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Major Article

Coverage and methods of surveillance of healthcare-associated infections in Middle Eastern and North African countries

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A B S T R A C T

Background: Surveillance of healthcare-associated infections (HAIs) is a cornerstone for effective infection prevention and control (IPC) programs. The objective was to evaluate the coverage and methods of HAI surveillance in Middle Eastern and North African (MENA) countries.

Methods: A cross-sectional study targeted IPC staff working in MENA countries using the Infection Control Network electronic database of the Arab countries. The study focused on self-reported surveillance-related characteristics of IPC staff, facilities, and the IPC program.

Results: A total of 269 IPC staff were included. They were mainly females (68%), nurses (63%), and working in GCC countries (83%). Approximately 69% of covered facilities had surveillance activities. Hand hygiene, multidrug-resistant organisms, central line-associated bloodstream infections, and catheter-associated urinary tract infections were the most common surveillance activities (>90%). The surveillance workload consumed 27% of the average weekly working time. The scores of performing multiple surveillance, with appropriate methods and tools, were 83%, 67%, and 61% (respectively). Appropriate surveillance methods and/or tools were linked to GCC region, CBIC qualifications, surveillance training, specific setting (acute care and long term), staff-to-bed ratio, presence and active function of IPC committee, presence of IPC annual plan, communications with health care workers, and leadership support.

Conclusions: While most health care facilities in the MENA region perform multiple surveillance, surveillance methods and tools are still suboptimal and their optimization should be a priority.

Surveillance of healthcare-associated infections (HAIs) driven by risk-assessment is the cornerstone of effective infection prevention and control (IPC) programs.[1]. Surveillance is a standardized process of continuous data collection, management, analysis, and interpretation, followed by disseminating findings and recommendations to relevant stakeholders.[2] The later include health care providers and administrators who can positively impact the monitored infections and their preventive practices.[3] This reactive cycle of data collection and feedback to relevant health care providers effectively reduces HAIs.[4] Additionally, surveillance can assist in multiple IPC roles and responsibilities. These include setting baseline rates for HAIs, monitoring the impacts of new interventions, assessing the compliance

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with preventive measures, detecting hospital outbreaks, and tracking trends of infections.[5,6] However, the specific goals of the surveillance may vary depending on the local challenges of the IPC program, including professional and financial resources available.[6]

Modern HAI surveillance has its own standard definitions, methods and guidelines, as recommended by the US and European Centers for Disease Prevention and Control (CDC).[7-9] Several Western surveys assessed the IPC activities and resources, underscoring the effort- and time-consuming nature of surveillance.[10-13] Additionally, surveillance methods implemented were variable in different Western countries.[14] Some efforts were done to replicate the US surveillance model in selected hospitals in limited-resource countries.[15] Even though the fact that IPC set up and activities are improving in the Middle Eastern and North African (MENA) countries,[16,17] regional data focusing on surveillance activities are lacking. Additionally, it is unclear if surveillance quality matches the rapid expansion of surveillance activities in the region. The objective of the present study was to evaluate the coverage and methods of HAI surveillance in the MENA region.

METHODS

Study design

A cross-sectional study using an online questionnaire was conducted between January and April 2019. The study obtained all required ethical approvals.

Setting and population

The target population was IPC staff working in MENA countries. The AcicN electronic database (approximately 900 professionals at the time of the study) was the primary source of reaching IPC staff in the MENA countries.[18] IPC staff who were actively working in the IPC programs at health care facilities, irrespective of nationality, educational background, and professional title, were included. The details of the study population and methods have been published elsewhere.[19]

Sample size and sampling

Based on the population size of the AcicN database, it was estimated that 269 participants would be required to detect 50% prevalence, using a 5% margin of error and 95% confidence level. This sample size would allow the detection of slightly less than 20% differences between groups. Participants were recruited using a convenience sampling technique. Out of 895 participants invited through email, 269 (30%) filled the questionnaire. The actual response rate may be higher than 30% if those who missed the email invitation would have been considered.

Definitions

Surveillance coverage in the present study was defined as the percentage of surveillance types conducted out of 15 different types of surveillance (Table 3).[8] Surveillance methods included comprehensive surveillance, targeted surveillance focusing on specific locations continuously, and targeted surveillance focusing on specific locations for particular periods. Appropriate surveillance methods were defined as conducting targeted surveillance preceded by risk-assessment (determining locations and times)[3,7] Surveillance tools were categorized by the type of data collection; manual, partially electronic, and fully electronic. Appropriate surveillance tools were defined as conducting fully electronic surveillance.[3,20]

Data collection tool

An online questionnaire was developed by experts in IPC, epidemiology, and surveillance. The survey content was a combination of the published APIC MegaSurvey questions[10,21] and additional questions suggested by subject matter experts. The questionnaire covered the following domains; demographic and professional characteristics of IPC staff, characteristics of the facilities and infection control program involved, and surveillance-related characteristics (Supplementary material). The later included data on 15 different types of surveillance with detailed information about hand hygiene and surgical site infection (SSI).

Validation of the data collection tool

The 3 experts described above did content and face validity. Additionally, a pilot study was conducted among 15 participants with very positive feedback. Cronbach's alpha for surveillance questions was 0.91, which indicates a strong reliability.

Statistical methods

Categorical variables were presented as frequencies and percentages while continuous variables were presented as means and standard deviations (SD). Three separate scores were created based on the responses of the IPC staff to conducting surveillance (yes/no), surveillance methods (3 levels), and surveillance tools (3 levels). Surveillance methods were categorized into comprehensive (1 point), targeting specific locations but not times (2 points), and targeting specific locations for particular periods (3 points). Surveillance tools were categorized into manual (1 point), partially electronic (2 points), and fully electronic (3 points). Direct observation with validation was scored highest for hand hygiene, followed by direct observation without validation, electronic monitoring, the estimated consumption rate of hand hygiene products, and self-reported compliance. Higher scores indicate conducting multiple surveillance, using appropriate surveillance methods and tools, respectively. Mann-Whitney or Kruskal-Wallis tests were used to compare the scores across 2 or multiple groups, respectively. Chi-squared test or Fisher's exact test, as appropriate, was used to compare categorical variables. All P-values were 2-tailed. A P-value <.05 was considered significant. Statistical Package for the Social Sciences software (SPSS version 27.0.: IBM Corp) was utilized for statistical analysis.

RESULTS

A total of 269 participants who responded to the survey were included in the current analysis. Table 1 shows the demographic and professional characteristics of the participants. The majority of IPC staff were females (67.7%) of Middle Eastern origin (56.3%) and working in GCC countries (83.1%). Most staffs were working as nurses (63.4%) or medical doctors (22.8%). The majority (90.6%) of staff received training in surveillance but only 32% obtained the certification board of infection control and epidemiology (CBIC). Compensation satisfaction was very variable, with 64% had some degree of satisfaction.

As shown in Table 2, the most frequent IPC setting was medical and surgical wards (81.4%), followed by intensive care settings (79.9%) and acute care settings (74.3%). Most facilities were part of the governmental sector (59.2%) and had a capacity of 100-500 beds (64.6%). The most frequent staff-to-bed ratio was one per 100 beds (39.5%), followed by one per 150 beds (24.6%). Most facilities had a formal IPC committee (93%) with regular meetings (90.8%). Most facilities had an IPC annual plans (90.7%), which were developed based on risk-assessment (88.1%) and included communications with

Table 1
Distribution of percentage scores assessing surveillance coverage, methods and tools by demographic and professional characteristics of the infection control staff

	Frequency (N = 269)	Conducting surveillance		Appropriate surveillance methods		Appropriate surveillance tools	
		Score	*P*-value	Score	*P*-value	Score	*P*-value
Gender							
Male	84 (32.2%)	84±21	.546	64±16	.217	58±23	.551
Female	176 (67.7%)	82±23		68±18		61±24	
Age groups (years)							
<35	76 (29.1%)	83±24	.634	65±18	.282	63±25	.581
35-44	113 (43.3%)	80±25		69±18		58±23	
≥45	72 (27.6%)	86±15		64±16		59±23	
Nationality, region							
Middle Eastern	150 (56.3%)	81±25	.420	68±18	.238	60±25	.452
Asian	96 (36.6%)	86±20		83±17		61±23	
Others	16 (6.1%)	85±15		70±15		51±20	
Region							
GCC	222 (83.1%)	87±19	<.001	65±17	.153	62±24	.002
Non-GCC	45 (16.9%)	65±29		71±18		47±19	
Professional background							
Nurse	170 (63.4%)	85±19	.307	65±17	.409	60±24	.409
Medical doctor	61 (22.8%)	77±26		69±17		56±23	
Laboratory	26 (9.7%)	77±35		66±20		58±26	
Others	11 (4.1%)	85±21		73±22		69±18	
CBIC qualifications							
No	183 (68.0%)	79±25	<.001	68±19	.517	56±23	.001
Yes	86 (32.0%)	91±16		65±16		67±25	
Training in Surveillance							
No	17 (9.4%)	70±32	.059	75±19	0.047	55±26	.291
Yes	164 (90.6%)	85±21		66±17		61±24	
Satisfaction with compensation							
Extremely satisfied	14 (5.3%)	77±23	.059	62±17	.734	68±27	.380
Very satisfied	46 (17.4%)	92±13		63±14		58±22	
Somewhat satisfied	109 (41.3%)	82±23		67±19		62±24	
Not satisfied	66 (25.0%)	80±23		68±17		54±23	
Extremely not satisfied	29 (11.0%)	82±27		65±19		62±27	

NOTE. Middle East and North Africa (MENA) countries include Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen. Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates constitute the GCC and are considered by the World Bank as high-income countries. On the other hand, all non-GCC countries are considered low/medium-income countries.
P-value tests for a significant difference in a relevant score between the group of a relevant characteristic and was placed opposite the first item of the group it compares.
CBIC, certification board of infection control and epidemiology; *GCC*, Gulf Cooperation Council states; *SD*, standard deviation.

health care workers (84.0%). Approximately 63.9% of participants reported enough leadership support.

As shown in Table 3, 68.8% of the staff reported one or more type of surveillance conducted in their facilities, which consumed 26.8% of their average weekly working time. Hand hygiene (97.8%), multidrug-resistant organisms (MDRO, 91.8%), central line-associated bloodstream infections (CLABSI, 91.3%), and catheter-associated urinary tract infections (CAUTI, 91.2%) were the most common surveillance conducted. Direct observation was the most common hand hygiene method (97.8%), followed by calculation of product consumption (31.9%) and self-reported by staff (21.6%). For hand hygiene surveillance, 81.1% of the participants reported having a written strategy/plan to improve hand hygiene rates and 75% reported having a validation process for reported compliance rates. The majority (68.5%) of SSI surveillance was based on risk-assessment.

Figure 1 shows surveillance methods and tools used in different type of surveillance conducted. Comprehensive surveillance was the primary surveillance method used (47.3%), followed by surveillance targeting specific locations and times (32.5%) and surveillance targeting specific locations but not times (20.2%). Surveillance of MDRO, *Clostridium difficile*, and antimicrobial use were more likely to be comprehensive while surveillance of SSI and ventilator-associated event (VAE) were more likely to be targeted. Manual surveillance was the primary surveillance tool (41.5%), followed by partial and then full electronic surveillance (32.5% and 26.0%, respectively). Unlike methods, there were no differences in surveillance tools by different types of surveillance.

The scores of conducting multiple surveillance, with appropriate methods and tools were 83%, 67%, and 61% (respectively). The distribution of the 3 scores by demographic and professional characteristics of the IPC staff and IPC programs are shown in Tables 1 and 2. Conducting multiple surveillance was linked to GCC region, CBIC qualifications, specific setting (acute care and long term), staff-to-bed ratio, presence and active function of IPC committee, presence of risk-based IPC annual plan, communications with health care workers, and leadership support. Appropriate surveillance methods and/or tools were linked to GCC region, CBIC qualifications, surveillance training, specific setting (acute care and long term), staff-to-bed ratio, presence and active function of IPC committee, presence of IPC annual plan, communications with health care workers, and leadership support. Most of the above IPC program components were negatively associated with the methods score but positively associated with the tools score.

DISCUSSION

The present study examined the surveillance prevalence and methods as perceived by IPC staff working in MENA countries. Almost 70% of the hospitals in the present study were conducting surveillance activities that covers more than 80% of commonly conducted types of surveillance. Comparing current finding with regional data is very challenging due paucity of similar studies. Yet, the prevalence of conducting surveillance in the present study is probably satisfactory, given the surveillance challenges and non-obligatory nature of

Table 2
Distribution of percentage scores assessing surveillance coverage, methods and tools by characteristics of the facilities and infection control programs

	Frequency (N = 269)	Conducting surveillance		Appropriate surveillance methods		Appropriate surveillance tools	
		Score	*P*-value	Score	*P*-value	Score	*P*-value
Settings of IPC services							
Ambulatory care center	160 (59.5%)	83±21	.781	65±18	.365	62±26	.435
Hemodialysis	157 (58.4%)	85±19	.356	66±17	.935	60±24	.640
Acute care setting	200 (74.3%)	86±18	.010	64±16	.033	62±24	.271
Intensive care setting	215 (79.9%)	85±19	.250	66±17	.337	59±24	.594
Medical and surgical wards	219 (81.4%)	84±20	.754	66±17	.737	59±24	.815
vHome health care	59 (21.9%)	84±23	.503	65±16	.704	59±24	.924
Long term care	99 (36.8%)	91±13	<.001	64±16	.269	68±23	<.001
Academic center	80 (29.7%)	89±14	.179	64±17	.201	59±24	.887
Others	24 (8.9%)	86±24	.429	67±17	.687	72±23	.037
Healthcare sector							
Governmental	157 (59.2%)	82±24	.711	65±18	.300	60±25	.822
Private	108 (40.8%)	84±20		68±17		59±23	
Number of beds in your facility							
≤100	43 (19.0%)	72±33	.428	68±20	.148	56±25	0.682
101-250	74 (32.7%)	86±20		62±14		60±23	
251-500	72 (31.9%)	89±14		62±16		64±24	
>500	37 (16.4%)	87±17		69±17		61±26	
Staff-to-bed ratio							
1/50	53 (21.4%)	79±26	.010	62±16	.003	65±23	.009
1/100	98 (39.5%)	90±15		62±17		64±23	
1/150	61 (24.6%)	84±19		69±16		52±23	
1/200	17 (6.9%)	73±27		76±17		51±26	
1/250	7 (2.8%)	77±34		65±23		69±27	
Other	12 (4.8%)	47±37		88±16		47±17	
Presence of formal IPC committee							
No	16 (6.3%)	31±21	<.001	83±16	.002	34±2	.001
Yes	236 (93.7%)	87±18		65±17		61±24	
Regular meetings of IPC committee							
No	23 (9.2%)	46±24	<.001	83±18	<.001	35±8	<.001
Yes	226 (90.8%)	87±18		64±16		62±24	
Presence of IPC annual plan							
No	25 (4.3%)	44±30	<.001	71±21	.497	42±17	.043
Yes	244 (90.7%)	85±21		66±17		60±24	
Risk-based IPC annual plan							
No	32 (11.9%)	52±32	<.001	69±17	.464	53±28	.155
Yes	237 (88.1%)	85±20		66±17		60±24	
IPC annual included communications with HCWs							
No	43 (16.0%)	55±28	<.001	82±15	<.001	43±20	<.001
Yes	226 (84.0%)	87±18		64±16		62±24	
Pressure to report HAI							
No	145 (80.1%)	83±22	.478	66±18	.738	61±24	.330
Yes	36 (19.9%)	87±19		66±16		56±22	
Enough leadership support for IPC							
No	65 (36.1%)	77±26	.003	70±17	.018	54±24	.011
Yes	115 (63.9%)	87±18		64±16		63±24	

P-value tests for a significant difference in a relevant score between the group of a relevant characteristic and was placed opposite the first item of the group it compares.
HAI, healthcare-associated infection; *HCWs*, healthcare workers; *IPC*, infection prevention and control.

surveillance in low and middle-income countries.[14,22] The current prevalence is better than previously reported in Saudi Arabia using a national survey of governmental acute care hospitals (50%)[17] and similar to the prevalence reported in South Korea using a national survey of acute care hospitals (68%).[11] However, the above studies are relatively old and may not represent the current situation. As expected, the current prevalence was lower than those reported in the US and European studies (>80%).[13,23]

Considering the standards of the World health organization (WHO), IPC set up and activities in MENA countries are generally improving but still suboptimal.[24,25] Like several low- and middle-income countries, surveillance activities in MENA countries largely follow the definitions and methods described by US CDC but not the European CDC.[14,15,22] However, reports characterizing surveillance coverage and methods in MENA countries are very limited and scattered.[16,17] Unlike hospitals that did not conduct surveillance in the present study (30%), those that did were very similar to Western countries as regards the number of different surveillance conducted.[13] This may reflect the apparent discrepancy in infection control settings in the MENA countries, including high (Gulf Cooperation Council) and low and middle-income countries.[19]

Surveillance of hand hygiene, MDRO, CLABSI, and CAUTI was the most commonly practiced surveillance in the present study. They represent the types usually recommended as surveillance priorities.[3] Studies that examined low- and middle-income countries showed that CLABSI, hand hygiene, VAP, and CAUTI were the most common types of surveillance practiced.[26] On the other hand, studies that examined high and upper-middle-income countries showed that SSI, CLABSI, and specific MDRO (methicillin-resistant Staphylococcus aureus) were the most common types of surveillance practiced.[13,14] Obviously, some types of surveillance in the present study were under-monitored compared with high and upper-middle-income countries, probably due to complexity (such as antimicrobial use) or inconsequential priority (such as *Clostridium difficile*).[13]

Table 3
Surveillance-related characteristics of the facilities where the infection control staff were working

	Total
Any type of surveillance (including hand hygiene) is conducted	
Yes	185 (68.8%)
No	84 (31.2%)
Average weekly time spent on surveillance (%)	26.8±16.7
Type of Surveillance conducted	
Catheter-associated urinary tract infection (CAUTI)	166 (91.2%)
Urinary catheter bundle	160 (87.9%)
Central line associated bloodstream infection (CLABSI)	168 (91.3%)
Central line bundle	160 (87.4%)
Ventilator associated event (VAE)	127 (70.6%)
Ventilator associated pneumonia (VAP)	144 (79.6%)
Ventilator bundle	147 (81.7%)
Multidrug-resistant organism (MDRO)	167 (91.8%)
Antimicrobial use	132 (73.7%)
Clostridium difficile (C. diff)	133 (75.6%)
Surgical site infection (SSI)	155 (85.6%)
Hand hygiene	181 (97.8%)
Adherence to contact precautions	132 (72.9%)
Environmental cleanliness	139 (76.0%)
Active surveillance testing	153 (85.0%)
Hand hygiene observation methods	
Direct observation	181 (97.8%)
Electronic system	20 (10.8%)
Calculation of product consumption	59 (31.9%)
Self-report by staff	40 (21.6%)
Others	5 (2.7%)
Hand hygiene surveillance	
Do you have a written strategy/plan to improve hand hygiene rates?	150 (81.1%)
Do you have a validation process for reported compliance rates of hand hygiene?	139 (75%)
Did the auditor receive training on how to conduct hand hygiene observation?	174 (94.1%)
Surgeries are done in your facility	
Yes	168 (92.8%)
No	13 (7.2%)
Target of SSI surveillance	
Specific surgeries based on risk-assessment	127 (81.9%)
Specific as mandated by regulator	23 (14.8%)
All surgeries	5 (3.2%)

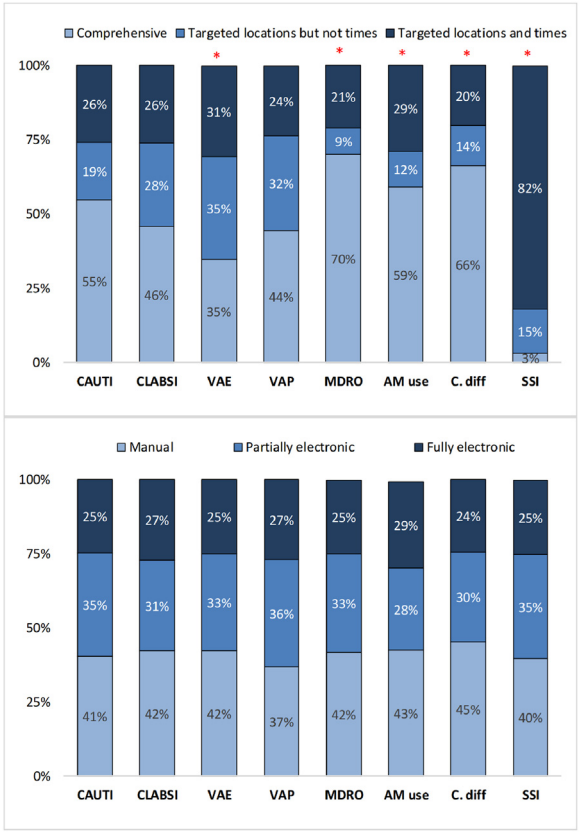

Fig. 1. Surveillance methods (above) and tools (below) used in different type of surveillance conducted. Abbreviations as in Table 3. * indicates significant difference compared with all other types of surveillance.

IPC staff in the present study consumed approximately 27% of their average weekly working time on surveillance activities. This is very similar to recent national data reported in the US (28%)[12] but much lower than relatively older national data in the U.S. and Korean hospitals (41%-45%).[11,27] Surveillance is very time-consuming, specially with more complicated definitions.[28] IPC staff spend much of their time manually reviewing patient charts, entering and analyzing data, and preparing reports[12,28]. The introduction of semielectronic and electronic surveillance in recent years (58% in the present study) may have shorten the staff time allocated for surveillance by bringing clinical, microbiologic, and radiologic patient information into one dashboard.[28,29] Such time reduction has been estimated at 75% in a recent meta-analysis.[28] Although approximately 90% of the staff in the present study reported getting some kind of surveillance training, only one-third had CBIC. This may indicate that the training provided is limited and probably not internationally accredited.

Unlike conducting multiple surveillance, appropriate methods and tools in the present study were still suboptimal. Interestingly, components of IPC programs such as availability of educated and trained staff, IPC committee, IPC activities driven by risk-assessment, and enough leadership support were consistently associated with comprehensive and electronic surveillance. Although targeted surveillance is the recommended surveillance method in Western countries,[7,9] comprehensive surveillance was the most common surveillance method reported in the present study. Comprehensive surveillance is perfect for setting priorities and detecting infections and outbreaks that would otherwise be missed.[30,31] However, it is a resource-and time-consuming method and probably unsuitable for MENA countries with limited staff and resources.[19] The finding may underscore the need to promote targeted surveillance in the region to effectively use limited staff and resources[20] while periodically conducting point-prevalence surveys to set priorities and to get a bigger picture of the HAIs burden.[32]

The present study had several strengths; it is probably the first to examine surveillance activities in the MENA countries, to focus not only on prevalence and coverage but also surveillance methods, and to examine the impact of the components of the IPC program on surveillance activities. Nevertheless, a number of limitations should be acknowledged. The study participants were recruited using a convenience sampling of the AcicN members. Since the database does not obviously include all IPC staff in the region, it may affect the generalizability of the findings to all MENA countries. This is especially important as these countries have extensive health care systems and resource variability. Yet, these limitations are not believed to affect the study findings considerably and should stimulate more international research and collaboration in HAI surveillance.

In conclusions, almost 70% of the hospitals in MENA countries included in the present study were conducting HAIs surveillance covering most of surveillance types, including HAIs, bundles, and pathogens. Surveillance of hand hygiene, MDRO, CLABSI, and CAUTI were the most commonly practiced types. Unlike prevalence and coverage, appropriate methods and tools were still suboptimal. Unlike

recommendations, comprehensive surveillance was still the most widely used surveillance method. The current finding provides IPC stakeholders with a list of staff and program characteristics to improve surveillance activities, including coverage and methods.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.ajic.2023.03.004.

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