importance and feasibility of implementation. They include metrics for epidemiology, laboratory, and environmental health. Metrics are measurements used to estimate performance indicators. For example, if the objective is HAIO detection, one of the performance indicators regarding this objective is the reported cases, and two of the metrics used here are completeness, i.e., the percentage of patients with complete data andtimeliness.

Each tool will focus on the program functions, both core and support functions. The core functions of the surveillance systems are case detection, case registration, case confirmation, reporting, data analysis and interpretation, epidemic preparedness, response and control, and feedback. The supporting functions of the surveillance systems are standards and guidelines, training, supervision, communication facilities, resources, monitoring and evaluation, and coordination. **[12]**

The research comprised a regional infection control directorate.

Analysis plan:

A simple calculator was used because it was a descriptive analysis. The data was analyzed to respond to the objectives of the study. Frequency of different explanatory variables, such as the availability forms, priority list of HAIs and standard case definition, etc. was estimated to know their percentages to find out the gaps and the opportunities in our surveillance and response systems of HAIs and HAIOs.

The investigator concentrated on both HAIs and HAIOs. The answer options were "present" and "absent."

Ethical concerns:

1- No ethical approval was taken because the study was to evaluate the system with minimal risk to participants.

2- The verbal consent was taken from health authorities and the participants after a summary of the study.

3- No incentives or rewards were given to the participants.

4- There are no conflicts of interest.

5- Participants' anonymity and autonomy were respected, and the principal investigator only was responsible for the content, and the participants were not included in the report.

6- The purpose of collecting information is to improve the surveillance of HAIs through scientific recommendations.

Budget:

No budget from MOH or any institution because they have complicated procedures and difficulty giving support. No other external fund. The study is self-funding.

Results

Regional level:

Identifiers:

Among 20 health directorates, 14 have completed the questionnaire and submitted it through email, with a response rate of 70 %. Six (30 %) health directorates did not finish till the moment of writing the result despite continuous contact by the principal investigator.

Indicator; availability of national surveillance manual:

11 health directorates (78.57 %) said that there is a national manual for surveillance and response systems of single HAIs, while two (14.29 %) said "no" and one (7.14 %) did not know.

10 health directorates (71.43 %) said that there is a national manual for surveillance and response systems of HAIOs, while 1 (21.43 %) said "no" and one (7.14 %) did not know.

Case confirmation indicator:

13 health directorates (92.86 %) reported that there is a capacity to transport specimens to a higher level laboratory, while 1 (7.14 %) said "no."

12 health directorates (85.71 %) reported that there are guidelines for specimen collection, handling, and transportation to the next level, while two (14.29 %) said "no."

Registration indicator:

Thirteen health directorates (92.86 %) admitted that there is a surveillance register for single HAIs, while one (7.14 %) admitted "no." Six health directorates (42.86 %) participants acknowledged that the type of register is electronic only, and the same percent admitted the presence of both manual and electronic, but one (7.14 %) admitted that there are manual registers only.

11 health directorates (78.57 %) admitted that there is a surveillance register for HAIOs. Four coordinators (28.57 %) revealed that the register type is electronic only, and the same admitted that the only manual record is available. There are manual and electronic registers in three regions (21.43 %).

10 coordinators (71.43 %) mentioned that they checked the logbook daily, while one (7.14 %) cited "no," aand three (21.43 %) said sometimes. **(Table 1)**

Table 1: Evaluation of surveillance and response systems of HAIs and HAIOs in KSA, 2019, registration at the regional level. (N=14)

Indicator: registration	Response	Frequency	Percentage %
Presence of a surveillance register for single HAIs.	Yes	13	92.86
	No	1	7.14
Type of register for single HAIs.	**Manual**	**1**	**7.14**
	Electronic only	**6**	**42.86**
	Both	**6**	**42.86**
Presence of a surveillance register for HAIOs.	Yes	11	78.57
	No	3	21.43
Type of register for HAIOs.	**Manual**	**4**	**28.57**
	Electronic only	**4**	**28.57**
	Both	**3**	**21.43**
The presence of a surveillance register is checked daily.	Yes	10	71.43
	No	1	7.14
	Sometimes	3	21.43

Data reporting indicator:

12 coordinators (85.71 %) admitted that there was no shortage in the surveillance forms for HAIOs during the past six months, while one (7.14 %) admitted “no” and one did not know.

12 regions (85.71 %) admitted that there was a reporting from part to the ministry by Email: five areas (35.71 %) by telephone and six regions (42.86 %) using HESN and WhatsApp.

Nine regions (64.29 %) admitted that both HAIs and outbreaks are reported to the ministry, while three areas (21.43 %) revealed that only HAIOs and two regions (14.29) are saying.

11 regions (78.57 %) admitted that there are 24-hours reporting times to the ministry of single cases and outbreaks, while three areas (21.43 %) revealed monthly reports for both.

The expected number of monthly reports by the participated 14 regions during the past year is 168, including zero reports (one per region per month). There were 41 monthly reports produced last year from areas out of 168 (24.4 %); six were outbreaks reports. Six (42.86 %) parts only sent messages last year. Three areas (50 %) admitted that the number of monthly reports, including zero reporting to the ministry in the last year, was 36 (100 %); one was about an outbreak, that is, 12 reports per region compared to the expected number. Two (33 %) admitted that only one (8.3 %) monthly report was sent to the ministry, one zero and one an outbreak report. One region (17 %) sent three monthly reports only out of 12 (25 %), all reports were outbreaks reports. All 41 words by six regions (100 %) had on-time reports **(Table 2)**

Table 2: Evaluation of surveillance and response systems of HAIs and HAIOs in KSA, 2019, data reporting at the regional level. (N=14)

Indicator: data reporting	**Response**	**Frequency**	**Percentage %**
Presence of deficiency* of appropriate surveillance forms recommended by MoH for HAIOs at any time during the last 6 months.	Yes	1	7.14
	No	12	85.71
	Do not know	1	7.14
Presence of the reporting to ministry.	**Yes**	**13**	**92.86**
	No	**1**	**7.14**
How to report to the ministry.	Telephone	5	35.71
	Email	12	85.71
	Other (specify)	6	42.86
The events to report.	**HAIOs**	**3**	**21.43**
	HAIs	**2**	**14.29**
	Both	**9**	**64.29**
The deadlines for reporting to the ministry.**	24-hours	11	78.57
	One month	3	21.43
	Other (specify)	1	7.14
Number of monthly reports in the last year compared to expected number from region to MoH.*	**12/12 (100 %)**	**3**	**50**
	3/12 (25 %)	**1**	**17**
	1/12 (8.3 %)	**2**	**33**
Number of monthly reports on time in the last year compared to expected number from regions to MoH.	41/41 (100 %)	6	50

***Response is for number of reports while frequency is for number of regions and calculation is from region sent reports.

* Presence of deficiency of forms means not available.

**One region said that there is also weekly reporting. One region said that, reporting for HAIOs is within 24 hours and there is a monthly reporting for surveillance. Three regions admitted that no monthly report. Data is unavailable in four regions.

Data analysis indicator:

12 regions (85.71 %) reported that there is an analysis of HAIs and HAIOs data by the person (gender and age), but two areas (14.29 %) said “no.”

13 regions (92.86 %) reported that there is an analysis of HAIs and HAIOs data by time and place, but one part (7.14 %) said “no.”

10 regions (71.43 %) reported that there is an analysis of HAIs and HAIOs data by causes, but three areas (21.43 %) said “no.” One region (7.14 %) said only partial analysis of causes.

Eight regions (57.14 %) reported that there is an analysis of HAIs and HAIOs data by vehicles, but five areas (35.71 %) said “no.” One coordinator (7.14 %) does not know.

Nine regions (64.29 %) reported that there is an analysis of HAIs and HAIOs data by contributing factors, but four areas (28.57 %) said “no.” One province (7.14 %) said only partial analysis of contributing factors.

12 regions (85.71 %) reported that there is an analysis of HAIs and HAIOs data by trends, but two areas (14.29 %) said “no.”

HAIR investigation indicator:

Nine directorates (64.29 %) reported 11 HAIOs in the last year. Six (54.54 %) of them were written. Seven (63.64 %) outbreaks were thoroughly investigated by five regions (35.71 %) with the identified risk factors and causative agents.

HAIR preparedness and response indicator:

12 directorates (85.71 %) mentioned that there is a written plan of HAIO preparedness and response, while two (14.29 %) said “no.”

Six directorates (42.86 %) mentioned that there are emergency stocks of drugs and supplies at all times in the past year, while four (28.57%) said “no” and four (28.57) do not know.

12 directorates (85.71 %) mentioned that there is a standard case management protocol for HAIOs, while one (7.14 %) said "no" and one (7.14 %) did not know.

Seven directorates (50 %) mentioned that there is no budget or access to funds for HAIO, while three directorates (21.43 %) said that there is a budget line or access to funds for HAIO response, while 4 (28.57 %) mentioned that "do not know."

Five directorates (35.71 %) admitted that there are indicators like the number of HAIOs as a region priority to take emergency action, while five (35.71 %) mentioned "no" and three (21.43 %) do not know.

All 14 directorates (100 %) mentioned rapid communication and coordination with all stakeholders during HAIOs.

13 coordinators (92.86 %) mentioned that they know all regional stakeholders.

11 coordinators (78.57 %) mentioned that the stakeholders implement preventive and control measures, while two (14.29 %) said "no" and one (7.14 %) did not know.

Eight coordinators (57.14 %) mentioned that the stakeholders did hold meetings the past year to evaluate their outbreak preparedness, while five (35.71%) said "no," and one (7.14 %) did not know. **(Table 3)**

Table 3: Evaluation of surveillance and response systems of HAIs and HAIOs in KSA, 2019, HAIO preparedness and response at the regional level. (N=14)

Indicator: HAIO preparedness and response	Response	Frequency	Percentage %
Presence of a written plan of HAIO preparedness and response.	Yes	12	85.71
	No	2	14.29
Presence of emergency stocks of drugs and supplies at all times in past year.	**Yes**	**6**	**42.86**
	No	**4**	**28.57**
	Do not know	**4**	**28.57**
Presence of a standard case management protocol for HAIOs.	Yes	12	85.71
	No	1	7.14
	Do not know	1	7.14
Presence of a budget line or access to funds for HAIO response.	**Yes**	**3**	**21.43**
	No	**7**	**50**
	Do not know	**4**	**28.57**
Presence of indicators like number of HAIOs as a region priority to take an emergency action.*	Yes	5	35.71
	No	5	35.71
	Do not know	3	21.43
Presence of a rapid communication and coordination with all stakeholders during HAIOs.	**Yes**	**14**	**100**
Do you know all stakeholders (if any committee) members in the region?*	Yes	13	92.86
Do stakeholders (if any committee) implement preventive and control measures?	**Yes**	**11**	**78.57**
	No	**2**	**14.29**
	Do not know	**1**	**7.14**
Did stakeholders (if any committee) hold meetings past year to evaluate their outbreak preparedness?	Yes	8	57.14
	No	5	35.71
	Do not know	1	7.14

* No data available for one region.

Feedback indicator:

12 regions (85.71 %) reported that 28 feedbacks were produced in the last year to the ministry, and six were received from it.

Supervision and training indicator:

Five coordinators (35.71 %) admitted that the ministerial team did visit the regions in the past year, while six (42.86 %) admitted no visits and two (12.29 %) did not know.

12 coordinators (85.71 %) admitted that the regional team did visit the lower levels (service levels, i.e., hospitals) in the past year, while one (7.14 %) admitted "no."

13 coordinators (92.86 %) admitted that they had been trained in surveillance and response systems of HAIOs. One region realized there was training in the outbreak but no training in the management.

11 coordinators (78.57 %) admitted that they had trained the lower levels in surveillance and response systems of HAIOs, while 2 (14.29 %) admitted "no." **(Table 4)**

Table 4: Evaluation of surveillance and response systems of HAIs and HAIOs in KSA, 2019, supervision and training at the regional level. (N=14)

Indicator: supervision and training	Response	Frequency	Percentage %
The ministerial infection control team visits to the region in the past year. *	Yes	5	35.71
	No	6	42.86
	Do not know	2	14.29
The regional team visits to the lower levels in the past year. *	Yes	12	85.71
	No	1	7.14
Have you been trained in surveillance and response systems of HAIOs? *	Yes	13	92.86
Have you trained the lower levels in surveillance and response systems of HAIOs? *	Yes	11	78.57
	No	2	14.29

* No data available in one region.

Resources indicator:

For data management resources in the regional infection control department; there are computers as reported by 11 (78.57 %) coordinators, printers as reported by eight (57.14 %) coordinators, photocopiers as reported by seven (50 %) coordinators, and data management as written by one (7.14 %) coordinator.

The department also has communication resources; telephone as reported by 12 (85.71 %) coordinators, fax as reported by two (14.29 %) coordinators, and Email as written by 13 (92.86 %) coordinators. For transportation, the department has a car, as reported by eight (57.14 %) coordinators, while four (28.57 %) coordinators said "no," and one (7.14 %) coordinator does not know.

The staff is enough to cover the program duties, as reported by 5 (35.71 %) coordinators, while not enough, as written by seven (50 %) and one (7.14 %) coordinator does not know.

Cooperation and coordination indicator:

12 regions (85.71 %) admitted that there is surveillance cooperation and coordination body at the regional level, while one (7.14 %) admitted "no."

Seven regions (50 %) were satisfied with the surveillance system, while seven (28.57 %) were not, and one (7.14 %) said does not know.

Discussion

General Directorate of Infection Prevention and Control (GDPIC) developed its manuals demonstrating healthcare-associated infection surveillance and outbreak investigation guidelines. These manuals were produced and distributed with the permission of MOH.

HAI can be broadly defined as HAI if it was not present or incubating when the patient was admitted to the hospital. Thus, HAI has not considered if it represents a complication or extension of an infectious process present on admission. It should occur more than 48 to 72 hours after entry and within 10 days after hospital discharge. The time frame is modified for infections with incubation periods shorter than 48 to 72 hours (e.g., gastroenteritis caused by Norwalk virus) or longer than 10 days (e.g., hepatitis A). Surgical-site HAIs are considered if the infection occurs 30 days after the operative procedure or if a device or foreign material is implanted within one year. HAI should be regarded as nosocomial if related to techniques, treatments, or other events that occur immediately after the patient is admitted to the hospital. **[13]**

For example, bloodstream infections associated with central venous catheters, pneumonia associated with mechanical ventilation, or UTIs associated with urethral catheterization should be considered HAIs, even if the onset of the disease occurs within the first 72 hours of hospitalization.

The study targeted the regional level, consisting of 20 health regions. The data were collected through email only, so the observation part of the evaluation is unavailable, negatively affecting the evaluation process. Representativeness of the surveillance system can appear here because both central and regional levels are involved.

14 regions participated in the study with a response rate of 70 %. This response rate is acceptable as long as it is above 60 %, as noted in the Canadian Medical Association journal's editorial policy. **[14]**

There is no complete consensus about the acceptable response rate of cross-sectional studies like in surveys, although some agencies ask for a response rate equal to or over 75 %. **[15,16]**

A response rate of over 50 % is considered adequate. **[17,18]**

In the current study, 70 % response rate was accepted.

Even among the participants, some data were incomplete, which affected the validity and quality of the study.

In the regional infection control department, 78.57 % of participants admitted that there is a national manual for surveillance and response systems for HAIs and HAIOs. One coordinator sent the manual by email, which proved its existence. The differences in answers can be attributed to a lack of information or misunderstanding. The manual was updated in 2017 for HAIs surveillance and in 2018 for HAIOs. The surveillance manual has a list of priority diseases, including

CLABSI (Central Line-Associated Blood Stream Infection), CAUTI (Catheter-Associated Urinary Tract Infection), VAP (Ventilator-Associated Pneumonia), and SSI (Surgical Site Infection).

The case definition was available for all diseases on the list. Regarding HAIO manual, the priority was given to MDRO (Multiple Drug Resistance Organisms), clostridium difficile, legionellosis, water-borne outbreaks, food-borne outbreaks, and Candida Auris. The outbreak definition for the above list was available. Also, there are special surveillance and outbreak guidelines for MERS-CoV. The past information was mentioned by a few regions, such as the eastern and Malouf regions. The presence of manuals with lists of priority diseases and their case definitions can enhance different attributes of the public health surveillance system. Acceptability attributes can be high when such guidelines are available. Also, case definitions can increase sensitivity, predictive value positive, and quality of surveillance data as well as the detection of cases and outbreaks and timeliness of reporting and response to epidemics. The presence of a priority diseases list can refer to the surveillance system's representativeness of health events under surveillance. **[19]**

The response rate can refer to some extent to a low acceptability rate. **[20]**

Regarding the case confirmation indicator, 92.86 % of the regional level admitted that there is a capacity to transport specimens to a higher level laboratory, and there are guidelines for specimen collection, handling, and transportation to the next level, as reported by 85.71 % of participants. Those high percentages in confirmation indicators besides the case definitions indicate that sensitivity and predictive value positive attributes were exceptionally accomplished. Laboratory data are essential in quality attributes because of their completeness and accuracy.

92.86 % of the study participants admitted a surveillance register for HAIs, and 78.57 % said there is a register for HAIOs. 42.86 % said there are both manual and electronic registers for single HAIs, and 21 % mentioned both manual and electronic records.

71.43 % of participants admitted that they check the registers daily. This will positively increase the sensitivity and predictive value, enhancing the detection process of HAIs and their outbreaks.

A surveillance register is a powerful tool to collect and store data that can monitor disease trends, including healthcare-associated diseases. The data help to provide information on incidence rates, remission, exacerbation, prevalence, and survival. It is also often used in data collection on risk factors and prevention programs, diagnosis, treatment approaches, and mortality. **[21]**

Registration also reflects the data quality and validity.

Surveillance forms are available all the time during the last year as admitted by 85.71 %. The mid-level receives regional surveillance reports through different means, mainly HESN and email. 64.29 % of regions reported both single HAI cases and outbreaks.

The 14 regions should have sent at least one monthly report, including zero notices, i.e., the expected number is 168 reports per year. Only six (42.86 %) regions sent messages. All six areas (100) admitted on-time reports. There were 41 monthly reports produced last year from regions out of 168 (24.4 %). This is a superficial reporting level, and it indicates the failure of the reporting system and the underestimation of zero reporting.

A monthly report from regions to MoH admitted by 21.43 %, but the majority of areas, 78.57 %, revealed that the reporting deadline is 24 hours. Among those with monthly reporting, only three regions, 21.43 %, have sent the reports by 100 %. Among 41 pieces, six (14.63 %) were for outbreaks, while 35 (85.37 %) were for zero reporting. Among 11 attacks that took place in 2019, only six (54.54 %) were reported. Even the outbreaks reporting system had significant defects as long as half of them were not reported.

The inconsistency in data may indicate a problem in the accuracy of reporting and reporting time. It may mean misunderstanding. Lack of understanding may be due to the language barrier. Removing the language barrier increases access to healthcare, promotes higher quality and safe care, improves patient satisfaction, enhances appropriate utilization of healthcare resources, and increases preventive health activities. **[22,23,24]**

There is also impairment in timelines characteristic of monthly reporting. Consequently, there might be an iceberg phenomenon at the service level due to underreporting process and lack of timeliness. Timely reporting is a significant measure of the performance of public health surveillance systems. It is known that the timeliness depends on disease nature (e.g., rapid onset and brief course), the purpose of use of the data, and the public health system level. Even in developed countries with high public health system levels like the USA, timelines lag. **[25]**

Rapid access to electronic representations of health events (e.g., laboratory reports, patient records, or health care claims) provides excellent opportunities for more timely and complete surveillance. Availability of simple forms, guidelines, and posters showing reporting system and designation of surveillance focal person can improve timely reports substantially. **[26,27]**

In most regions, 85-90 % have data analysis by time, place, person (age and gender), and trend, but 57-71 % said there is data analysis for causes, vehicles, and contributing factors. This means that although there is good data analysis at the regional level, improvement is required. This core function (data analysis) indicates that the representativeness characteristic is present, which helps in the detection of outbreaks if the event is above the expected level. **[19]**

Only 63.64 % of the HAIOs were thoroughly investigated with the identified risk factors and causative agents. The findings of those investigated outbreaks were used to improve the outbreak investigation. This finding indicates a significant defect in the investigating process.

As scientifically known, three types of investigation must be conducted: epidemiological, laboratory, and environmental. **[28]**

In most regions, 85.71 % had a written plan of HAIOs preparedness and response and case management protocol. This indicator reflects a high level of readiness.

Only 42.86 % of coordinators mentioned that there are emergency stocks of drugs. This means that about 60 % of regions do not have emergency stocks of medicines, which is a severe problem in case of an outbreak.

There is a significant problem in a budget line or access to funds. Because half of the regions do not have a budget. Also, meetings with stakeholders are only held in 50 % of areas. Those gaps in preparedness and response indicator question the written plan and protocol and their contents and advantages. Also, they asked about the outputs of meetings to review and evaluate the preparedness and response plan.

Two-thirds of regions admitted that there are no indicators like the number of HAIOs as a region priority to take emergency action. This ambiguity mandates a regulation about such hands.

The communication and coordination with stakeholders were very high, up to 100 %. This is an excellent indicator to know all stakeholders and rapidly contact them. The implementation of preventive and control measures was reported by 78.57 %, which is fair but needs more improvement.

85.71 % of the regions produced feedback in the last year to the ministry, but only 42.86 % of parts received input from the church. The defect here is in the mid-level, but there is a need to evaluate this level to ensure data reliability.

There might have been confusion between feedback and outbreak investigation reports.

Feedbacks represent one of the primary components of the surveillance system (dissemination).

Feedbacks play a crucial role in improving the practice. They are essential in maintaining a spirit of collaboration among the public health and medical communities and improving reporting to the surveillance system. Making the health departments accessible at all times to receive reports and provide consultation and maintaining current directories of persons for dissemination of surveillance data, alerts, and recommendations will ease the achievement of core activities of surveillance systems, namely data collection, analysis, and dissemination of information about health events under surveillance. **[26,29]**

The ministerial surveillance team did visits to 35.71 % of the regions in the past year, which is lower than the visits of the regional surveillance team to the service level (hospitals). 87.71 % of the areas carried out at least one hospital visit during the past year. These mandates intensifying the central team visits to regions at least once yearly. 92.86 % of parts received training in the main level's surveillance and response systems of HAIs and outbreaks. 78.57 % of areas have carried out training courses for the lower classes. One region did not receive training in surveillance. The training indicator accomplished high levels of activity but needs slight improvement to cover all areas and all hospitals and both surveillance and outbreak training.

Regarding resources indicator, the regional level has good communication and data management. The main problem is a shortage of staff to cover program duties and transportation. Half of the regions did not have enough staff or vehicles during the outbreak investigation. This leads to a late response to outbreak events. It also minimizes the efficiency of regional teams in facing their duties. It also reduces the acceptability of the surveillance system. Availability of resources and diagnostic and therapeutic services might be effective incentives that healthcare providers need. **[26]**

More than 85 % of the regions have good collaboration and coordination with central and service levels regarding cooperation and coordination. One of the striking features is that only 50 % of regional coordinators are satisfied with the surveillance system. Satisfaction is an essential characteristic of the surveillance system because it reflects its acceptability and performance among all system functions.

From the discussion, it is clear that the study results answered the research question that the surveillance and response systems of HAIs and HAIOs in regions are functioning but not ideally. Hence they need support and improvement.

The results could not reject the research hypothesis that the surveillance and response systems of HAIs and HAIOs in the regions are ineffective, not sensitive, inconsistent, and not timely. There are significant defects in core and support functions at the regional level. **(Tables 5A and 5B)**

Table 5A: Evaluation of surveillance and response systems of HAIs and HAIOs in KSA, 2019, core functions indicators at the regional level. (N=14)

Indicators: case detection	**Response**	**Percentage %**
Presence of a national manual for surveillance and response systems of single HAIs.	Yes	78.57
	No, Do not know	21.43
Presence of a national manual for surveillance and response systems of HAIOs?	Yes	71.43
	No, Do not know	28.57
Indicator: case confirmation		
Presence of the capacity to transport specimens to a higher level lab.	Yes	92.86
	No, Do not know	7.14

Presence of guidelines for specimen collection, handling and transportation to the next level.	Yes	85.71
	No, Do not know	14.29
Indicator: registration		
Presence of surveillance register for single HAIs.	Yes	92.86
	No, Do not know	7.14
Presence of surveillance register for HAIOs.	Yes	78.57
	No, Do not know	21.43
Presence of surveillance register checked daily.	Yes	71.43
	No, Sometimes	28.57
Indicator: data reporting		
Presence of deficiency* of appropriate surveillance forms recommended by MoH for HAIOs at any time during the last 6 months.	Yes	7.14
	No, Do not know	92.86
Presence of the reporting to ministry.	Yes	92.86
	No, Do not know	7.14
The events to report.	HAIOs only	21.43
	HAIs only	14.29
	Both	64.29
The deadlines for reporting to the ministry.	24-hours	78.57
	One month	21.43
	Others	7.14
Number of monthly reports in the last year compared to expected number from region to MoH.	24.4	
Number of monthly reports on time in the last year compared to expected number from region to MoH.	100	

* Presence of deficiency of forms means not available.

Table 5B: Evaluation of surveillance and response systems of HAIs and HAIOs in KSA, 2019, core functions indicators at the regional level. (N=14)

Indicator: data analysis	**Response**	**Percentage %**
Presence of data analysis for HAI and HAIOs by person (age and gender).	Yes	85.71
	No, Do not know	14.29
Presence of data analysis for HAI and HAIOs by time.	Yes	92.86
	No, Do not know	7.14
Presence of data analysis for HAI and HAIOs by place.	Yes	92.86
	No, Do not know	7.14
Presence of data analysis for causes of HAI and HAIOs.	Yes	71.43
	No, Do not know	21.43
Presence of data analysis for vehicles of HAI and HAIOs.	Yes	57.14
	No, Do not know	42.86
Presence of data analysis for contributing factors of HAI and HAIOs.	Yes	64.29
	No, Do not know	28.57
Presence of data analysis for the trends HAI and HAIOs.	Yes	85.71
	No, Do not know	14.29
Number of HAIOs in the past year.*	11	64.29
Of those HAIOs in the past year, percent investigated.*	7 (63.64%)	35.71
Of the investigated HAIOs in the past year, percent in which the risk factors were identified.	7(63.64%)	35.71
Of the investigated HAIOs in the past year, percent in which the causative agents were confirmed.	7 (63.64%)	35.71

Of the investigated outbreaks in the past 1 year, percent in which findings were used for action.	7 (63.65%)	35.71
Indicator: HAIO preparedness and response		
Presence of a written plan of HAIO preparedness and response.	Yes	85.71
	No, Do not know	14.29
Presence of emergency stocks of drugs and supplies at all times in past year.	Yes	42.86
	No, Do not know	57.14
Presence of a standard case management protocol for HAIOs.	Yes	85.71
	No, Do not know	14.29
Presence of a budget line or access to funds for HAIO response.	Yes	21.43
	No, Do not know	78.57
Presence of indicators like number of HAIOs as a region priority to take an emergency action.	Yes	35.71
	No, Do not know	57.14
Presence of a rapid communication and coordination with all stakeholders during HAIOs.	Yes	100
Do you know all stakeholders (if any committee) members in the region?	Yes	92.86
Do stakeholders (if any committee) implement preventive and control measures?	Yes	78.57
	No, Do not know	21.43
Did stakeholders (if any committee) hold meetings past year to evaluate their outbreak preparedness?	Yes	57.14
	No, Do not know	42.85
Indicator: feedback		
Number of feedbacks written reports has the region produced in the last year.	28	85.71
Number of feedback reports has the region received in the last year from ministry.	9	42.86

* Nine regions admitted the outbreak presence. Seven of them were investigated by five regions.

Limitation: Difficulty in carrying out an observational evaluation. No evaluation of the primary or service level could affect representativeness. There is difficulty in comparing our study with other studies.

Conclusion:

Regional level:

1- The surveillance and response systems of HAIs and HAIOs are working at the regional level.

2- Complete updated national surveillance manuals and priority lists existed for HAIs and HAIOs in infection control departments in regions. This will improve acceptability, sensitivity, positive predictive value, simplicity, flexibility, stability, and representativeness, leading to a high level of case detection and thence the investigation.

3- Data analysis and interpretation, epidemic preparedness, besides response and control, were acceptable. Data analysis reflects the representativeness of the surveillance system, which improves the monitoring of health events and detects any changes in trends, agent or host characteristics, and health services.

4- Feedback (dissemination) was impaired severely.

5- Underreporting is presented clearly in both zero reporting and outbreak reporting.

6- Registers for HAIOs were there, which enhanced detection.

7- No budget, unfortunately in high percentages of regions that undermines the preparedness and response process of outbreaks.

8- The excellent communication facilities maximize and speed up the response process to outbreaks.

9- Supervisory visits were markedly low.

Therefore

Core functions of surveillance and response systems of HAIs and HAIOs were not fulfilled entirely but were mainly present and needed improvement.

The supporting functions of the surveillance and response systems for HAIs and HAIOs were doing less than what is expected in KSA.

These indicators and others indicate that significant gaps in the surveillance and response systems of HAIs and HAIOs in Saudi Arabia (regional level) must be filled as soon as possible.

Recommendations:

1- Update the existing systems for surveillance and outbreaks in English and Arabic languages with the engagement of stakeholders.

2- Developing a unified definition of HAI and a list of priority infections based on the most prevalent organisms during the past 10 years.

3- Improvement of reporting system by simplifying the forms and using electronic systems and designate a surveillance focal person.

4- Availability of registers and development of HAIs database.

5- Bulletin establishment.

6- Provision of resources.

7- Intensified training and supervision.

8- Continue studies to assess central and service levels of surveillance and response systems.

Acknowledgment: The authors would like to thank everyone who helped during this study.

References

1. Thacker SB, Choi K, Brachman PS (1983) The Surveillance of Infectious Diseases. JAMA. 249(9): 1181-1185.
2. Scheckler WE, Brimhall D, Buck AS, Farr BM, Friedman C, et al. (1998) Requirements for infrastructure and essential activities of infection control and epidemiology in hospitals: a consensus panel report. Am J Infect Control. 26(1): 47-60.
3. Friedman C, Barnette M, Buck AS, Ham R, Harris J-A, et al. (1999) Requirements for infrastructure and essential activities of infection control and epidemiology in out-of-hospital settings: a consensus panel report. Am J Infect Control. 20(10): 695-705.
4. Peterson LR, Brossette ES (2002) Hunting Health Care-Associated Infections from the Clinical Microbiology Laboratory: Passive, Active, and Virtual Surveillance. J Clin Microbiol. 40(1): 1–4.
5. Guzewich JJ, Bryan FL, Todd ECD (1997) Surveillance of foodborne disease I. Purposes and types of surveillance systems and networks. Journal of Food Protection. 60(5): 555–566.
6. MOH, GDIPC. Healthcare-associated infections surveillance manual. 1st ed. 2017.
7. Mushkhis AA, Aiad ME. Surveillance and preventive measures guidelines of communicable diseases. WHO, EMRO, MOH, assistance deputy of preventive medicine. KSA; 2007.
8. Ducel G, Fabry y L. Nicolle (2002) Guide pratique pour la lutte contre l'infection hospitalière. WHO/BAC/79.1. As cited in (who. prevention of hospital-acquired infections: a practical guide. 2nd ed. World Health Organization, Geneva, Switzerland)
9. Benenson AS. Control of communicable diseases manual, 16th edition. Washington, American Public Health Association, 1995. As cited in (who. prevention of hospital-acquired infections: a practical guide. 2nd ed. World Health Organization, Geneva, Switzerland; 2002;)
10. Revelas A (2012) Healthcare - associated infections: A public health problem. Niger Med J. 53(2): 59–64.
11. World Health Organization (2001) Protocol for the Assessment of National Communicable Disease Surveillance and Response Systems. Generic questionnaires. World Health Organization, Geneva, Switzerland.
12. World Health Organization (2006) Communicable disease surveillance and response systems. Guide to monitoring and evaluating. World Health Organization, Geneva, Switzerland. WHO/CDS/EPR/LYO/2006.2
13. Pottinger JM, Herwaldt LA, Perl TM (1977) Basics of surveillance-an overview. Infect Control Hosp Epidemiol. 18(7): 513-527.
14. Huston P (1996) Reporting on surveys: information for authors and peer reviewers. Can Med Assoc J. 154(11): 1695–8.
15. Fowler FJ (2002) Survey Research Methods. 3rd ed. Thousand Oaks, CA: Sage Publications.
16. Bailey KD (1987) Methods of Social Research. 3rd ed. New York, NY: Free Press.
17. Schutt RK (1999) Investigating the Social World: The Process and Practice of Research. 2nd ed. Thousand Oaks, Calif: Pine Forge Press; 1999.
18. Babbie E (1990) Survey Research Methods. Belmont. Calif: Wadsworth.
19. World Health Organization (2006) Communicable disease surveillance and response systems. Guide to monitoring and evaluating. World Health Organization, Geneva, Switzerland. WHO/CDS/EPR/LYO/2006.2
20. CDC. Updated guidelines for evaluating public healthsurveillance systems. Morbidity Mortality Weekly Report 2001;50 (RR 13):1–35.
21. Institute of Medicine (US) Committee on a National Surveillance System for Cardiovascular and Select Chronic Diseases. A Nationwide Framework for Surveillance of Cardiovascular and Chronic Lung Diseases. Washington (DC): National Academies Press (US); 2011. 5, Existing Surveillance Data Sources and Systems.
22. Jacobs EA, Shepard DS, Suaya JA, Stone EL (2004) Overcoming language barriers in health care: costs and benefits of interpreter services. Am J Public Health. 94(5): 866–869.
23. Osae-Larbi JA (2016) Bridging the language barrier gap in the health of multicultural societies: report of a proposed mobile phone-based intervention using Ghana as an example. Springer plus. 5(1): 900.
24. Schyve PM (2007) Language differences as a barrier to quality and safety in health care: the Joint Commission perspective. Journal of General Internal Medicine. 22 Suppl 2(Suppl 2): 360–361.
25. Jajosky RA, Groseclose SL (2004) Evaluation of reporting timeliness of public health surveillance systems for infectious diseases. BMC Public Health. 4: 29.

26. Hopkins RS (2005) Design and operation of state and local infectious disease surveillance systems. J Public Health Management Practice. 11(3): 184-90.
27. Mwatondo AJ, Ng'ang'a Z, Maina C, Makayotto L, Mwangi M, et al. (2016) Factors associated with adequate weekly reporting for disease surveillance data among health facilities in Nairobi County, Kenya, 2013. Pan Afr Med J. 23: 165.
28. Viazis S, Beal JK, Monahan C, Lanier WA, Kreil KR, et al. (2015) Laboratory, Environmental, and Epidemiologic Investigation and Regulatory Enforcement Actions in Response to an Outbreak of Salmonella Bredeney Infections Linked to Peanut Butter. Open Forum Infect Dis. 2(3): of v114.
29. Wuhib T, Chorba TL, Davidiants V, Kenzie WRM, McNabb SJ (2002) Assessment of the infectious diseases surveillance system of the Republic of Armenia: an example of surveillance in the Republics of the former Soviet Union. BMC Public Health. 2: 3.