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Questionnaire-based analysis of infection prevention and control in healthcare facilities in Saudi Arabia in regards to Middle East Respiratory Syndrome

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ABSTRACT

Effective implementation of infection prevention and control in healthcare facilities depends on training, awareness and compliance of healthcare workers. In Saudi Arabia recent significant hospital outbreaks, including Middle East Respiratory Syndrome Coronavirus (MERS-CoV), have resulted from lack of, or breakdown in, infection prevention and control procedures. This study was designed to assess attitudes to, and awareness of, infection prevention and control policies and guidelines among healthcare workers of different professions and institution types in Saudi Arabia. A questionnaire was administered to 607 healthcare workers including physicians (n = 133), nurses (n = 162), laboratory staff (n = 233) and other staff (n = 79) in government hospitals, private hospitals and poly clinics. Results were compared using Chi square analysis according to profession type, institution type, age group and nationality (Saudi or non-Saudi) to assess variability. Responses suggested that there are relatively high levels of uncertainty among healthcare workers across a range of infection prevention and control issues, including institution-specific issues, surveillance and reporting standards, and readiness and competence to implement policies and respond to outbreaks. There was evidence to suggest that staff in private hospitals and nurses were more confident than other staff types. Carelessness of healthcare workers was the top-cited factor contributing to causes of outbreaks (65.07% of total group), and hospital infrastructure and design was the top-cited factor contributing to spread of infection in the hospital (54.20%), followed closely by lack and shortage of staff (53.71%) and no infection control training program (51.73%). An electronic surveillance system was considered the most effective by staff (81.22%). We have identified areas of concern among healthcare workers in Saudi Arabia on infection prevention and control which vary between institutions and among different professions. This merits urgent multi-factorial actions to try to ensure outbreaks such as MERS-CoV can be minimized and contained.

Introduction

Effective infection prevention and control in healthcare facilities depends on awareness and compliance of healthcare workers (HCWs) at all levels of the organization. Thus, as for all health policy, multi-disciplinary teams involving staff from frontline workers to management should be involved in formulation and implementation of infection prevention and control policies and procedures to ensure that they function effectively [1].

In the case of Saudi Arabia, as in any other country, there are specific challenges to infection prevention and control which need to be met by nationally and locally relevant policies and procedures. Various nosocomial and community infectious disease outbreaks have been experienced in Saudi Arabia in recent years. These include pandemic influenza A (H1N1) [2], H5N1 highly pathogenic avian influenza [3], Rift Valley Fever [4] and most significantly Middle East Respiratory Syndrome (MERS), an acute viral respiratory

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illness associated with high mortality, caused by a new betacoronavirus strain, MERS-CoV [5–8].

MERS-CoV was first positively identified in 2012 in the sputum of a 60-year old man, who died after presenting at a private hospital in Jeddah with acute pneumonia and subsequent renal failure [8]. Human MERS-CoV is believed to have originated via cross-over from dromedary camels, but the major outbreaks experienced in the Middle East and Korea have been healthcare facility–associated and linked to a lack of, or breakdown in, infection prevention and control procedures [5,6,9–12]. As a result, the World Health Organization (WHO) have identified issues such as overcrowding in emergency department waiting rooms and insufficient attention to basic infection control procedures, such as hand hygiene and use of personal protective equipment (PPE), in hospitals in Saudi Arabia [11]. New infection prevention and control guidelines for MERS-CoV patients were introduced by the Ministry for Health (MOH) in Saudi Arabia, largely based on WHO and Centers for Disease Control and Prevention (CDC) guidelines, with modifications based on epidemiological evidence, clinical experience and local circumstances [6,13–16].

The effectiveness of promotion and consistent application of both basic infection control procedures such as hand hygiene, and more advanced measures, have been demonstrated in hospital-associated MERS-CoV outbreaks in Saudi Arabia and in Korea [17–20]. However, in order for MOH-prescribed infection prevention and control measures to be effectively implemented in individual healthcare facilities and their constituent departments, clear direction must be given to employees. Expectations of both management and employees should be clearly defined, communicated and understood [1,7]. The objective of this questionnaire-based study was to gauge staff awareness of infection prevention and control policies and procedures in different healthcare facilities in Saudi Arabia, including government hospitals, private hospitals and poly clinics. The questionnaires were completed by a range of HCWs, including nurses, physicians, laboratory staff and others such as physiotherapists. They addressed staff training and access to information, confidence in the ability of HCWs to implement policies and carry out procedures, their assessment of the main threats in terms of possible outbreak causes and factors contributing to infection spread, and preparedness of their institution to deal with an infection outbreak.

Material and methods

Subjects and questionnaires

607 HCWs including physicians (n = 133), nurses (n = 162), laboratory staff (n = 233) and other staff (n = 79), in government hospitals, private hospitals and poly clinics in Saudi Arabia filled in a questionnaire. The questionnaire was administered via SurveyMonkey and distributed to HCWs through emails, Facebook, and other communication tools. Responses were anonymous and the institutions where respondents were working were not identified by name. Hence, it was not considered necessary to seek ethical approval. The questionnaire included a range of thirteen questions on their knowledge and application of, and attitudes to, infection prevention and control measures in their institutions. The questionnaire administered is shown in Appendix A. For aid of interpretation, the questions have been numbered as follows for consideration in the Results and Discussion Sections of this paper.

Question 1:

(a) Do you have infection control program at your institution?
(b) Do you have infection control policies and guidelines in your unit?

Question 2: Have you received some form of training or orientation about infection prevention and control?

Question 3: At your institution, do you have active infection control team?

Question 4: Do you have an emerging infectious diseases task force (dealing with outbreaks)?

Question 5: Have you encountered any outbreak?

Question 6: Is your hospital is enrolled in national surveillance system?

Question 7: Do you have a list of reportable infectious agents available in your unit and accessible to all staff?

Question 8: Which infections are reported to MOH?

Question 9: In your institution, is there known turnaround time of laboratory results of the reportable infectious agents?

Question 10: Do you think your hospital is prepared for any infection outbreak?

Question 11: Do you agree that surveillance tool used in your institution is effective to prevent or control infection?

Question 12: Do you think that all staff in your unit are following promptly infection control policies, rules and guidelines?

Question 13: Do you think that all staff can differentiate between different isolation protocol such as droplet or contact?

The group were also asked to choose from a number of options as to what, in their opinion, was the cause(s) of outbreaks and what factors contribute to the spread of infection in the hospital? They were also asked what reporting system they had in their hospitals (Electronic surveillance, paper version or telephone communication) and which of these systems they would consider to be the most effective reporting system for reporting infectious agents.

Statistics

Data were analyzed statistically using Excel (Microsoft Corporation, Redmond, WA, USA) and/or Social Science Statistics (http://www.socscistatistics.com/Default.aspx). The chi-square test was used at the 5% level of significance to estimate differences in proportions between different staff types (physicians, nurses, laboratory staff and others), between staff in different institution types (government hospital, private hospital and poly clinic), between staff of different age groups, or between Saudi and non-Saudi staff. Where appropriate, median and interquartile range (IQR) were also calculated (staff type analyses).

Results

Characteristics of study group

A total of 607 HCWs, comprising physicians, nurses, laboratory staff and others (for example physiotherapists, respiratory technicians, X-ray technicians), working between government hospitals, private hospitals and poly clinics, submitted responses to the questions shown in Section "Subjects and questionnaires". The characteristics of the group in terms of age group, gender, profession, institution and nationality (Saudi or non-Saudi) are shown in Table 1.

Responses by profession

The responses to the questions asked were compared between the different HCW professions across the three institution types. Numbers and percentages of responses in each group and the p values obtained from Chi square analyses are shown in Table 2. The Chi square breakdowns are shown in Appendix B.

There was some variation in responses to questions related to institution-specific issues (Questions 1–5, Section "Subjects and questionnaires"). In terms of knowledge of whether or not there

Table 1
Characteristics of subjects.

Age (y)	Number (total 607)
18–29	179
30–44	305
45–59	112
>60	11
Gender	
Male	269
Female	338
Profession	
Physician	133
Nurse	162
Laboratory staff	233
Others	79
Institution	
Private hospital	119
Government hospital	452
Poly clinic (private sector)	36
Nationality	
Saudi	446
Non-Saudi	161

is an infection control program at their institution (Question 1a), there was no significant difference noted across the groups (Chi square 10.331; p = 0.111379; Table 2, Appendix B). However, there was significant variation in responses on whether there is an infection control program in their unit (Question 1b; Chi square 20.526; p = 0.00223). This was mainly attributable to disparity in the 'don't know' response levels (Table 2, Appendix B). The highest percentage of uncertainty was among 'others' (13.92% don't know), while the lowest level of uncertainty was expressed by nurses (2.47%).

There was also significant variation in response to the question concerning receipt of training/orientation on infection prevention and control (Question 2; Chi square 15.9627, p = 0.001154; Table 2, Appendix B). Nurses were the group least likely to have received no training (12.35%) (Table 2). Overall, 23.06% of participants reported having received no training (Table 2, Appendix B).

There were significantly different levels of awareness between different HCW professions regarding implementation of infection prevention and control policy. On there was an active infection control team at the institution, there was significant variation (Question 3; Chi square 13.708, p = 0.03307). Physicians were 1.67 times more likely than nurses to state that there was no infection control team, while the level of uncertainty reflected in 'don't know' answers was similar between these two groups (Table 2, Appendix B). Meanwhile, the laboratory staff and 'others' groups had a higher level of uncertainty than either the physicians or nurses ('don't know' percentages). However, on the related point of whether the institution had an emerging infectious diseases task force (dealing with outbreaks) (Question 4), there was no significant difference across the groups. On this question, there was a high level of uncertainty across the whole cohort (32.13% 'don't know') and within all individual subgroups. On the question of whether an outbreak had ever been encountered in their institution, there was again significant variation (Question 5; Chi square 18.531, p = 0.00503), largely accounted for by the significantly lower levels of uncertainty expressed by physicians as compared to the other groups ('don't know' responses, Table 2, Appendix B), and the fact that the laboratory staff were the only group more likely to state there had not been an outbreak, rather than that there had been an outbreak.

On questions on surveillance and reporting standards (questions 6–9, Section "Subjects and questionnaires"), there were also elements of variation. There was no significant variation on the question of whether their hospital is enrolled in the national surveillance system (Question 6; Chi square 8.015; p = 0.237; Table 2, Appendix B). On this question, there were uniformly high levels of uncertainty across the groups, with an overall level of 'don't know' answers of 35.09% (Table 2). By contrast, on the question of whether there was a list of reportable infectious agents available in their unit and accessible to all staff (Question 7), there was significant variation (Table 2; Chi square 23.58; p = 0.000624; Table 2, Appendix B). This was largely due to the higher than expected levels of nurses reporting positively compared to other groups. It was also attributable to the high levels of uncertainty (don't know percentages) of both laboratory and other staff compared to both physicians and nurses (Table 2, Appendix B). Overall, only 46.95% of participants reported that there is an accessible list in their unit (Table 2). On the related question of which infections are reported to the MOH (Question 8), there was again significant variation in responses (Chi square 19.7608; p = 0.00305; Table 2, Appendix B). This was mainly attributable to higher than expected numbers of nurses responding that all infections were reported and lower than expected levels of 'don't know' answers for nurses compared to the other groups, and to higher than expected levels of uncertainty among lab staff (Table 2, Appendix B). On the question of whether their institution had a known turnaround time of laboratory results for reportable infectious agents (Question 9), there was a substantial level of uncertainty among staff, with overall 'don't know' responses of 28.99% (Table 2). There was significant variation across the groups (Chi square 34.373; p = 0.0000057; Table 2, Appendix B). This was mainly attributable to the significantly lower than expected levels of 'don't know' responses among laboratory staff and the higher than expected levels for the other groups (Table 2, Appendix B).

On questions relating to readiness and competence of the institution and staff (Questions 10–13, Section "Subjects and questionnaires"), there was again a level of variation between staff types. On the question of whether their hospital is prepared for any infection outbreak, there were significant differences of opinion (Question 10; Chi square 26.74; p = 0.000162; Table 2, Appendix B). In particular, while the majority of nurses (58.64%) thought their hospital was prepared for an outbreak, only 37.60% of physicians agreed. Overall, only 48.76% of total staff thought their hospital was prepared for an outbreak (Table 2, Appendix B). On the question of whether the surveillance tool used in their institution is effective to prevent or control infection (Question 11) there was no significant variation (Chi square 9.955; p = 0.1265599; Table 2, Appendix B), with an overall 'don't know' response level of 22.24%. On the question of whether all staff in their unit were following promptly infection control policies, rules and guidelines (Question 12), there was a high level of pessimism across the groups, with 54.01% of all staff responding negatively (Table 2). There was significant variation between the groups (Chi square 19.583; p = 0.00328437). This was mainly attributable to the substantially lower than expected numbers of physicians responding positively, and the lower than expected 'don't know' responses of nurses and higher than expected 'don't know' responses of physicians on this question (Table 2, Appendix B). On the related question of whether all staff can differentiate between different isolation protocols such as droplet or contact (Question 13), again there was significant variation (Chi square 39.826; $p = 4.9 \times 10^{-7}$; Table 2, Appendix B). This was mainly attributable to the higher than expected number of 'yes' responses and lower number of 'no' responses from nurses and to the opposite trend for physicians (Table 2, Appendix B). Additionally, both the lab and 'others' staff had higher than expected levels of 'don't know' responses, while nurses had lower than expected levels. Overall, only 31.96% of total staff agreed that all staff can differentiate between different isolation protocols such as droplet or contact (Table 2).

Table 2
Distribution of responses according to profession.

Question	Response	All staff (N = 607)	Physicians (N = 133)	Nurses (N = 162)	Lab staff (N = 233)	Others (N = 79)	p
		Number/percentage of group					
Question 1a	Y	500/82.37	116/87.22	136/83.95	191/81.97	57/72.15	0.111379
	N	55/9.06	8/6.02	15/9.26	23/9.87	9/11.39	
	DK	52/8.57	9/6.77	11/6.79	19/8.15	13/16.46	
Question 1b	Y	486/80.07	99/74.44	142/87.65	191/81.97	54/68.35	0.00223
	N	82/13.51	21/15.79	16/9.88	31/13.30	14/17.72	
	DK	39/6.43	13/9.77	4/2.47	11/4.72	11/13.92	
Question 2	Y	467/76.94	102/76.69	142/87.65	165/70.82	58/73.42	0.001154
	N	140/23.06	31/23.31	20/12.35	68/29.18	21/26.58	
Question 3	Y	389/64.09	77/57.89	116/71.60	143/61.37	53/67.09	0.03307
	N	144/23.72	43/32.33	31/19.36	57/24.46	13/16.46	
	DK	74/12.19	13/9.77	15/9.26	33/14.16	13/16.46	
Question 4	Y	242/39.87	49/36.84	73/45.06	87/37.34	33/41.77	0.6109
	N	170/28.01	42/31.58	44/27.16	63/27.04	21/26.58	
	DK	195/32.13	42/31.58	45/27.78	83/35.62	25/31.65	
Question 5	Y	272/44.81	70/52.63	82/50.62	84/36.05	36/45.57	0.00503
	N	218/35.91	48/36.09	46/28.40	99/42.49	25/31.65	
	DK	117/19.28	15/11.28	34/20.99	50/21.46	18/22.78	
Question 6	Y	269/44.15	60/45.11	84/51.23	89/38.30	36/45.57	0.2370
	N	125/20.76	26/19.55	27/17.28	54/23.18	18/22.78	
	DK	213/35.09	47/35.34	51/31.48	90/38.63	25/31.65	
Question 7	Y	285/46.95	60/45.11	96/59.26	93/39.91	36/45.57	0.000624
	N	206/33.94	55/41.35	45/27.78	84/36.05	22/27.85	
	DK	116/19.11	18/13.53	21/12.96	56/24.03	21/26.58	
Question 8	Healthcare associated	129/21.25	25/18.80	38/23.46	50/21.46	16/20.25	0.00305
	All	282/46.46	60/45.11	92/56.79	91/39.06	39/49.37	
	DK	196/32.29	48/36.09	32/19.75	92/39.48	24/30.38	
Question 9	Y	313/51.57	50/37.59	82/50.62	146/62.66	35/44.30	0.0000057
	N	118/19.44	30/22.56	27/16.67	48/20.60	13/16.46	
	DK	176/28.99	53/39.85	53/32.72	39/16.74	31/39.24	
Question 10	Y	296/48.76	50/37.60	95/58.64	107/45.92	44/55.70	0.000162
	N	217/35.75	62/46.62	56/34.57	79/33.91	20/25.32	
	DK	94/15.49	21/15.79	11/6.79	47/20.17	15/18.94	
Question 11	Y	316/52.06	54/40.60	91/56.17	128/54.94	43/54.43	0.1265599
	N	156/25.70	43/32.22	37/22.84	59/25.32	17/21.52	
	DK	135/22.24	36/27.07	34/20.99	46/19.74	19/24.05	
Question 12	Y	196/32.29	28/21.05	55/33.95	82/35.91	31/39.24	0.00328437
	N	329/54.01	79/59.40	95/58.64	121/51.93	34/43.04	
	DK	82/13.51	26/19.55	12/7.41	30/12.88	14/17.73	
Question 13	Y	194/31.96	28/21.05	77/47.53	64/27.47	25/31.65	4.9×10^{-7}
	N	314/51.73	88/66.17	69/42.59	124/53.22	33/41.77	
	DK	99/16.31	17/12.78	16/9.88	45/19.31	21/26.58	

Y: yes; N: no; DK: don't know; $p < 0.05$ considered significant (from Chi square comparison).

Responses by institution

The responses to the questions asked were also compared between the different institution types (Table 1) to determine if there was any variation. Numbers and percentages of responses in each group and the *p* values obtained from Chi square analyses are shown in Table 3 and the Chi square breakdowns are shown in Appendix C.

There was variation in responses to questions related to institution-specific issues (Questions 1–5, Section "Subjects and questionnaires"). In terms of knowledge of whether or not there is an infection control program at their institution (Question 1a) or their unit (Question 1b), there was significant variation (Chi square 27.6147, p = 0.000015 and Chi square 24.8587; p = 0.000054 respectively; Table 3, Appendix C). This was mainly attributable to the responses of the poly clinics staff, who had lower than expected levels of 'yes' responses, and higher than expected 'no' and 'don't know' responses, compared to government or private hospitals (Table 3, Appendix C). In terms of whether staff had received some form of training or orientation about infection prevention and control, there was also significant variation (Question 2; Chi square 7.0553; p = 0.029373; Table 3, Appendix C). This was mainly due to private hospital staff being less likely than expected to report no training in comparison to the other institution types (Table 3, Appendix C). There were also significantly different levels of awareness between staff at different institutions of whether there was an active infection control team (Question 3; Chi square 32.5774; p < 0.00001). This was mainly due to private hospital staff being more likely than expected to respond positively and less likely to respond negatively, while poly clinics staff were substantially less likely to respond positively (Table 3, Appendix C). As mentioned in Section "Responses by profession", there was a high level of uncertainty across the whole group (32.13% 'don't know') on the related point of whether the institution had an emerging infectious diseases task force (dealing with outbreaks) (Question 4; Table 3, Appendix C). However, there was variation across the institution

Table 3
Distribution of responses by institution.

Question Number/percentage of groups	Response	All staff (n = 607)	Government hospital (n = 452)	Private hospital (n = 119)	Poly clinic (n = 36)	p
Question 1a	Y	500/82.37	373/82.52	108/90.76	19/52.78	0.000015
	N	55/9.06	41/9.07	5/4.20	9/25.00	
	DK	52/8.57	38/8.41	6/5.04	8/22.22	
Question 1b	Y	486/80.07	350/77.43	113/87.65	23/63.89	0.000054
	N	82/13.51	70/15.49	4/3.36	8/22.22	
	DK	39/6.43	32/7.08	2/1.68	5/13.89	
Question 2	Y	467/76.94	340/75.22	102/85.71	25/69.44	0.029373
	N	140/23.06	112/24.78	17/14.29	11/30.56	
Question 3	Y	389/64.09	279/61.73	96/80.67	14/38.89	<0.00001
	N	144/23.72	111/24.56	14/11.76	19/52.78	
	DK	74/12.19	62/13.72	9/7.56	3/8.33	
Question 4	Y	242/39.87	166/36.73	64/53.78	12/33.33	0.012449
	N	170/28.01	132/29.20	25/21.01	13/36.11	
	DK	195/32.13	154/34.07	30/25.21	11/30.56	
Question 5	Y	272/44.81	205/45.35	55/46.22	12/33.33	0.087021
	N	218/35.91	153/33.85	45/37.82	20/55.56	
	DK	117/19.28	94/20.80	19/15.97	4/11.11	
Question 6	Y	269/44.15	190/42.04	66/55.46	13/36.11	0.061478
	N	125/20.76	93/20.58	23/19.33	9/25.00	
	DK	213/35.09	169 37.39	30/25.21	14/38.89	
Question 7	Y	285/46.95	204/45.13	66/55.46	15/41.67	0.171037
	N	206/33.94	163/36.06	32/26.89	11/30.56	
	DK	116/19.11	85/18.81	21/17.64	10/27.78	
Question 8	Healthcare associated	129/21.25	101/22.35	17/14.29	10/27.78	0.003537
	All	282/46.46	198/43.81	73/61.34	11/30.56	
	DK	196/32.29	153/33.85	29/24.37	15/41.67	
Question 9	Y	313/51.57	209/46.24	87/73.11	17/47.22	0.000011
	N	118/19.44	95/21.02	14/11.76	9/25.00	
	DK	176/28.99	148/32.74	18/15.13	10/27.78	
Question 10	Y	296/48.76	194/42.92	86/72.27	16/44.44	<0.00001
	N	217/35.75	187/41.37	18/15.13	12/33.33	
	DK	94/15.49	71/15.71	15/12.61	8/22.22	
Question 11	Y	316/52.06	227/50.22	73/61.34	16/44.44	0.15522
	N	156/25.70	124/27.43	23/19.33	9/25.00	
	DK	135/22.24	101/22.35	23/19.33	11/30.56	
Question 12	Y	196/32.29	131/28.98	51/42.86	14/38.89	0.001288
	N	329/54.01	263/58.19	54/45.38	12/33.33	
	DK	82/13.51	58/12.83	14/11.76	10/27.78	
Question 13	Y	194/31.96	134/29.65	48/40.34	12/33.33	0.215902
	N	314/51.73	245/54.20	52/43.70	17/47.22	
	DK	99/16.31	73/16.15	19/15.97	7/19.44	

Y: yes; N: no; DK: don't know; $p < 0.05$ considered significant (from Chi square comparison).

types (Chi Square 12.7713; p = 0.012449), mainly due to the private hospitals staff being more likely than expected to respond positively (Table 3, Appendix C). On the question of whether an outbreak had ever been encountered in their institution, there was no significant variation (Question 5; Chi square 8.1274; p = 0.087021).

On questions on surveillance and reporting standards (questions 6–9, Section "Subjects and questionnaires"), there were also elements of variation. There was no significant variation on the question of whether their hospital is enrolled in the national surveillance system (Question 6; Chi square 8 8.9849; p = 0.061478; Table 3, Appendix C). As mentioned in Section "Responses by profession", there were uniformly high levels of uncertainty across the groups on this question (Tables 2 and 3). There was also no significant variation on the question of whether there was a list of reportable infectious agents available in their unit and accessible to all staff (Question 7; Chi square 6.4025; p = 0.171037; Table 3, Appendix C). However with respect to the question of which infections are reported to the MOH (Question 8), there was significant variation (Chi square 15.6436; p = 0.003537; Table 3, Appendix C). This was mainly due to staff at private hospitals being relatively more likely to respond that all infections are reported (Table 3, Appendix C). On the question of whether their institution had a known turnaround time of laboratory results of the

Table 4
Gender distribution of healthcare professions.

Profession	Gender	
	Male (n = 269) N (expected) [Chi square] % of males	Female (n = 338) N (expected) [Chi square] % of females
Physician	63 (58.94) [0.28] 23.42	70 (74.06) [0.22] 20.71
Nursing	26 (71.79) [29.21] 9.67	136 (90.21) [23.25] 40.24
Laboratory	135 (103.26) [9.76] 50.19	98 (129.74) [7.77] 28.99
Others	45 (35.01) [2.85] 16.73	34 (43.99) [2.27] 10.06

reportable infectious agents (Question 9), there was significant variation (Chi square 28.1901; p = 0.000011; Table 3, Appendix C). This was mainly accountable to differences of private hospital staff responses compared to other institutions, as they were significantly more likely to respond positively (Table 3, Appendix C).

On questions relating to readiness and competence of the institution and staff (Questions 10–13, Section "Subjects and questionnaires"), there was again a level of variation between institutions. On the question of whether their hospital was prepared for any infection outbreak, there were significant differences (Question 10; Chi square 36.7054; p < 0.00001; Table 3, Appendix C). This was again due to private hospital staff being significantly more likely to respond positively and less likely to respond negatively than expected (Table 3, Appendix C). On whether the surveillance tool used in their institution is effective to prevent or control infection (Question 11) there was no significant variation (Chi square 9 6.656; p = 0.15522; Table 3, Appendix C), with uniformly high levels of uncertainty across the groups (Table 3). On the question of whether all staff in their unit were following promptly infection control policies, rules and guidelines (Question 12), there was a high level of pessimism across the groups, as mentioned in Section "Responses by profession" (Tables 2 and 3). There was significant variation between the groups (Chi square 17.9049; p = 0.001288), mainly due to the higher than expected numbers of private hospital staff who responded positively (Table 3, Appendix C). On the related question of whether all staff can differentiate between different isolation protocols such as droplet or contact (Question 13), however, there was no significant variation between institution types (Chi square 5.7836; P = 0.215902; Table 3, Appendix C).

Gender, age group and nationality

Distribution of males and females across the different HCW professions varied significantly (Chi square 75.6004; $p < 0.00001$; Table 4). In particular, nurses were significantly less likely to be males and significantly more likely to be females than expected, while both lab and other staff were more likely than expected to be males (Table 4). As distribution of answers to some of the questions varied according to profession, and there was a difference in the gender balance across the four professions included, we checked if there was also any impact of gender on responses. However, response distributions for males and females were generally both very similar to those for the group as a whole (data not shown).

We also considered whether there might be variation in profession type or institution type, and/or in responses to questions, according to age group of participants. Distribution of HCW profession varied significantly according to age group (Chi-square 50.3116; $p < 0.00001$). This was mainly attributable to a higher than expected number of nurses falling in the 18–29 year age group, and fewer than expected in the 45–59 year age group, while the opposite was the case for physicians (Table 5). Also, there was some variation in distribution of age groups of participants with respect to institution type (Chi-square 22.8911; $p = 0.000834$). This was mainly attributable to higher than expected numbers of participants in the 18–19 and 45–59 year age groups, and lower than expected numbers of participants in the 30–44 year age group, working in private hospitals (Table 5).

We also considered whether there might be a variation in responses to the questionnaire among staff of different age groups (Table 6, Appendix D). In terms of institution-specific questions 1–5, there was significant variation with age group in response to question 1A (whether or not there is an infection control program at their institution; Chi-square 19.2662; $p = 0.003737$), question 3 (whether there is an active infection control team in their institution; Chi square 21.3123; $p = 0.001612$), question 4 (whether the institution had an emerging infectious diseases task force; Chi square 22.4748; $p = 0.000993$) and question 5 (whether an outbreak had ever been encountered in their institution; Chi square 19.018; $p = 0.004133$). In each case, the variation was mainly attributable an age-dependent decrease in levels of uncertainty (don't know answers). Staff in the 18–29 years category tended to have higher than expected levels of 'don't know' answers to these questions, while respondents in the 45–59 year category had lower than expected levels of 'don't know' responses (Table 6, Appendix D). There was no apparent age-dependent effect on the likelihood of staff having received training (Question 2; Chi-square 1.2854; $p = 0.732612$) or on their awareness of whether there is an infection control program in their unit (Question 1b; Chi-square 7.7791; $p = 0.254737$).

On questions on surveillance and reporting standards (questions 6–9, Section "Subjects and questionnaires"), there was significant variation with age group for every question (Table 6, Appendix D). Once again, the variation was mainly attributable to higher than expected levels of 'don't know' answers among the 18–29 years category, while again respondents in the 45–59 year category had lower than expected levels of 'don't know' responses (Table 6, Appendix D).

Table 5
Age group distribution of healthcare professions and institution types.

	Age group (y)			
	18–29 (n = 179) N (expected) [Chi square] % of age group	30–44 (n = 305) N (expected) [Chi square] % of age group	45–59 (n = 112) N (expected) [Chi square] % of age group	≥60 (n = 11) N (expected) [Chi square] % of age group
Profession				
Physician	27 (39.22) [3.81] 15.1	53 (66.83) [2.86] 17.4	49 (24.54) [24.38] 43.8	4 (2.41) [1.05] 36.4
Nursing	62 (47.77) [4.24] 34.6	85 (81.40) [0.16] 27.9	13 (29.89) [9.55] 11.6	2 (2.94) [0.30] 18.2
Laboratory	63 (68.71) [0.47] 35.2	130 (117.08) [1.43] 42.6	36 (42.99) [1.14] 32.1	4 (4.22) [0.01] 36.4
Others	27 (23.30) [0.59] 15.1	37 (39.70) [0.18] 12.1	14 (14.58) [0.02] 12.5	1 (1.43) [0.13] 9.1
Institution				
Government hospital	125 (133.29) [0.52] 69.9	245 (227.12) [1.41] 80.3	75 (83.40) [0.85] 67	7 (8.19) [0.17] 63.6
Private hospital	43 (35.09) [1.78] 24	40 (59.79) [6.55] 13.1	34 (21.96) [6.61] 30.4	2 (2.16) [0.01] 18.2
Poly clinic	11 (10.62) [0.01] 6.1	20 (18.09) [0.20] 6.6	3 (6.64) [2.00] 2.6	2 (0.65) [2.78] 18.2

Table 6
Distribution of responses by age group.

Question	Response	All staff (N = 607)	18–29 (N = 179)	30–44 (N = 305)	45–59 (N = 112)	≥60 (N = 11)	p
		Number/percentage of group					
Question 1a	Y	500/82.37	140/78.2	246/80.7	103/92.0	11/100	0. 003737
	N	55/9.06	14/7.8	36/11.8	5/4.5	0/0	
	DK	52/8.57	25/14.0	23/7.5	4/3.5	0/0	
Question 1b	Y	486/80.07	140/78.2	238/78.0	97/86.6	11/100	0.254737
	N	82/13.51	26/14.5	44/14.4	12/10.7	0/0	
	DK	39/6.43	13/7.3	23/7.5	3/2.7	0/0	
Question 2	Y	467/76.94	134/74.9	235/77.0	90/80.4	8/72.7	0.732612
	N	140/23.06	45/25.1	70/23.0	22/19.6	3/27.3	
Question 3	Y	389/64.09	97/54.2	198/64.9	85/75.9	9/81.8	0.001612
	N	144/23.72	51/28.5	68/22.3	24/21.4	1/9.1	
	DK	74/12.19	31/17.3	39/12.8	3/2.7	1/9.1	
Question 4	Y	242/39.87	61/34.1	113/37.0	62/55.4	6/54.5	0.000993
	N	170/28.01	44/24.6	95/31.2	28/25.0	3/27.3	
	DK	195/32.13	74/41.3	97/31.8	22/19.6	2/18.2	
Question 5	Y	272/44.81	74/41.3	137/44.9	55/49.1	6/54.5	0.00503
	N	218/35.91	54/30.2	113/37.1	47/42.0	4/36.4	
	DK	117/19.28	51/28.5	55/18.0	10/8.9	1/9.1	
Question 6	Y	269/44.15	64/35.8	138/45.2	60/53.6	7/63.6	0. 000631
	N	125/20.76	31/17.3	64/21.0	29/25.9	1/9.1	
	DK	213/35.09	84/46.9	103/33.8	23/20.5	3/27.3	
Question 7	Y	285/46.95	74/41.3	137/44.9	66/58.9	8/72.7	0.029958
	N	206/33.94	64/35.8	107/35.1	32/28.6	3/27.3	
	DK	116/19.11	41/22.9	61/20.0	14/12.5	0/0	
Question 8	Healthcare associated	129/21.25	32/17.9	67/22.0	24/21.4	5/45.4	0.009744
	All	282/46.46	74/41.3	141/46.2	64/57.2	3/27.3	
	DK	196/32.29	73/40.8	97/31.8	24/21.4	3/27.3	
Question 9	Y	313/51.57	74/41.3	164/53.8	68/60.7	7/63.6	0.006374
	N	118/19.44	34/19.0	61/20.0	22/19.6	1/9.1	
	DK	176/28.99	71/39.7	80/26.2	22/19.6	3/27.3	
Question 10	Y	296/48.76	83/46.4	144/53.8	62/34.6	7/63.6	0.130947
	N	217/35.75	62/34.6	114/37.4	40/35.7	1/9.1	
	DK	94/15.49	34/19.0	47/15.4	10/8.9	3/27.3	
Question 11	Y	316/52.06	75/41.9	167/54.8	68/60.7	6/54.5	0.004331
	N	156/25.70	48/26.8	74/24.3	30/26.8	4/36.4	
	DK	135/22.24	56/31.3	64/20.9	14/12.5	1/9.1	
Question 12	Y	196/32.29	50/27.9	106/34.8	36/32.1	4/36.4	0.78509
	N	329/54.01	104/58.1	161/52.8	59/52.7	5/45.4	
	DK	82/13.51	25/14.0	38/12.4	17/15.2	2/18.2	
Question 13	Y	194/31.96	57/31.8	92/30.2	39/34.8	6/54.5	0.237384
	N	314/51.73	88/49.2	161/52.8	62/55.4	3/27.3	
	DK	99/16.31	34/19.0	52/17.0	11/9.8	2/18.2	

For the questions relating to readiness and competence of the institution and staff (Questions 10–13, Section "Subjects and questionnaires"), there was significant variation with age group for question 11 (whether the surveillance tool used in their institution is effective to prevent or control infection; Chi square 18.9028; $p = 0.004331$). Once again, this was mainly attributable to higher than expected levels of 'don't know' answers among the 18–29 years category, while respondents in the 45–59 year category had lower than expected levels of 'don't know' responses (Table 6, Appendix D). For question 10 (whether their hospital is prepared for any infection outbreak; Chi square 9.8538, $p = 0.130947$), question 12 (whether all staff in their unit were following promptly infection control policies, rules and guidelines; Chi square 3.1866; $p = 0.78509$) and question 13 (whether all staff can differentiate between different isolation protocols such as droplet or contact; Chi square 8.0098; $p = 0.237384$), there was no significant difference in age group distribution (Table 6, Appendix D). This was reflective of a relatively uniform level of pessimism ('No' responses) regardless of age group in response to these questions.

In terms of nationality, we considered whether there were any differences in responses between Saudi and non-Saudi staff. There was a significant difference in distribution of Saudi versus non-Saudi staff by institution type (Chi square 85.6424; $p < 0.00001$; Table 7). This was mainly due to non-Saudi staff being significantly more likely than expected to work in private hospitals or poly clinics, and significantly less likely to work in government hospitals, while the opposite was the case for Saudi staff (Table 7). By contrast, there was no significant variation in Saudi and non-Saudi staff among the different HCW professions (Chi square 4.8523; $p = 0.18294$).

There was some variation in responses between Saudi and non-Saudi staff (Table 8, Appendix E). Numbers and percentages of responses in each group and the p value obtained from Chi square analyses are shown in Table 6 and the Chi square breakdowns are shown in Appendix E.

There was variation in responses to questions related to institution-specific issues (Questions 1–5, Section "Subjects and questionnaires"). For knowing whether or not there is an infection control program at their institution (Question 1a), there was

Table 7
Institution distribution by nationality.

Type of institution			
	Government hospital N (expected) [Chi square] % of national group	Private hospital N (expected) [Chi square] % of national group	Poly clinic (n/%) N (expected) [Chi square] % of national group
Saudi (n = 446)	376 (332.11) [5.80] 84.30	54 (87.44) [12.79] 12.11	16 (26.45) [4.13] 4.44
Non-Saudi (n = 161)	76 (119.89) [16.07] 47.20	65 (31.56) [35.42] 40.37	20 (9.55) [11.44] 12.42

Table 8
Distribution of responses by nationality.

Question	Response	All staff (n = 607)	Saudi (n = 446)	Non-Saudi (n = 161)	p
Number/percentage of groups					
Question 1a	Y	500/82.37	362/81.17	138/85.71	0.429242
	N	55/9.06	43/9.64	12/7.45	
	DK	52/8.57	41/9.19	11/6.83	
Question 1b	Y	486/80.07	346/77.58	142/88.20	0.006838
	N	82/13.51	70/15.70	10/6.21	
	DK	39/6.43	30/6.73	9/5.59	
Question 2	Y	467/76.94	333/74.66	134/83.23	0.026984
	N	140/23.06	113/25.34	27/16.77	
Question 3	Y	389/64.09	267/59.87	122/75.78	0.000354
	N	144/23.72	113/25.34	31/19.25	
	DK	74/12.19	66/14.80	8/4.97	
Question 4	Y	242/39.87	156/34.98	86/53.42	0.000036
	N	170/28.01	127/28.48	43/26.71	
	DK	195/32.13	163/36.55	32/19.88	
Question 5	Y	273/44.98	198/44.39	74/45.96	0.002252
	N	217/35.75	148/33.18	70/43.48	
	DK	117/19.28	100/22.42	17/10.56	
Question 6	Y	269/44.15	177/39.69	92/57.14	0.000019
	N	125/20.76	89/19.96	36/22.36	
	DK	213/35.09	180/40.36	33/20.50	
Question 7	Y	285/46.95	189/42.38	96/59.63	0.000697
	N	206/33.94	162/36.32	44/27.33	
	DK	116/19.11	95/21.30	21/13.04	
Question 8	Healthcare associated	129/21.25	90/20.18	38/23.60	0.033835
	All	282/46.46	198/44.39	84/52.17	
	DK	196/32.29	158/35.43	39/24.22	
Question 9	Y	313/51.57	205/45.96	108/67.08	<0.00001
	N	118/19.44	89/19.96	29/18.01	
	DK	176/28.99	152/34.08	24/14.91	
Question 10	Y	296/48.76	193/43.27	103/63.98	<0.00001
	N	217/35.75	183/41.03	34/21.1	
	DK	94/15.49	70/15.70	24/14.91	
Question 11	Y	316/52.06	217/48.65	99/61.49	0.012195
	N	156/25.70	119/26.68	37/22.98	
	DK	135/22.24	110/24.66	25/15.53	
Question 12	Y	196/32.29	125/28.03	71/44.10	0.000642
	N	329/54.01	260/58.30	69/42.86	
	DK	82/13.51	61/13.68	21/13.04	
Question 13	Y	194/31.96	119/26.68	75/46.58	0.000021
	N	314/51.73	248/55.61	66/40.99	
	DK	99/16.31	79/17.71	20/12.42	

Y: yes; N: no; DK: don't know; $p < 0.05$ considered significant (from Chi square comparison).

no significant difference noted across the groups (Chi square 1.6915; p = 0.429242). However, there was significant variation in responses as to whether there is an infection control program in their unit (Question 1b; Chi square 9.9706; p = 0.006838), mainly due to higher than expected numbers of Saudi staff responding negatively, while the opposite was the case for non-Saudi staff. In terms of whether staff had received some form of training or orientation about infection prevention and control, there was also significant variation (Question 2; Chi square 4.8919; p = 0.026984; Table 8, Appendix E). This was mainly due to lower than expected numbers of non-Saudi staff responding negatively. There were also significantly different levels of awareness of whether there is an active infection control team in their institution (Question 3; Chi square 15.8924; p = 0.000354), mainly attributable to non-Saudi staff being more likely than expected to respond positively and less likely to respond negatively or with a 'don't know' answer. The

distribution was similar to that obtained for private hospital staff (Tables 3 and 8, Appendices C and E). There was also significant variation in responses to the question of whether the institution had an emerging infectious diseases task force (dealing with outbreaks) (Chi square 20.4543; p = 0.000036; Question 4; Table 8, Appendix E). This was mainly due to non-Saudi staff being more likely than expected to respond positively, and less likely to respond 'don't know. On the question of whether an outbreak had ever been encountered in their institution, there was also significant variation (Question 5; Chi square 12.1919; p = 0.002252), mainly due to non-Saudi staff being significantly less likely than expected to respond negatively or with a 'don't know' answer, while Saudi staff were more likely than expected to respond 'don't know' (Table 8, Appendix E).

On questions on surveillance and reporting standards (questions 6–9, Section "Subjects and questionnaires"), there was also significant variability in responses to all questions. There was significant variation on the question of whether their hospital is enrolled in national surveillance system (Question 6; Chi square 21.7659; p = 0.000019; Table 8, Appendix E), and on whether there was a list of reportable infectious agents available in their unit and accessible to all staff (Question 7; Chi square 14.5375; p = 0.000697). In both cases, this was mainly attributable to non-Saudi staff being more likely than expected to respond positively and less likely to respond 'don't know', while the opposite was true for Saudi staff. (Table 8, Appendix E). With respect to the question of which infections are reported to the MOH (Question 8), there was also significant variation (Chi square 6.7725; p = 0.033835; Table 8, Appendix E). This was mainly due to non-Saudi staff being relatively less likely to respond 'don't know'. On the question of whether their institution had a known turnaround time of laboratory results of the reportable infectious agents (Question 9), there was again significant variation (Chi square 25.4586; p < 0.00001; Table 8, Appendix E). This was mainly attributable to non-Saudi staff being significantly more likely to respond positively and significantly less likely to respond with a 'don't know' answer, similar to private hospital staff.

On questions relating to readiness and competence of the institution and staff (Questions 10–13, Section "Subjects and questionnaires"), there also variability in responses to all questions between staff of different nationalities (Question 10: Chi square 23.5655, $p < 0.00001$; Question 11: Chi square 8.8135, $p = 0.012195$; Question 12: Chi square 14.7013, $p = 0.000642$; Question 13: Chi square 21.5735, $p = 0.000021$; Table 8, Appendix E). In all cases, this was again due to non-Saudi staff being significantly more likely to respond positively and less likely to respond either negatively or with a 'don't know' than expected, while the opposite was the case for Saudi staff.

Causes, contributing factors and surveillance/reporting systems

The staff were asked to identify what they considered to be the cause(s) of outbreaks from a list of choices (Table 9). The top cited overall cause was carelessness of healthcare workers (cited by 395 HCW, 65.07% of the total group). This was the case across all three institution types. They were also asked to identify factors that contribute to the spread of infection in the hospital from a series of choices. The top-cited factor by the group overall was hospital infrastructure and design (329; 54.20%), followed closely by lack and shortage of staff (326; 53.71%) and no infection control training program (314; 51.73%) (Table 9). When considered for different institution types, lack and shortage of staff was the top cited factor within both government and private hospitals (53.8% and 65.6% respectively), while this was cited by only 13.9% of poly clinics staff. In poly clinics, the top-cited cause it was no infection control training program (20; 55.6%). Staff were also asked what surveillance/reporting systems were used in their institutions, and which surveillance/reporting system they would consider most effective (Table 9). The most widely used was a paper version (395; 65.07%), but this was the least frequently chosen option by participants (197/32.45%). An electronic surveillance system was the least often used (312; 51.40%), but considered the most effective by the highest number of staff (493; 81.22%). An electronic surveillance system was reported as the most commonly used only in private hospitals (81.51% compared to 43.58% of government hospitals and 50.00% of poly clinics).

Discussion

The aim of this study was to assess awareness of, and adherence to, infection prevention and control guidelines and policies among HCWs in healthcare institutions in Saudi Arabia, including government hospitals, private hospitals and poly clinics. Responses to a series of questions on infection prevention and control were assessed from the perspectives of different HCW professions, institution types, participant age groups and Saudi versus non-Saudi staff.

Saudi Arabia faces unique public health challenges, for example the Umrah and Haji pilgrimages attract more than seven million pilgrims to Saudi Arabia from nearly 200 countries [21]. Infection prevention and control policies at both national macro-policy and at institution and departmental micro-policy level must reflect these challenges. In all cases, training of staff and effective communication of specific guidelines, policies and procedures are imperative in ensuring implementation. Responses in our study suggested relatively high levels of uncertainty among HCWs on personnel and institution-specific issues, surveillance and reporting standards, and readiness and competence to implement policies and respond to outbreaks. There was evidence of variability between different HCW professions, institution types, age groups, and between Saudi versus non-Saudi staff. Evidence emerged, for example, that many staff were unaware of availability of information on reportable infections in their own units, did not feel they had sufficient training and were not confident that infection control guidelines and procedures were being implemented by colleagues. Staff in private hospitals expressed more confidence than those in government hospitals on a number of issues. Differences between Saudi and non-Saudi staff may reflect the fact that non-Saudi staff were more likely than Saudi staff to work in private hospitals.

There have been a number of infection outbreaks in Saudi Arabia in recent years, most significantly Middle East Respiratory Syndrome (MERS) [5–8]. Most outbreaks have occurred in government hospitals, consistent with the results of our study suggesting greater confidence and preparedness of staff in private hospitals compared to government hospitals. The largest hospital-associated outbreak occurred in a government hospital in Jeddah in 2014, in which illness spread among both hospital patients and HCWs [5,9,11,12]. Other government hospital-based clusters of MERS-CoV cases occurred in Riyadh in 2014 and 2015 [5,22]. A World Health Organization (WHO) investigation revealed issues such as overcrowding in emergency department waiting rooms, and inconsistent application of basic infection control procedures, such as hand hygiene and use of personal protective equipment (PPE), as factors in MERS-CoV outbreaks in hospitals in Saudi Arabia [11]. In the Jeddah hospital, aggressive improvement in infection control deficiencies resulted in a decline in cases [18]. The MOH introduced new infection prevention and control guidelines for MERS-CoV patients [6,13–16]. Many of these guidelines are generally applicable to infection prevention and control for all infectious diseases, with emphasis on standard, contact, droplet and airborne precautions, management of overcrowding, and triaging in the emergency department [6]. The MOH expressed the hope that they would be strictly adhered to by all HCWs and in all healthcare facilities [6].

Table 9
Causes, contributing factors and surveillance system effectiveness.

	Number/percentage of total
In your opinion, what is the cause(s) of outbreaks:	
Breaching infection control policies, rules, and guidelines	308/50.74
No clear infection control policies, rules, and guidelines	229/37.73
Carelessness of healthcare workers	395/65.07 (top cited cause))
Shortage of appropriate personnel protective equipment	259/42.67
Infection control infrastructures do not exist	207/34.10
Factors that contribute to the spread of infection in the hospital:	
Hospital infrastructure and design	329/54.20 (top cited factor)
Lack and shortage of staff	326/53.71
No infection control training program	314/51.73
No resources to fulfil the infection control requirements and needs	264/43.49
No infection control on-call	199/32.78

Reporting system	Used in institution? (number/percentage)	Most effective? (number/percentage)
Electronic surveillance system	312/51.40	493/81.22
Paper version	395/65.07	197/32.45
Telephone communication	280/46.13	259/42.67

Despite this, in our study the majority of staff of all professions did not think staff in their unit were following promptly infection control policies, rules and guidelines, or that all staff can differentiate between different isolation protocols such as droplet or contact. Nurses generally tended to have more confidence and be less uncertain than the other professions on these and other questions. While nurses were more likely to be female than male, gender had no impact on responses to any of the questions asked, thus the variation in nurses' responses did not relate to gender. Physicians were notably more pessimistic than other staff on these points. While staff in private hospitals were more likely to think that staff in their unit were following promptly infection control policies, rules and guidelines, nevertheless positive responses were confined to a minority of staff, and there was no significant difference across institution types on whether staff can differentiate between different isolation protocols such as droplet or contact. Effective staff training on these elements appears to be urgently required.

A majority of staff of all types and across all institutions reported some experience of training or orientation, with nurses and staff in private hospitals most likely to have received training. Despite this, staff also identified lack of an infection control training program as one of the most important factors that contribute to the spread of infection in the hospital. This suggests that the level of staff training is not considered adequate by HCWs to equip them for implementation of infection control and prevention policy and guidelines. Consistent with this, there was a low level of confidence in the preparedness of institutions for any infection outbreak, although staff in private hospitals and nurses in general were more positive. Staff perceive that government hospitals and poly clinics in particular need urgently to address staff training and orientation to ensure effective implementation of MOH guidelines and ensure preparedness for any infection outbreak.

The effectiveness of promotion and consistent application of both basic infection control procedures, such as hand hygiene, and more advanced measures, has been demonstrated in the hospital-associated MERS-CoV outbreaks in Saudi Arabia and in Korea [17–20]. A combination of advanced and basic infection control measures also reduced transmission of MERS-CoV to HCWs in a recent study in a tertiary care institution in Saudi Arabia [17]. However, for effective implementation of MOH-prescribed infection control and prevention measures, consultation of front-line employees is vital, and expectations of both management and employees should be clearly defined, communicated and understood [1,7]. Understaffing, frequent staff turnover, poor design and infrastructure of facilities and lack of education and training opportunities are factors that can impact on effective infection prevention and control [23]. Consistent with this, in our study staff identified hospital infrastructure and design, lack and shortage of staff and no infection control training program as the top factors contributing to the spread of infection in the hospital. Participants perceived that carelessness of healthcare workers was the main cause of outbreaks. Although this perception may be faulty, the pressures imposed on staff by inadequate nurse/physician to patient ratios, lack of adequate system resources and sub-optimal hospital infrastructure can challenge the ability of staff to consistently and carefully apply infection prevention and control procedures. Furthermore, there was a relatively high level of uncertainty among some staff types, notably physicians and staff in poly clinics, as to existence of infection control policies and guidelines in their unit. This suggests a breakdown in communication of expectations and guidelines. This could contribute to apparent carelessness in application of procedures, as staff are unclear as to what the required procedures are. There was also a strikingly high lack of uncertainty among staff of all HCW professions as to whether their institution had an emerging infectious diseases task force (dealing with outbreaks), and indeed as to whether their institution has ever experienced an outbreak. Uncertainty on these questions was particularly striking among younger staff, suggesting that further training and communication with HCWs in the 18–29 year old age group across all professions would be beneficial.

MOH-prescribed infection control and prevention measures include advice and directions on enrolment of hospitals in the national surveillance system and the reporting of infectious agents to the MOH. There was a strikingly high lack of certainty among staff of all types and across institutions as to whether their hospital was enrolled in the national surveillance system. There was also high uncertainty as to what infections should be reported, with nurses and staff at private hospitals being less uncertain than other staff. Again, younger staff were significantly less certain than staff aged over 45 years old. Lack of certainty on this point may relate to lack of availability of, access to, or awareness of, a list of reportable infectious agents available within units. In either case, this suggests an urgent need to meet staff needs for access to such lists, which would be relatively easily addressed.

Overall, disappointingly low numbers of staff of all types thought that the surveillance tool used in their institution was effective to prevent or control infection, even in private hospitals, an element that could be relatively easily addressed. The most commonly used tool–except for in private hospitals–was a paper version, but this was considered least effective by staff. An electronic surveillance system was the least often used–except in private hospitals–but considered the most effective by staff. Imple-

mentation of electronic surveillance systems would therefore be a measure that could be implemented more widely in government hospitals and poly clinics to improve staff confidence.

Effectiveness of adherence to effective infection control procedures has been demonstrated in hospitals in Saudi Arabia. For example, increased compliance with hand hygiene practices due to a series of interventions over a five year period was associated with reduction in HC-MRSA and device-associated infections in a Saudi hospital [24]. Also, a suite of advanced infection control measures in addition to basic IC measures resulted in no transmission of MERS-CoV to HCWs [17]. The results of our study suggest that HCWs in Saudi Arabia are aware of limitations in infection control and prevention implementation, and of exacerbating factors in their institutions. Multiple steps are needed to facilitate staff in implementation of guidelines and policies and to improve awareness and compliance, for example on hand hygiene compliance in ICU units [7]. Thus, as evident from the responses of staff in our study, the approach to infection prevention and control measures should be multi-factorial and include ongoing provision of education and training, prominent reminders and reliable provision of the materials needed to implement the policies and guidelines, as well as the involvement and support of hospital management [7]. Attention should also be paid to differences in emphases that may be required in different vulnerable units or departments, including the emergency department, inpatient areas, the dialysis unit and outpatient areas [18,23,25].

While our study has given some insights into the knowledge and perception of HCWs in Saudi Arabia in infection prevention and control in their institutions, it has some limitations. The method by which the questionnaire was administered meant that we had no information as to the number of institutions the respondents were gathered from. Nor could we check whether the 'yes' and 'no' responses were 'correct' for particular institutions, as we did not ask respondents for the identity of their institutions. The questionnaire also did not allow participants to elaborate on elements such as the level or type of training they received or what they would class as 'carelessness' in implementation of infection prevention and control measures. Participants also chose to respond, and might therefore be more than averagely motivated individuals rather than completely representative of the HCW population as a whole.

In conclusion, we have identified areas of concern among HCWs in healthcare facilities in Saudi Arabia on infection prevention and control, which vary between institutions and among different professions. These issues merit urgent action in terms consultation with and training of staff, improvement of communication of infection prevention and control guidelines and policies, and provision of adequate resources and equipment, to improve implementation of infection prevention and control policies and try to ensure outbreaks such as MERS-CoV can be minimized and contained.

Acknowledgment

The authors would like to thank all the participants in this survey.

Appendix A. : Study questionnaire

Age:
18–24
25–30
31–40
41–50
51–60
>60

Gender:
Male
Female

Medical Profession:
Physician
Nursing
Lab Tech
Others

I am working at:
Private hospital
Government hospital
Poly clinic (private sector)

Do you have infection control program at your institution?
Yes
No
Don't know

Have you received some form of training or orientation about infection prevention and control?
Yes
No

Do you have infection control policies and guidelines in your unit?
Yes
No
Don't know

Do you think that all staff in your unit are following promptly infection control policies, rules and guidelines?
Yes
No
Don't know

Do you think your hospital is prepared for any infection outbreak?
Yes
No
Don't know

In your opinion, what is the cause(s) of outbreaks?
Breaching infection control policies, rules, and guidelines
No clear infection control policies, rules, and guidelines
Carelessness of healthcare workers
Shortage of appropriate personnel protective equipment
Infection control infrastructures do not exist

Factors that contribute to the spread of infection in the hospital:
Hospital infrastructure and design
Lack and shortage of staff
No infection control training program
No resources to fulfill the infection control requirements and needs
No infection control on-call

At your institution, do you have active infection control team?
Yes
No
Don't know

Do you think that all staff can differentiate between different isolation protocol such as droplet or contact?
Yes
No
Don't know

Do you have a list of reportable infectious agents available in your unit and accessible to all staff:
Yes
No
Don't know

Is your hospital is enrolled in national surveillance system:
Yes
No
Don't know

Which infections are reported to MOH:
All healthcare associated infections
All infections (both hospital and community acquired)
Don't know

In your institution, is there known turnaround time of laboratory results of the reportable infectious agents:
Yes
No
Don't know

What is reporting system do you have at your hospitals:
Electronic surveillance system
Paper version
Telephone communication

In your opinion, what is the effective reporting system for reporting infectious agents:
Electronic surveillance system
Paper version
Telephone communication

Do you have an emerging infectious diseases task force (dealing with outbreaks)
Yes
No
Don't know

Do you agree that surveillance tool used in your institution is effective to prevent or control infection
Yes
No
Don't know

Appendix B. : Chi square breakdown profession type

Profession					
Question N (Expected) [Chi square]	Response	Physicians	Nurses	Lab staff	Others
1a	Y	116 (109.6) [0.38]	136 (133.44) [0.05]	191 (191.93) [0.00]	57 (65.07) [1.00]
	N	8 (12.05) [1.36]	15 (14.68) [0.01]	23 (21.11) [0.17]	9 (7.16) [0.47]
	DK	9 (11.39) [0.50]	11 (13.88) [0.60]	19 (19.96) [0.05]	13 (6.77) [5.74]
1b	Y	99 (106.49) [0.53]	142 (129.71) [1.17]	191 (186.55) [0.11]	54 (63.25) [1.35]
	N	21 (17.97) [0.51]	16 (21.88) [1.58]	31 (31.48) [0.01]	14 (10.67) [1.04]
	DK	13 (8.55) [2.32]	4 (10.41) [3.95]	11 (14.97) [1.05]	11 (5.08) [6.91]
2	Y	102(102.32)[0.00]	142 (124.64) [2.42]	165 (179.26) [1.13]	58 (60.78) [0.13]
	N	31 (30.68) [0.00]	20 (37.36) [8.07]	68 (53.74) [3.78]	21 (18.22) [0.42]
3	Y	77 (85.23) [0.80]	116 (103.82) [1.43]	143 (149.32) [0.27]	53 (50.63) [0.11]
	N	43 (31.55) [4.15]	31 (38.43) [1.44]	57 (55.28) [0.05]	13 (18.74) [1.76]
	DK	13 (16.21) [0.64]	15 (19.75) [1.14]	33 (28.41) [0.74]	13 (9.63) [1.18]
4	Y	49 (53.02) [0.31]	73 (64.59) [1.10]	87 (92.89) [0.37]	33 (31.50) [0.07]
	N	42 (37.25) [0.61]	44 (45.37) [0.04]	63 (65.26) [0.08]	21 (22.13) [0.06]
	DK	42 (42.73) [0.01]	45 (52.04) [0.95]	83 (74.85) [0.89]	25 (25.38) [0.01]
5	Y	70 (59.60) [1.82]	82 (72.59) [1.22]	84 (104.41) [3.99]	36 (35.40) [0.01]
	N	48 (47.77) [0.00]	46 (58.18) [2.55]	99 (83.68) [2.80]	25 (28.37) [0.40]
	DK	15 (25.64) [4.41]	34 (31.23) [0.25]	50 (44.91) [0.58]	18 (15.23) [0.50]
6	Y	60 (58.94) [0.02]	84 (71.79) [2.08]	89 (103.26) [1.97]	36 (35.01) [0.03]
	N	26 (27.39) [0.07]	27 (33.36) [1.21]	54 (47.98) [0.75]	18 (16.27) [0.18]
	DK	47 (46.67) [0.00]	51 (56.85) [0.60]	90 (81.76) [0.83]	25 (27.72) [0.27]
7	Y	60 (58.94) [0.02]	84 (71.79) [2.08]	89 (103.26) [1.97]	36 (35.01) [0.03]
	N	26 (27.39) [0.07]	27 (33.36) [1.21]	54 (47.98) [0.75]	18 (16.27) [0.18]
	DK	47 (46.67) [0.00]	51 (56.85) [0.60]	90 (81.76) [0.83]	25 (27.72) [0.27]
8	Healthcare	60 (58.94) [0.02]	84 (71.79) [2.08]	89 (103.26) [1.97]	36 (35.01) [0.03]
	All	26 (27.39) [0.07]	27 (33.36) [1.21]	54 (47.98) [0.75]	18 (16.27) [0.18]
	DK	47 (46.67) [0.00]	51 (56.85) [0.60]	90 (81.76) [0.83]	25 (27.72) [0.27]
9	Y	50 (68.58) [5.03]	82 (83.54) [0.03]	146 (120.15) [5.56]	35 (40.74) [0.81]
	N	30 (25.86) [0.66]	27 (31.49) [0.64]	48 (45.29) [0.16]	13 (15.36) [0.36]
	DK	53 (38.56) [5.40]	53 (46.97) [0.77]	39 (67.56) [12.07]	31 (22.91) [2.86]
10	Y	50 (64.86) [3.40]	95 (79.00) [3.24]	107 (113.62) [0.39]	44 (38.52) [0.78]
	N	62 (47.55) [4.39]	56 (57.91) [0.06]	79 (83.30) [0.22]	20 (28.24) [2.41]
	DK	21 (20.60) [0.01]	11 (25.09) [7.91]	47 (36.08) [3.30]	15 (12.23) [0.63]
11	Y	54 (69.24) [3.35]	91 (84.34) [0.53]	128 (121.30) [0.37]	43 (41.13) [0.09]
	N	43 (34.18) [2.28]	37 (41.63) [0.52]	59 (59.88) [0.01]	17 (20.30) [0.54]
	DK	36 (29.58) [1.39]	34 (36.03) [0.11]	46 (51.82) [0.65]	19 (17.57) [0.12]
12	Y	28 (42.95) [5.20]	55 (52.31) [0.14]	82 (75.24) [0.61]	31 (25.51) [1.18]
	N	79 (72.09) [0.66]	95 (87.81) [0.59]	121 (126.29) [0.22]	34 (42.82) [1.82]
	DK	26 (17.97) [3.59]	12 (21.88) [4.46]	30 (31.48) [0.07]	14 (10.67) [1.04]
13	Y	28 (42.51) [4.95]	77 (51.78) [12.29]	64 (74.47) [1.47]	25 (25.25) [0.00]
	N	88 (68.80) [5.36]	69 (83.80) [2.61]	124 (120.53) [0.10]	33 (40.87) [1.51]
	DK	17 (21.69) [1.01]	16 (26.42) [4.11]	45 (38.00) [1.29]	21 (12.88) [5.11]

Y: yes; N: No; DK: Don't know.

Appendix C. : Chi square breakdown institution type

Institution				
Question N (Expected) [Chi square]	Response	Government hospital	Private hospital	Poly clinic
1a	Y	373 (372.3) [0.00]	108 (98.02) [1.02]	19 (29.65) [3.83]
	N	41 (40.96) [0.00]	5 (10.78) [3.10]	9 (3.26) [10.09]
	DK	38 (38.72) [0.01]	6 (10.19) [1.73]	8 (3.08)[7.84]
1b	Y	350 (361.9) [0.39]	113 (95.28) [3.30]	23 (28.82) [1.18]
	N	70 (61.06) [1.31]	4 (16.08) [9.07]	8 (4.86) [2.02]
	DK	32 (29.04) [0.30]	2 (7.65) [4.17]	5 (2.31) [3.12]
2	Y	340 (347.8) [0.17]	102 (91.55) [1.19]	25 (27.70) [0.26]
	N	112 (104.3) [0.58]	17 (27.45) [3.98]	11 (8.30) [0.88]
3	Y	279 (289.7) [0.39]	96 (76.26) [5.11]	14 (23.07) [3.57]
	N	111 (107.2) [0.13]	14 (28.23) [7.17]	19 (8.54) [12.81]
	DK	62 (55.10) [0.86]	9 (14.51) [2.09]	3 (4.39) [0.44]
4	Y	166 (180.20) [1.12]	64 (47.44) [5.78]	12 (14.35) [0.39]
	N	132 (126.59) [0.23]	25 (33.33) [2.08]	13 (10.08) [0.84]
	DK	154 (145.21) [0.53]	30 (38.23) [1.77]	11 (11.57) [0.03]
5	Y	205 (202.54) [0.03]	55 (53.32) [0.05]	12 (16.13) [1.06]
	N	153 (162.33) [0.54]	45 (42.74) [0.12]	20 (12.93) [3.87]
	DK	94 (87.12) [0.54]	19 (22.94) [0.68]	4 (6.94) [1.24]
6	Y	190 (200.31) [0.53]	66 (52.74) [3.34]	13 (15.95) [0.55]
	N	93 (93.08) [0.00]	23 (24.51) [0.09]	9 (7.41) [0.34]
	DK	169 (158.61) [0.68]	30 (41.76) [3.31]	14 (12.63) [0.15]
7	Y	204 (212.22) [0.32]	66 (55.87) [1.84]	15 (16.90) [0.21]
	N	163 (153.40) [0.60]	32 (40.39) [1.74]	11 (12.22) [0.12]
	DK	85 (86.38) [0.02]	21 (22.74) [0.13]	10 (6.88) [1.42]
8	Healthcare	101 (95.31) [0.34]	17 (25.09) [2.61]	10 (7.59) [0.76]
	All	198 (209.99) [0.68]	73 (55.29) [5.68]	11 (16.72) [1.96]
	DK	153 (146.70) [0.27]	29 (38.62) [2.40]	15 (11.68) [0.94]
9	Y	209 (233.07) [2.49]	87 (61.36) [10.71]	17 (18.56) [0.13]
	N	95 (87.87) [0.58]	14 (23.13) [3.61]	9 (7.00) [0.57]
	DK	148 (131.06) [2.19]	18 (34.50) [7.89]	10 (10.44) [0.02]
10	Y	194 (220.42) [3.17]	86 (58.03) [13.48]	16 (17.56) [0.14]
	N	187 (161.59) [4.00]	18 (42.54) [14.16]	12 (12.87) [0.06]
	DK	71 (70.00) [0.01]	15 (18.43) [0.64]	8 (5.57) [1.05]
11	Y	227 (235.31) [0.29]	73 (61.95) [1.97]	16 (18.74) [0.40]
	N	124 (116.16) [0.53]	23 (30.58) [1.88]	9 (9.25) [0.01]
	DK	101 (100.53) [0.00]	23 (26.47) [0.45]	11 (8.01) [1.12]
12	Y	131 (145.95) [1.53]	51 (38.43) [4.12]	14 (11.62) [0.49]
	N	263 (244.99) [1.32]	54 (64.50) [1.71]	12 (19.51) [2.89]
	DK	58 (61.06) [0.15]	14 (16.08) [0.27]	10 (4.86) [5.43]
13	Y	134 (144.46) [0.76]	48 (38.03) [2.61]	12 (11.51) [0.02]
	N	245 (233.82) [0.53]	52 (61.56) [1.48]	17 (18.62) [0.14]
	DK	73 (73.72) [0.01]	19 (19.41) [0.01]	7 (5.87) [0.22]

Y: yes; N: No; DK: Don't know.

Appendix D. : Chi square breakdown age group

Age group					
Question N (Expected) [Chi square]	Response	18–29	30–44	45–59	≥60
1a	Y	140 (147.45) [0.38]	246 (251.24) [0.11]	103 (92.26) [1.25]	11 (9.06) [0.41]
	N	14 (16.22) [0.30]	36 (27.64) [2.53]	5 (10.15) [2.61]	0 (1.00) [1.00]
	DK	25 (15.33) [6.09]	23 (26.13) [0.37]	4 (9.59) [3.26]	0 (0.94) [0.94]
1b	Y	140 (143.32) [0.08]	238 (244.20) [0.16]	97 (89.67) [0.60]	11 (8.81) [0.55]
	N	26 (24.18) [0.14]	44 (41.20) [0.19]	12 (15.13) [0.65]	0 (1.49) [1.49]
	DK	13 (11.50) [0.20]	23 (19.60) [0.59]	3 (7.20) [2.45]	0 (0.71) [0.71]
2	Y	134 (137.71) [0.10]	235 (234.65) [0.00]	90 (86.17) [0.17]	8 (8.46) [0.03]
	N	45 (41.29) [0.33]	70 (70.35) [0.00]	22 (25.83) [0.57]	3 (2.54) [0.08]
3	Y	97 (114.71) [2.74]	198 (195.46) [0.03]	85 (71.78) [2.44]	9 (7.05) [0.54]
	N	51 (42.46) [1.72]	68 (72.36) [0.26]	24 (26.57) [0.25]	1 (2.61) [0.99]
	DK	31 (21.82) [3.86]	39 (37.18) [0.09]	3 (13.65) [8.31]	1 (1.34) [0.09]
4	Y	61 (71.36) [1.51]	113 (121.60) [0.61]	62 (44.65) [6.74]	6 (4.39) [0.59]
	N	44 (50.13) [0.75]	95 (85.42) [1.07]	28 (31.37) [0.36]	3 (3.08) [0.00]
	DK	74 (57.50) [4.73]	97 (97.98) [0.01]	22 (35.98) [5.43]	2 (3.53) [0.67]
5	Y	74 (80.21) [0.48]	137 (136.67) [0.00]	55 (50.19) [0.46]	6 (4.93) [0.23]
	N	54 (64.29) [1.65]	113 (109.54) [0.11]	47 (40.22) [1.14]	4 (3.95) [0.00]
	DK	51 (34.50) [7.89]	55 (58.79) [0.24]	10 (21.59) [6.22]	1 (2.12) [0.59]
6	Y	64 (79.33) [2.96]	138 (135.16) [0.06]	60 (49.63) [2.16]	7 (4.87) [0.93]
	N	31 (36.86) [0.93]	64 (62.81) [0.02]	29 (23.06) [1.53]	1 (2.27) [0.71]
	DK	84 (62.81) [7.15]	103 (107.03) [0.15]	23 (39.30) [6.76]	3 (3.86) [0.19]
7	Y	74 (84.04) [1.20]	137 (143.20) [0.27]	66 (52.59) [3.42]	8 (5.16) [1.56]
	N	64 (60.75) [0.17]	107 (103.51) [0.12]	32 (38.01) [0.95]	3 (3.73) [0.14]
	DK	41 (34.21) [1.35]	61 (58.29) [0.13]	14 (21.40) [2.56]	0 (2.10) [2.10]
8	Healthcare	32 (37.75) [0.87]	67 (64.32) [0.11]	24 (23.62) [0.01]	5 (2.32) [3.10]
	All	74 (83.16) [1.01]	141 (141.70) [0.00]	64 (52.03) [2.75]	3 (5.11) [0.87]
	DK	73 (58.09) [3.82]	97 (98.99) [0.04]	24 (36.35) [4.20]	3 (3.57) [0.09]
9	Y	74 (92.30) [3.63]	164 (157.27) [0.29]	68 (57.75) [1.82]	7 (5.67) [0.31]
	N	34 (34.80) [0.02]	61 (59.29) [0.05]	22 (21.77) [0.00]	1 (2.14) [0.61]
	DK	71 (51.90) [7.03]	80 (88.43) [0.80]	22 (32.47) [3.38]	3 (3.19) [0.01]
10	Y	83 (87.29) [0.21]	144 (148.73) [0.15]	62 (54.62) [1.00]	7 (5.36) [0.50]
	N	62 (63.99) [0.06]	114 (109.04) [0.23]	40 (40.04) [0.00]	1 (3.93) [2.19]
	DK	34 (27.72) [1.42]	47 (47.23) [0.00]	10 (17.34) [3.11]	3 (1.70) [0.99]
11	Y	75 (93.19) [3.55]	167 (158.78) [0.43]	68 (58.31) [1.61]	6 (5.73) [0.01]
	N	48 (46.00) [0.09]	74 (78.39) [0.25]	30 (28.78) [0.05]	4 (2.83) [0.49]
	DK	56 (39.81) [6.58]	64 (67.83) [0.22]	14 (24.91) [4.78]	1 (2.45) [0.86]
12	Y	50 (57.80) [1.05]	106 (98.48) [0.57]	36 (36.16) [0.00]	4 (3.55) [0.06]
	N	104 (97.02) [0.50]	161 (165.31) [0.11]	59 (60.71) [0.05]	5 (5.96) [0.16]
	DK	25 (24.18) [0.03]	38 (41.20) [0.25]	17 (15.13) [0.23]	2 (1.49) [0.18]
13	Y	57 (57.21)[0.00]	92 (97.48) [0.31]	39 (35.80) [0.29]	6 (3.52) [1.76]
	N	88 (92.60) [0.23]	161 (157.78) [0.07]	62 (57.94) [0.28]	3 (5.69) [1.27]
	DK	34 (29.19) [0.79]	52 (49.74) [0.10]	11 (18.27) [2.89]	2 (1.79) [0.02]

Appendix E. : Chi square breakdown nationality

Nationality			
Question N (Expected) [Chi square]	Response	Saudi	Non-Saudi
1a	Y	362 (367.38) [0.08]	138 (132.62) [0.22]
	N	43 (40.41) [0.17]	12 (14.59) [0.46]
	DK	41 (38.21) [0.20]	11 (13.79) [0.57]
1b	Y	346 (358.56) [0.44]	142 (129.44) [1.22]
	N	70 (58.78) [2.14]	10 (21.22) [5.93]
	DK	30 (28.66) [0.06]	9 (10.34) [0.17]
2	Y	333 (343.13) [0.30]	134 (123.87) [0.83]
	N	113 (102.87) [1.00]	27 (37.13) [2.77]
3	Y	267 (285.82) [1.24]	122 (103.18) [3.43]
	N	113 (105.81) [0.49]	31 (38.19) [1.36]
	DK	66 (54.37) [2.49]	8 (19.63) [6.89]
4	Y	156 (177.81) [2.68]	86 (64.19) [7.41]
	N	127 (124.91) [0.03]	43 (45.09) [0.10]
	DK	163 (143.28) [2.71]	32 (51.72) [7.52]
5	Y	198 (199.86) [0.02]	74 (72.14) [0.05]
	N	148 (160.18) [0.93]	70 (57.82) [2.56]
	DK	100 (85.97) [2.29]	17 (31.03) [6.35]
6	Y	177 (197.65) [2.16]	92 (71.35) [5.98]
	N	89 (91.85) [0.09]	36 (33.15) [0.24]
	DK	180 (156.50) [3.53]	33 (56.50) [9.77]
7	Y	189 (209.41) [1.99]	96 (75.59) [5.51]
	N	162 (151.36) [0.75]	44 (54.64) [2.07]
	DK	95 (85.23) [1.12]	21 (30.77) [3.10]
8	Healthcare	90 (94.05) [0.17]	38 (33.95) [0.48]
	All	198 (207.20) [0.41]	84 (74.80) [1.13]
	DK	158 (144.75) [1.21]	39 (52.25) [3.36]
9	Y	205 (229.98) [2.71]	108 (83.02) [7.52]
	N	89 (86.70) [0.06]	29 (31.30) [0.17]
	DK	152 (129.32) [3.98]	24 (46.68) [11.02]
10	Y	193 (217.49) [2.76]	103 (78.51) [7.64]
	N	183 (159.44) [3.48]	34 (57.56) [9.64]
	DK	70 (69.07) [0.01]	24 (24.93) [0.03]
11	Y	217 (232.18) [0.99]	99 (83.82) [2.75]
	N	119 (114.62) [0.17]	37 (41.38) [0.46]
	DK	110 (99.19) [1.18]	25 (35.81) [3.26]
12	Y	125 (144.01) [2.51]	71 (51.99) [6.95]
	N	260 (241.74) [1.38]	69 (87.26) [3.82]
	DK	61 (60.25) [0.01]	21 (21.75) [0.03]
13	Y	119 (142.54) [3.89]	75 (51.46) [10.77]
	N	248 (230.71) [1.29]	66 (83.29) [3.59]
	DK	79 (72.74) [0.54]	20 (26.26) [1.49]

Y: yes; N: No; DK: Don't know.

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