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## Lanyard Cards and Mobile Phones: Vectors for Transmission of Infection at New Najran General Hospital, Saudi Arabia? A cross-Sectional Observation Study with Epidemiological Analysis

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### ABSTRACT

**Background:** Nosocomial infections represent one of the challenging problems of the modern medicine. Healthcare providers play an important role in the transmission of these infections. We aimed to determine the extent of colonization of identity (ID) tags worn around the necks of healthcare workers, and mobile phones and to describe the organisms isolated from them.

**Patients and Methods:** This cross-sectional study was conducted on 69 hospital staff volunteers. Data were collected on job location, description base and the age of the lanyard and the time. The sample were collected from Staff who were wearing fabric or metal-bead ID card lanyards in a range of intensive care unit (ICU), wards and non-clinical areas.

**Results:** On basis of the working place, nurses showed higher tag-cleaning frequency, followed by doctors (37.5%, 20.7%, respectively), while technicians never cleaned their tags. Doctors showed higher frequency of hand hygiene/day followed by nurses ( $6.07 \pm 2.4$ ,  $5.81 \pm 2.3$  respectively). Tag swab results revealed higher growth of Coagulase-negative *staphylococci* among doctors (51.7%) and *Alpha-hemolytic streptococci* were detected only among nurses (6.3%). Mobile swab results revealed higher growth of Coagulase-negative *staphylococci* among doctors and technicians (58.6%, 50% respectively).

**Conclusions:** ID tags and mobiles are potential sources of pathogen spread so many efforts should be taken to make staff awareness toward the potential danger in every institution.

**Keywords:** Lanyards Card; ID Tags; Mobile Phones; Transmission; Infection.



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## INTRODUCTION

It has been established that hospital pathogens can be transmitted by hand from healthcare workers to patients. This may occur as a result of direct contact with patients or indirectly via an inanimate object <sup>(1)</sup>. Nosocomial infections, especially those involving resistant microorganisms, represent one of the challenging problems of modern medicine. Healthcare providers play an important role in the transmission of these infections. White coats, neckties and stethoscopes are among the culprits implicated as vectors for transmission of infections by healthcare providers <sup>(2,3)</sup>. Both pathogenic and non-pathogenic bacteria commonly colonise these items and simple infection-control measures such as strict hand hygiene, specific dress codes for staff and the bare-below-the-elbow policy often help in the fight against nosocomial infections <sup>(4,5)</sup>.

A number of publications have reported on the bacterial colonisation of white coats, neckties and stethoscopes and their possible role in cross infection. With modern security systems in place in most hospitals, it has become important to wear clearly displayed identity (ID) tags, and to have an easily accessible access disc <sup>(6)</sup>.

At Red Cross War Memorial Children's Hospital (RCWMCH), Cape Town, South Africa, as at many other institutions worldwide, these access and ID tags are worn around the neck on a lanyard <sup>(7)</sup>. Mobile phones have become one of the most indispensable accessories of both social and professional life. In the hospital setting, use of mobile phones can lead to improved quality of healthcare, by providing fast and easy access to laboratory and imaging results, and faster communication in case of an emergency <sup>(8,9)</sup>. Simultaneously, they also hold several disadvantages, including noise, distraction, reduced concentration, threats of data safety, and interference with patient safety. Moreover, they may serve as vehicles for transmission of micro-organisms, potentially resulting in nosocomial infection <sup>(10)</sup>.

We aimed to determine the extent of colonization of ID tags worn around the necks of healthcare workers, and mobile phones of staff at New Najran General Hospital, Ministry of Health, Kingdom of Saudi Arabia (KSA) and to describe the organisms isolated from these ID tags, mobile phones and their implication on regular local hospital antibiogram results.

## SUBJECTS AND METHODS

This cross-sectional study was conducted on 69 hospital staff volunteers recruited at New Najran General Hospital, Ministry of Health, KSA. This hospital is a secondary referral include 250-beds, had Saudi Central Board for Accreditation of Healthcare Institutions. Data were also collected on job location, description base and the age of the lanyard and the time, if ever since it was last laundered. A written informed consent was obtained and the details of the participant's grades, specialties, wards, lanyard acquisitions and decontamination histories were

record. The study protocol was reviewed and accepted by Najran IRB (#number: KACST, KSA: H-11-N-081, on September 13,2022).

Samples were collected from Staff (doctors, nurses, cleaners, and administrators (technicians) who were wearing fabric or metal-bead identity card lanyards in a range of intensive care unit (ICU), wards and non-clinical areas i.e., employees were invited to participate and were given a study information sheet.

Also, samples for bacterial culture from the anterior nares, mobile phone (MPs) that used only by owners were collected with a cotton swab moistened with distilled water. Culture samples from anterior nares were collected by rubbing the swab against the anterior 1 cm of the nasal vestibular wall of both nares. After swabbing around anterior nasal nares, mobile phone respectively, a culture plate was streaked with the cotton swab immediately in the scene. The cotton swab of every sample (anterior nares, or MPs) had been cultured on the culture media.

In addition, swabs were moistened with sterile saline, and the surface (front and back) of the ID tag (lanyard), as well as the corners of the tag holder, nasal swab and mobile phone swab, were swabbed in a criss-cross manner. Swabs were inoculated onto standard microbiological media at the laboratory department (microbiology unit) located at new Najran General Hospital. Only potential pathogens (*Staphylococcus aureus* and Gram-negative bacilli) were followed up; organisms resembling normal skin commensals were reported as such.

**Statistical analysis:** Statistical analysis was done by SPSS v28 (IBM Inc., Armonk, NY, USA). Quantitative variables were presented as mean and standard deviation (SD) and comparison between groups was achieved by ANOVA (F) test. Qualitative variables were presented as frequency and percentage (%) and were analysed utilizing the Chi-square test. A two tailed *P* value < 0.05 was considered statistically significant.

## RESULTS

The ID tags and mobile phones of 29 (42.0%) doctors, 32 (46.4%) Nurses and 8 (11.6%) technicians were swabbed. We found that the cards of all participants 69 (100%) not exchanged since (3 months). Of the participants, 50 (72.5%) had never cleaned their ID tag, 18 (26.1%) had sometimes cleaned their ID tag, and 1 (1.4%) had cleaned their ID tag per week. The mean frequency of hand hygiene/day was  $5.80 \pm 2.2$  times. The tag swab results revealed no growth in 45 (65.2%), coagulase-negative *staphylococci* in 22 (31.9%), and alpha-hemolytic streptococci in 2 (2.9%) of the collected swabs. The mobile swab results revealed no growth in 34 (49.3%), coagulase-negative *staphylococci* in 29 (42.0%), alpha-hemolytic *streptococci* in 2 (2.9%) and *staphylococcus aureus* in 4 (5.8%) of the collected swabs. (Table 1)

Table (2) shows the frequency of hand hygiene/day among the different staff departments, ER department had the highest frequency of hand hygiene/day ( $8.0 \pm 3.6$ ), followed by OPD ( $7.2 \pm 2.1$ ), then medical word and surgical word ( $5.8 \pm 1.7$ ,  $5.7 \pm 0.9$  respectively), whereas ICU doctor and radiology had the lowest frequency of hand hygiene/day ( $4.4 \pm 0.9$ ,  $4.5 \pm 1.5$  respectively).

Regarding the decontamination practices and risk of carrying pathogens on basis of the staff department, we found that the tag-cleaning frequency was significantly higher in OPD and ER department (60.0%, 50.0% respectively), while other departments had significantly lower frequency, with being never cleaned in Lab and blood bank (100%). Concerning the frequency of hand hygiene/day, the ER department had significantly the highest frequency of hand hygiene/day ( $8.0 \pm 3.6$ ), followed by OPD ( $7.2 \pm 2.1$ ), then medical word and surgical word ( $5.8 \pm 1.7$ ,  $5.7 \pm 0.9$  respectively), whereas ICU doctor and radiology had the lowest frequency of hand hygiene/day ( $4.4 \pm 0.9$ ,  $4.5 \pm 1.5$  respectively). The results of the obtained tag swab revealed that higher growth of Coagulase-negative staphylococci among ICU doctor, Medical and surgical words (50%, 50%, 45.5% respectively) and was less common among ER departments (10%). Additionally, the results of the obtained mobile swab revealed that higher growth of *Staphylococcus aureus* among Lab and blood bank (40%), higher growth of Coagulase-negative staphylococci among medical word, Lab and blood bank and surgical

word (80%, 60%, 54.5% respectively). This concluding that Lab and blood bank had the least Tag-cleaning frequency, lower frequency of hand hygiene/day, higher growth of mobile swab result including (Coagulase-negative staphylococci and *Staphylococcus aureus*).

There was a significant relation between the staff department and working place, tag-cleaning frequency and frequency of hand hygiene/day ( $P < 0.05$ ) and an insignificant relation between the staff department and tag and mobile swab results (Table 3).

Regarding the decontamination practices and risk of carrying pathogens on basis of the working place, nurses showed higher tag-cleaning frequency, followed by doctors (37.5%, 20.7%, respectively), while technician never cleaned their tags. Doctors showed higher frequency of hand hygiene/day followed by nurses ( $6.07 \pm 2.4$ ,  $5.81 \pm 2.3$  respectively). Tag swab results revealed higher growth of Coagulase-negative staphylococci among doctors (51.7%) and Alpha-hemolytic streptococci were detected only among nurses (6.3%). Additionally, mobile swab results revealed higher growth of Coagulase-negative staphylococci among doctors and technician (58.6%, 50% respectively). There was a significant relation between the working place and the tag swab result ( $P = 0.027$ ) (Table 4).

**Table (1): Demographics, ID-tag cleaning practices and the result of collected swabs of the study participants**

		Total (n=69)
Working place	Doctors	29 (42.0%)
	Nurse	32 (46.4%)
	Technician	8 (11.6%)
Card exchanged since 1 year	No	69 (100%)
Tag-cleaning frequency	No	50 (72.5%)
	Yes, sometimes	18 (26.1%)
	Weekly	1 (1.4%)
Frequency of hand hygiene/day		$5.80 \pm 2.2$
Tag swab result	No growth	45 (65.2%)
	Coagulase-negative <i>staphylococci</i>	22 (31.9%)
	Alpha-hemolytic streptococci	2 (2.9%)
Mobile swab result	No growth	34 (49.3%)
	Coagulase-negative <i>staphylococci</i>	29 (42.0%)
	Alpha- hemolytic <i>streptococci</i>	2 (2.9%)
	<i>Staphylococcus aureus</i>	4 (5.8%)

Data presented as mean  $\pm$  SD or frequency (%).

**Table (2): Frequency of hand hygiene/day among the different staff departments**

	Frequency of hand hygiene/day
ICU doctor	$4.4 \pm 0.9$
Medical word	$5.8 \pm 1.7$
Surgical word	$5.7 \pm 0.9$
Radiology	$4.5 \pm 1.51$
ER department	$8.0 \pm 3.6$
OPD	$7.2 \pm 2.1$
Lab and blood bank	$4.7 \pm 0.8$

Data presented as mean  $\pm$  SD, ICU: intensive care unit, ER: emergency room, OPD: outpatient department.

**Table (3):** Decontamination practices and risk of carrying pathogens regarding the staff department

		ICU doctor (n=8)	Medical word (n=10)	Surgical word (n=11)	Radiology (n=10)	ER department (n=10)	OPD (n=10)	Lab and blood Bank (n=10)	P value
Working place	Doctors	4(50%)	6(60%)	5(45.5%)	4(40%)	3 (30%)	5(50%)	2(20.0%)	<0.001*
	Nurse	4(50%)	4(40%)	6(54.5%)	6(60%)	7(70%)	5(50%)	0 (0%)	
	Technician	0 (0%)	0(0%)	0(0%)	0 (0%)	0(0%)	0 (0%)	8 (80.0%)	
Card exchanged since 1 year	No	8 (100%)	10 (100%)	11 (100%)	10 (100%)	10 (100%)	10 (100%)	10 (100%)	---
Tag-cleaning frequency	No	7(87.5%)	7(70.0%)	9(81.8%)	8(80.0%)	5(50.0%)	4(40.0%)	10 (100%)	0.027*
	Yes, sometimes	0(0%)	3 (30.0%)	2(18.2%)	2 (20.0%)	5 (50.0%)	6 (60.0%)	0 (0%)	
	Per week	1(12.5%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
Frequency of hand hygiene/day		4.4±0.9	5.8± 1.7	5.7± 0.9	4.5±1.51	8.0 ± 3.6	7.2±2.1	4.7± 0.8	<0.001*
Tag swab result	No growth	4 (50.0%)	5(50.0%)	6(54.5%)	5(50.0%)	9 (90.0%)	8(80.0%)	8(80.0%)	0.077
	Coagulase-negative staphylococci	4 (50.0%)	5 (50.0%)	5 (45.5%)	3 (30.0%)	1 (10.0%)	2 (20.0%)	2 (20.0%)	
	Alpha-hemolytic streptococci	0 (0%)	0 (0%)	0 (0%)	2 (20%)	0 (0%)	0 (0%)	0 (0%)	
Mobile swab result	No growth	5 (62.5%)	2(20.0%)	3 (27.3%)	6 (60.0%)	7 (70.0%)	7 (70.0%)	4 (40.0%)	0.288
	Coagulase-negative staphylococci	2 (25.0%)	8 (80.0%)	6 (54.5%)	3 (30.0%)	2 (20.0%)	2 (20.0%)	6 (60.0%)	
	Alpha- hemolytic streptococci	0 (0%)	0 (0%)	1 (9.1%)	1 (10.0%)	0 (0%)	0 (0%)	0 (0%)	
	Staphylococcus aureus	1(12.5%)	0 (0%)	1 (9.1%)	0 (0%)	1 (10.0%)	1(10.0%)	4 (40.0%)	

Data presented as mean ± SD or frequency (%), ICU: intensive care unit, ER: emergency room, OPD: outpatient department.

**Table (4):** Decontamination practices and risk of carrying pathogens regarding the working place

		Doctors (n=29)	Nurse (n=32)	Technician (n=8)	P value
Card exchanged since 1 year	No	29 (100%)	32 (100%)	8 (100%)	---
Tag-cleaning frequency	No	22 (75.9%)	20 (62.5%)	8 (100%)	0.152
	Yes, sometimes	6 (20.7%)	12 (37.5%)	0 (0%)	
	Per week	1 (3.4%)	0 (0%)	0 (0%)	
Frequency of hand hygiene/day		6.07 ± 2.4	5.81 ± 2.3	4.75 ± 0.9	0.340
Tag swab result	No growth	14 (48.3%)	24 (75.0%)	7 (87.5%)	0.027*
	Coagulase-negative staphylococci	15 (51.7%)	6 (18.8%)	1 (12.5%)	
	Alpha-hemolytic streptococci	0 (0%)	2 (6.3%)	0 (0%)	
Mobile swab result	No growth	10 (34.5%)	20 (62.5%)	4 (50.0%)	0.147
	Coagulase-negative staphylococci	17 (58.6%)	8 (25.0%)	4 (50.0%)	
	Alpha- hemolytic streptococci	0 (0%)	2 (6.3%)	2 (2.9%)	
	Staphylococcus aureus	2 (6.9%)	2 (6.3%)	0 (0%)	

Data presented as mean ± SD or frequency (%), ICU: intensive care unit, ER: emergency room, OPD: outpatient department.

## DISCUSSION

There have been numerous studies illustrating the bacterial contamination of different personal or nonpersonal items in hospital settings, such as computer keyboards, curtains, cell phones, white coats, and ties (11). Similar studies have shown contamination of identification badges and lanyards in a clinical setting (12). This contamination can have a potential impact of transmitting hospital-acquired infections (HAIs), which is acknowledged as the most frequent adverse event in healthcare and has a high global burden. The effects of healthcare-associated infections imply prolonged hospital stay, long-term disability, increased resistance of microorganisms to antimicrobials, massive additional

financial burden for health systems, high costs for patients and their family, and unnecessary deaths (13). It was documented that clothing worn by healthcare staff can harbour potential pathogens such as methicillin-resistant *S. aureus* (MRSA) and *S. aureus* on doctors' neckties and MRSA on stethoscopes (14). Contaminated equipment and clothing provide a reservoir from which healthcare workers may reinoculate their hands after hand hygiene practices have been carried out (15,16). The relatively low prevalence of both methicillin-susceptible *S. aureus* (MSSA) and MRSA can be explained by the low annual incidence of bacteraemia at 3.28 cases per 1 000 hospital admissions and the fact that MRSA was responsible for only 26% of *S. aureus* bacteraemia (17).

It has previously been shown that lanyards were particularly contaminated, with a median bacterial load per unit surface area up to ten times greater than ID tags<sup>(18)</sup>. Studies have also shown that bacteria are able to survive on plastic surfaces for long periods of time, with Gram-negative bacteria surviving for >60 days and enterococci for >90 days<sup>(19)</sup>. Hence, our study focused on ID tags as a separate entity.

In line with the current work, *Cox et al.*<sup>(7)</sup> showed that decontamination practices by 52% of staff were more prevalent than in previous reports (16% and 27%)<sup>(20, 21)</sup>. The tags that had never been cleaned were more likely to carry pathogenic growth. Also, there was a significant positive likelihood of pathogenic growth within the first 30 minutes of patient contact, irrespective of the nature of the patient contact. Hence, they recommend that an effective decontamination regimen (e.g. 30 seconds criss-cross scrubbing with a cleaning swab) be implemented where ID tags may have been in contact with patients. *Alfarawi et al.*<sup>(12)</sup> performed a cross-sectional study of 200 healthcare workers at King Abdulaziz Medical City in Riyadh, Saudi Arabia. They found that badges of 37% of participants were contaminated with pathogens. Coagulase-negative Staphylococcus was isolated from 70 badges (35%), and methicillin-sensitive Staphylococcus aureus was isolated from four badges (2%). However, such microbiological finding of high prevalence of coagulase-negative bacteria was found in Shakir *et al.*<sup>(22)</sup> study on the contamination of cell phones. It showed an overall rate of 83% pathogenic contamination of cell phones including coagulase-negative Staphylococci.

Earlier studies showed contamination in 12.5 and 25.3% of identification badges but these findings are confined to smaller numbers of participants (64 and 71, respectively)<sup>(18, 23)</sup>. It has been suggested that the United Kingdom National Health Service (UK NHS) recommendation of removing ties to prevent infection should be extended to include lanyards, but this is based on indirect evidence only<sup>(21)</sup>.

*Pepper et al.*<sup>(20)</sup> suggested that fabric lanyards should be laundered at least once every two months. Some NHS hospitals already do not recommend lanyards for frontline staff, but this is only on intuitive reasoning. The 8.8% positive *S. aureus* on general hospital staff lanyards compares with 18.6% in a study by *Kotsanas et al.*<sup>(18)</sup> within a group of doctors and nurses, and 2% in the study by *Alexander et al.*<sup>(21)</sup>.

Similarly with our Findings, *Murphy et al.*<sup>(24)</sup> in their finding of no MRSA on lanyard culture is perhaps encouraging for this hospital but differs from 4.7% of frontline staff lanyards positive with MRSA in the *Kotsanas et al.*<sup>(18)</sup> study which also showed a fourfold greater risk of doctors' lanyards positive for MSSA compared to nurses' lanyards. In their study, lanyards were

in use for prolonged periods (mean: 22 months), and in 91% without ever undergoing any form of decontamination or laundry. This compares to 12 months and 84% respectively in a study by *Pepper et al.*<sup>(20)</sup>. The semi-mobile nature of staff neck lanyards presents potential close direct contact with the patients and their immediate physical environment. If contaminated the lanyard would represent a clear risk of transmission either from or to a patient. The finding that one-third of hospital staff were nasal carriers of *S. aureus* is not remarkable; however, that 26% of those carriers also carry the same genetically indistinguishable strain on their lanyards would suggest limited effectiveness of decontamination as an infection control strategy.

We found that tag swab revealed that higher growth of Coagulase-negative staphylococci among ICU doctor, Medical and surgical words and was less common among ER departments (10%). Additionally, the results of the obtained mobile swab revealed that higher growth of Staphylococcus aureus among Lab and blood bank (40%), higher growth of Coagulase-negative staphylococci among medical word, Lab and blood bank and surgical word. This concluding that Lab and blood bank had the least Tag-cleaning frequency, lower frequency of hand hygiene/day, higher growth of mobile swab result including (Coagulase-negative staphylococci and Staphylococcus aureus).

A previous study showed that physicians have higher rates of contamination compared to other groups of participants<sup>(12)</sup>. An observational study by Pittet *et al.*<sup>(25)</sup> showed that physicians have lower compliance to hand hygiene compared to nurses. This could explain the findings of higher levels of contamination of identification badges among physicians.

Our study had some limitation, it was a single centre study, with relatively small sample size. We did not do a baseline evaluation of the current pathogenic bacterial occurrence on the ward at the time of data collection. Hence, we were unable to correlate between inoculated bacteria from the swabs and the clinical occurrence on the wards. Another limitation was that we did not estimate staff members the length of time for which they had been using the ID tags, we were unable to establish the exact point of contamination.

**Conclusions:** We found that the ID tag showed a higher contamination of of Coagulase-negative staphylococci and  $\alpha$ -hemolytic streptococci were detected only among nurses (6.3%).

Mobile swab results revealed higher growth of Coagulase-negative staphylococci among doctors and technicians. ID tags and mobile have to be as a potential source of pathogen spread so many efforts should be taken to make staff awareness toward the potential danger in every institution. Therefore, regular disinfection of ID tag

and mobile might reduce the levels of contamination, but ultimately, strict compliance of hand hygiene among healthcare workers is the best way to prevent the transmission of infections.

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