

Mobile Phones of Healthcare Professionals: A Silent Bacterial Threat in Al-Jumhory Hospital, Sana'a, Yemen

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Hospital acquired infections are a major worldwide health problem in all hospital settings. The use of mobile phones could act as a fomite for microorganisms and it can transmit pathogenic as well as nonpathogenic microorganisms.

To determine the bacterial contamination rate of mobile phones of Health Care Workers (HCWs) and to describe their microbiological profile, a cross-sectional study was conducted in Al-Jumhory Teaching Hospital, Sana'a. Sterile swabs were collected from cell phone of 46 healthcare workers (HCWs), doctors, nurses and dustman, at different departments. The samples were processed as per standard microbiological techniques and antimicrobial susceptibility testing was performed.

The study revealed that bacterial growth was positive in 27 out of 46 (58%) mobile phones, out of which 20 (43%) were of male and 7 (15%) of female. The most commonly isolated bacteria were *Staphylococcus aureus* followed by *Bacillus spp.* as 51.3% and 26.92% respectively. Most of the isolates were from doctors (51.43%) followed by nurses (51.43%). The order of wards according to number of isolates was: the ICU, NCU, EMR, and BCU with a statistical significant difference between the growth bacteria and non-growth bacteria according to a ward ($P=0.003$ & $X^2=13.7$). Gentamycin was the most effective antibiotic against *Bacillus spp.* and *S. aureus*. Moreover, *Methicillin-resistant S. aureus (MRSA)* was identified in 25% and Multiple Drug Resistant (MDR) bacteria were detected in 65% and 67 % for *S. aureus* and *Bacillus spp.*

In conclusion, more than one-half of the HCWs mobile phones were contaminated by bacteria and HCWs' mobile phones may serve as potentially vectors for transmission of nosocomial infections particularly *MRSA*. Therefore, it is recommended to make infection control guidelines, which target the use of suitable disinfectants to avoid mobile phone contamination.

Key words: Bacterial contamination, mobile phones, Healthcare workers, Sana'a, Yemen.

ABSTRACT:

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الهواتف المحمولة لمتخصصي الرعاية الصحية: تهديد بكتيري صامت في مستشفى الجمهوري ، صنعاء ، اليمن.

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الملخص:

تعتبر العدوى المكتسبة من المستشفيات مشكلة صحية رئيسية على مستوى العالم. وتمثل الهواتف المحمولة بمثابة أداة لحمل الكائنات الحية الدقيقة الممرضة والغير ممرضة. وقد عملت هذه الدراسة لتحديد معدل تلوث الهواتف المحمولة للعاملين في الرعاية الصحية (HCWs) وتحديد نوعية الكائنات الحية الدقيقة التي تحملها هواتفهم النقالة في مستشفى الجمهوري التعليمي بصنعاء، ولإجراء الدراسة تم جمع مسحات معقمة من الهواتف الخلوية لعدد 46 من العاملين في الرعاية الصحية (HCWs) من الأطباء والممرضين وعمال النظافة في مختلف الإدارات بالمستشفى. وتمت معالجة العينات وفقا للتقنيات الميكروبيولوجية القياسية وتم إجراء اختبار الحساسية المضادة للميكروبات. وكشفت الدراسة أن النمو البكتيري كان إيجابياً في 27 من أصل 46 (58%) من الهواتف المحمولة ، منها 20 (43%) من هواتف الذكور و 7 (15%) من هواتف الإناث. وكانت البكتيريا المعزولة الأكثر شيوعاً هي البكتيريا العنقودية *Staphylococcus aureus* متبوعة بـ *Bacillus spp.* 51.3 % و 26.92 % على التوالي، ومعظم العزلات كانت من الأطباء (51.43%) تلتها فئة الممرضين (51.43%). وكان ترتيب الأقسام وفقاً لعدد العزلات: وحدة العناية المركزة ثم وحدة العناية بالمواليد ثم وحدة الطوارئ ثم وحدة الحروق. وكان الجنتاميسين أكثر المضادات الحيوية فعالية ضد *Bacillus spp.* و *S. aureus*. تم اكتشاف وجود بكتيريا *S. aureus* المقاومة للميثيسيلين (MRSA) في 25% من العينات المعزولة وتم الكشف عن بكتيريا متعددة المقاومة للأدوية في 65% من بكتيريا *S. aureus* 67% من بكتيريا *Bacillus spp.*

في الختام ، فإن أكثر من نصف الهواتف النقالة لمتخصصي الرعاية الصحية كانت ملوثة بالبكتيريا ويمكن أن تعمل هذه الهواتف كأداة محتملة لنقل عدوى المستشفيات ولذلك فمن المستحسن وضع مبادئ إرشادية لمكافحة العدوى ، والتي تستهدف استخدام المطهرات المناسبة لتجنب تلوث الهاتف المحمول.

1. Introduction:

Nowadays mobile phones have become an inevitable part of our lives. Their number per capita is often much larger than the population of a country¹. Despite the advances in modern medicine, nosocomial infections still pose a risk of increased mortality and morbidity to the hospitalized patients. Hands of the Doctors and health care personnel play important role in transmission of hospital acquired infections². Using mobile phones in hospitals can lead to improved quality of health care, especially in terms of faster communication in emergencies within hospital departments³. However, with all the benefits that mobile phones offer, their potential role in microorganism transmission has to be emphasized as well⁴. While working with patients and touching their mobile phones, health care workers (HCW) can easily transmit microorganisms from patients to their mobile phones and vice versa. Combination of constant handling with the heat generated by the mobile phones can create a prime breeding ground for many microorganisms⁵.

There are few reports on the role of mobile phones in the spread of nosocomial infections^{6, 7} and even fewer in a tropical setting⁸. Those infections are increasing day-by-day and are causing increased morbidity and mortality of hospitalized patients. Not only do they affect the general patients' health but they are also a huge financial burden⁹. Many of personal instruments used daily by medical health care workers (HCW), such as stethoscope, cell phones and writing pens in the hospitals can act as carriers of the infection¹⁰.

Presence of nosocomial microorganisms is one of the main problems in the intensive care unit (ICU) today as well. The ICU cares for patients whose vital functions are at risk, patients are connected to

various tubes and the entry of pathogens is very pronounced and easily enabled. Due to their characteristics, such patients are extremely sensitive to be infected by microorganisms that can be transmitted, not only from any of the objects connected to the patient but also from mobile phones of HCWs¹¹. In recent years, much importance has attributed to contaminated mobile phones belonging to healthcare workers as a source of nosocomial infections. A number of studies have reported 5-95% of mobile phones belonging to healthcare workers to be contaminated, and therefore to be a significant source of the microorganisms responsible for nosocomial infections^{12, 13}. The contamination rate of HCWs mobile phones was varies from one country to another, so that; this is the first study in Yemen concerned with this topic.

The aim of this study was to investigate the microbial contamination rate of mobile phones of health care workers (HCWs) in ICUs, NCUs, Emergency care unit ECU and Burn CUs at Al-Jumhory Teaching Hospital in Sana'a city and to describe their microbiological profile.

2. Material and methods:

The present study was a cross-sectional hospital based study, carried out in Al-Jumhory Teaching Hospital, Sana'a city, Yemen, during the period of April to July 2018. A total of 46 swab samples were collected from mobile phones of healthcare workers (HCWs) including doctors, nurses and dustman working in the intensive care unit (ICU) n=13, neonate care unit (NCU) n=11, emergency unit (EU) n=11 and burns care unit (BCU) n=11. Sterile swabs moistened with sterile de-mineralized water were rotated over the surfaces of the mobile phone by rotating the swabs on the keys, mouthpiece, and earpiece. All the swabs were cultured directly on blood agar,

MacConkey agar, and then incubated aerobically at 37°C for 24 hours. Identification of isolates was done based on colonial appearance, Gram stain, and conventional biochemical tests¹⁴.

All identified isolates were sub-cultured on Muller Hinton agar to perform antibiotics susceptibility tests using disc diffusion technique according to Clinical and Laboratory Standards Institute (CLSI) 2011 guidelines using Oxicillin (OX) 1 µg disc to detect MRSA¹⁵.

- **Ethical consideration:** Verbal consent was taken from each participant and all samples were collected after he/she accepted and knew that they are participating in clinical study.
- **Statistical analysis:** Data was analyzed with the aid of the Statistical program Package¹⁶. The statistical significance of difference between categorical variables was evaluated by Chi –square (χ^2) in cross tab. Significance was accepted when $P \leq 0.05$.

3. Results:

Out of the 46 samples collected, 76.1% (35/46) were of males mobile phones while 23.9% (11/46) were belong to females (table-1). Of the 46 samples collected, 27 (58.7%) showed bacterial growth. Regarding the gender of the owner of mobile phone, of the 35 samples collected from mobiles of males HCWs, 20 samples (57.1%) showed positive bacterial growth. On the other hand, seven (63.6%) samples of the female samples showed positive bacterial growth. There was no statistical significant difference between the two groups regarding the bacterial growth and gender (table-2).

Out of the 27 (58.7%) samples showed bacterial growth, two bacterial species were found: *Staphylococcus aureus* with 20 (43.5%) isolates and *Bacillus sp.* 7 (15.2%) (table-3).

Regarding the ward or unit, the bacterial contamination rate was more prevalent in the ICU, 12 (92.31%), followed by NCU, 7 (63.64%), ECU, 6 (54.55%), and less prevalent at BCU, 2 (18.18%). There was a statistical significant correlation between the isolated bacteria and ward or unit, ($X^2=13.7$ $P=0.003$), table-2.

The frequency of *S. aureus* had more prevalent in the ICU followed by ECU, NCU and BCU. In addition, *Bacillus sp.* was more prevalent in the NCU and absent in BCU, with no statistical significant difference between the isolated bacteria and ward, table-3.

Regarding to HCWs occupation and bacterial contamination, the bacterial contamination rate was high, 8 (88.9%), among doctors followed by nurses, 18 (51.43%), and dustman, 1 (50%), with no statistical significant difference at $P=0.122$ and $X^2=4.21$, table-2.

Table-1: Demographics characteristics of HCWs at Al-Jumhory Hospital, Sana'a city.

Demographics Characteristics		No	%
Gender	Male	35	76.1
	Female	11	23.9
Occupation	doctor	9	19.6
	Nurse	35	76.1
	Dustman	2	4.3
Ward	ICU	13	28.3

	ECU	11	23.9
	NCU	11	23.9
	BCU	11	23.9
Microbial growth	yes	27	58.7
	No	19	41.3

Table-2: Participant demographics variables of HCWs at Al-Jumhory Hospital, Sana'a city.

Attribute	Microbial growth	Non Microbial growth	Chi-square P. value
<u>Gender:</u>			
- Male	20 (57.1%)	15 (42.9%)	$X^2=0.146$ $P=0.703$
- Female	7 (63.6%)	4 (36.4%)	
<u>Ward :</u>			
- ICU	12 (92.31%)	1 (7.7%)	$X^2=13.7$ $P=0.003$
- NCU	7 (63.64%)	4 (36.36%)	
- ECU	6 (54.55%)	5 (45.45%)	
- BCU	2 (18.18%)	9 (81.82%)	
<u>Occupation:</u>			
- Doctors	8 (88.9%)	1 (11.11%)	$X^2=4.21$ $P=0.122$
- Nurses	18 (51.43%)	17 (48.6%)	
- Dustmen	1 (50%)	1 (50%)	

Table-3: Isolated bacteria from mobile phone of HCWs at Al-Jumhory Hospital, Sana'a.

Isolated Microorganisms:	Microbial growth	Non Microbial growth	Chi-square P. value

	No	%	No	%	
<i>S. aureus</i>	20	43.5	26	56.5	$X^2=3.81$ $P=0.051$
<i>Bacillus sp</i>	7	15.2	39	84.8	

Table-4: Prevalence of isolated bacteria from mobile phone among HCWs according to the studied ward, at Al-Jumhory Hospital, Sana'a city.

The variable		<i>S. auerus</i>				<i>Basillus. spp</i>				Chi-square P. value
		positive		negative		positive		negative		
		No	%	No	%	No	%	No	%	
Ward	ICU	11	55	2	7.7	1	14.3	12	30.7	$X^2=$ 6.36 $P=0.09$ 5
	ECU	4	20	7	26.9	2	28.6	9	23.1	
	NCU	3	15	8	30.8	4	57.1	7	17.9	
	BCU	2	10	9	34.6	0	0.00	11	28.2	

As far as anti-biogram of isolated bacteria, it was found that *S.aures* showed 25 % sensitivity to Co-trimoxazole, and Piperacillin tazobactam. Moreover, *S.aureus* (25%) was resistant to Cefoxitin, Oxacillin and this regarded as *Methicillin-Resistant Staphylococcus aureus* (MRSA), and 13 (65%) *S.aures* isolates were Multiple Drug Resistant (MDR), table-5. On the other hand, isolated *Bacilus spp.* showed 71% sensitivity to Gentamycin followed by Noroxin 42% and 56% were resistant to Optichin and Noroxin. In addition, 67% of the isolated *Bacilus spp.* were Multiple Drug Resistant (MDR), table-5.

Table-5: Antibiotic Sensitivity Profile of bacterial Isolates (n=27)

Antibiotics	Isolated bacteria					
	<i>S. aureus</i> (n=20)			<i>Bacillus spp</i> (n=7)		
	S%	M%	R %	S%	M%	R %
Gen	3(15)		1(5)	5(71)		
CTX	2(10)	1(5)		1(14)	1(14)	2(28)
DOX	-			1(14)		
AMP	-		2(10)	2(28)		2(28)
p	5(25)	1(5)	2(10)			
B	-	2(10)	1(5)		2(28)	3(42)
OP	1(5)		3(15)			4(56)
NA	-		1(5)	3(42)		4(56)
DO	1(5)			1(14)		
CTP	-			1(14)		
COT	5(25)					
CIP	1(5)		1(5)	1(14)		
NX	1(5)					
O	-		1(5)			
AMX	1(5)					3(42)
PEN	-					
COP	1(5)					
N	-					
POT	-			1(14)		
MRSA	5(25)					
MDR	13(65)			18(67)		

GEN= Gentamicin, CTX= Cefoxitin, DOX= Doxycycline, AMP= Ampicillin, P= Permapen''Pencillin''
B= Bacitracin,

OP=Optichin, NA=Nalidixic, CTP= Citalopram , COT= Cotrimoxazole, CIP= Ciprofloxacin, NX =
Norfloxacin, O=

Oxacillin, AMX= Amoxicillin, PEN=Penicillin, COP= Copsin, N= Neomycin, S=Sensitive, M=
Moderate, R= Resistance.

4. Discussion:

All over the world, maintaining hygiene standards is a prerequisite in all hospital settings. Excessive usage of mobile phone in the hospital by healthcare professionals has emerged as a matter of valid concern in recent years. It is due to its threat to act as a source of potential pathogens or as vectors for the nosocomial infections.

Many reports have documented the contamination of mobile phones among HCWs^{17, 18, 19}. In this study, the majority of mobile phones (58.7%) were contaminated by bacterial agents, which was approximately comparable to a study conducted in India²⁰. While other studies showed higher contamination rate, it was reported that 94.5% of health care workers' mobile phones were contaminated with various microorganisms, including nosocomial pathogens¹². Another study done in India has shown that as much as 98.5% of HCWs' mobile phones were bacterially contaminated²¹. However, a study done in Queen Elizabeth hospital in Barbados, West Indies and other in Saudi Arabia had showed lower contamination rate with 45% and 43% respectively^{22, 19}.

The disparity in rate of contamination may be due to variation in the hand hygiene practices and frequency of the use and disinfection of mobile phones among HCWs in various hospitals.

This study revealed that male HCW's mobile phones (57.1%) had comparatively more contaminated than female HCWs phone (63.6%). The present study concurs with the findings of other studies which showed 76% and 69% of mobile phones of male doctors and 44% and 31% of mobile phones of female doctors to be contaminated respectively^{23, 24}. As suggested by other study, it might be due to the reason that females generally keep their phones in purses and use it

less frequently than male HCWs whereas male HCW keep it in pocket and use it whenever, wherever it was needed, and were thus more contaminated²³.

Regarding the isolated microorganisms in the present study, the most frequently isolated bacteria was *S.aureus*, which was (20 samples), followed by *Bacillus sp.* (7 samples) as in other studies stated that *S. aureus* the most frequently isolated microorganism^{8, 25, 26}. Their high occurrence rate could be traced to the fact that they are abundant in human body especially as the normal flora. Moreover, *Bacillus sp* bacteria are omnipresent in nature being able to colonize anything. Moreover, it was found that 100% of mobile phones grew only one bacterial species without polymicrobial growth as showed by other studies^{27, 11}.

In the present study, there was a statistical significant difference in the frequency of isolated bacteria from different wards of the hospital and no statistical significant difference in the frequency of isolated bacteria and different wards ($X^2=13.7, P=0.003$ & $X^2= 6.36, P=0.095$ respectively). It was noted that the frequency of *S.aureus* was more prevalent in the ICU followed by EMR, NCU and BCU. In addition, *Bacillus sp.* was more prevalent in the NCU and absent in BCU. Other researchers observed similar finding, approximately, 74 % of mobile phones that belong to clinicians in ICUs, PICUs, and NCUs was contaminated in Kuwait and 43.6 % was reported from Saudi Arabia^{28, 19}.

Regarding to HCWs occupation and isolated bacteria, it was found that the prevalence of *S.aureus* and *Bacillus sp.* was more isolated from doctors followed by nurses with no statistical significant difference between the isolated bacteria and ward. This was in

concordance with Almeshal F. *et al.* 2018, Trivedi *et al.* 2011²⁹ and Heyba *et al.* 2015.

According to antibiotic sensitivity pattern of bacterial isolates, the study revealed that *S.aures* showed 25 % sensitivity to Co-trimoxazole, and Piperacillin tazobactam. Moreover, *S.aureus* was 25% resistant to Cefoxitin, Oxacillin and this regarded as Methicillin-Resistant *Staphylococcus aureus* (MRSA), and 13 (65%) *S.aureus* isolates were Multiple Drug Resistant (MDR). In other hand, isolated *Bacilus spp.* showed 71% sensitivity to Gentamycin followed by Noroxin 42% and 56% resistant to Optichin and Noroxin. In addition, 67% isolated *Bacilus spp.* were Multiple Drug Resistant (MDR). This was in agreement with another study conducted in Sudan^{30, 31}.

Methicillin-Resistant *Staphylococcus aureus* (MRSA) was 25%, which in accordance with study conducted in India²⁰. Incidence of MRSA isolated from cell phones was variable in different geographical areas like 16.9% in Mumbai³² 52.4% in Bhabnagar²⁹ , 52% in Turkey¹² and 26.8% in Sudan with 21.4% *Multiple Drug Resistant (MDR)*^{30, 31}.

Variation in antibiotic resistance pattern in different geographic areas or different time frame in same place might depend on antibiotic policy of the hospital at that particular time³².

The observed high rate of antibiotic-resistant bacteria (MRSA and MDR in this study could be attributed to both the misuse and abuse of antibiotics. The prevalence of antibiotic-resistant bacteria is a serious problem with important implications for hospital infection prevention and control program. Although the geographic distribution of these bacteria is worldwide, the epidemiology and dissemination patterns appear to differ within and across regions^{32, 11}.

MRSA, like all *S.aureus* survives on skin, dust and on environmental surfaces. In healthy individuals, they can be colonized asymptotically. Therefore, the most common sources of transmission to patients and hospital environment are hospital staff as well as visitors and patients with MRSA infection or who carry the infection asymptotically³³. Until now, hands are considered the main mode of transmission to inanimate objects like apron, swipe cards, mobiles; key boards etc. have also been studied to carry MRSA³¹.

MRSA is problematic for patients in hospital with invasive devices or surgical wounds and lowered immunity having higher risk of contracting infection as compared to public. Among patients being treated in hospital and/or having weakened immune system, MRSA occurs most commonly and found to cause life threatening infections, such as blood stream infections, surgical site infections or pneumonia³⁴.

5. Conclusion:

More than one-half of the HCWs mobile phones were contaminated by bacteria and HCWs' mobile phones may serve as potentially vectors for transmission of nosocomial infections particularly MRSA and therefore it is recommended to make infection control guidelines, which target the use of suitable disinfectants to avoid mobile phone contamination. Furthermore, the use of mobile phones should be restricted in high-risk situations.

- Competing interests:

The authors declare that they have no competing interests.

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6. References:-

- 1- **Radicati. S. (2017):** Mobile Statistics Report, 2014-2018. Radicati S, Ed. Palo Alto, CA, USA: The Radicati Group, Inc, 2014. <http://www.radicati.com/wp/wp-content/uploads/2014/01/Mobile-Statistics-Report-2014-2018-Executive-Summary.pdf> (30 August 2016).
- 2- **Landman D, Quale JM, Mayorga D, Adedeji A, Vangala K, Ravishankar J, Flores C, Brooks S. (2002):** Citywide clonal outbreak of multiresistant *Acinetobacter baumannii* and *Pseudomonas aeruginosa* in Brooklyn, NY: the preantibiotic era has returned. Arch Intern Med. 8; 162(13):1515-20.
- 3- **Jacobs M, Dagan R. (2004):** Antimicrobial resistance among pediatric respiratory tract infections: clinical challenges. Sem. Pediatr. Inf. Dis. 15:5-20.
- 4- **West DM. (2013):** Improving Health Care through Mobile Medical Devices and Sensors. https://www.brookings.edu/wp-content/uploads/2016/06/West_Mobile-Medical-Devices_v06.pdf (30 August 2016).
- 5- **Abdollahi, A. and Mahfouzi, S. (2010):** Bacterial contamination of Hospital Telephones. Pakistan J Med. Sci., 26:747-750.
- 6- **Karabay, O., Kocoglu, E. and Tahtaci, M. (2007):** The role of mobile phone in the spread of bacteria associated with nosocomial infections. J Infect Develop Countries.1: 72-73.

- 7- **Borer A, Gilad, J., Smolyakov, R., Eskira, S., Peled, N. and Porat, N. (2005):** Cell Phones and Acinetobacter Transmission. *Emerg. Infect Dis.* 11: 1160-1161.
- 8- **Jayalakshmi J, Appalaraju B, Usha S. (2008):** Cellphones as reservoirs of nosocomial pathogens. *J. Assoc. Physicians Ind.* 56: 388-389.
- 9- **Revelas A. J. (2012):** Healthcare-associated infections: a public health problem. *Niger. Med.* Apr 1; 53 (2):59-64.
- 10- **Neely, A.N. (2007):** Persistence of micro-organisms on common hospital surfaces: strategies to control their dissemination. *Infect. Control Resour.* 4 (4): 1 8.
- 11- **Selim H.S & Abaza A.F (2015):** Microbial contamination of mobile phones in a health care setting in Alexandria, Egypt. *GMS Hyg. Infect. Control.* 10:1-9.
- 12- **Ulger F, Esen S, Dilek A, Yanik K, Gunaydin M, Leblebicioglu H. (2009):** Are we aware how contaminated our mobile phones with nosocomial pathogens? *Ann Clin Microbiol Antimicrob.* Mar; 8:7 doi:10.1186/1476-0711-8-7.
- 13- **Kister M, Borowska K, Jodłowska-Jędrych B, Karolina A, Drop B (2016):** The potential role of cell phones in dissemination of bacteria in a healthcare setting. *Our Dermatol Online.* 7(2):219-224.
- 14- **Colle G, Fraser AG, Marmion BP, Simmons A (1996):** Makie and McCarthey practical microbiology, Churchill Livingstone, 14 Edn. New York, USA.
- 15- **Cockerill FR, Wikler MA, Bush K, Dudley MN, Eliopoulos GM, et al. (2011):** Performance standards for

antimicrobial susceptibility testing: twenty-first informational supplement. CLSI 31.

- 16- **Dorak, 2018:** <http://statpages.info/>. at 6-7-2018.
- 17- **Goel M & Goel A. (2009):** Beware! Your phone is 'bugged' mobile phones of dental professionals a potential source of bacterial contamination-A bacteriological study. Indian J Dent Sci.; 1:42-7.
- 18- **Lavanya J, Swaroop Rani NB, Jais M, Upadhya AK. (2016):** Microbial Contamination of Mobile Phones in a Tertiary Health Care Setting. Int.J.Curr.Microbiol.App.Sci. 5(9); 508-13.
- 19- **Almeshal F, Asiri F., Alyamani A, Altuwaijri M, Aljehani S, Abdulhai Almuhana A. & Alothman A. (2018):** Bacterial contamination of Health care workers mobile phones in a tertiary care center in Saudi Arabia. Int. J. Adv. Res. 5(1), 1179-1183.
- 20- **Sharma K, Najotra D.K, Slathia P, Raina S. (2017):** Microbiological flora of cell phones: a reservoir of potential pathogens? Int J Med Res Rev 5(02):204-208.
- 21- **Sham S.B, Sundeep H.K, Shailaja S. (2011):** Potential of mobile phones to serve as a reservoir in spread of nosocomial pathogens. J. Hosp. Infect. 10:2.
- 22- **Ramesh J, Carter AO, Campbell MH, Gibbons N, Powlett C, Moseley H Sr, Lewis D, Carter T (2008):** Use of mobile phones by medical staff at Queen Elizabeth Hospital, Barbados: evidence for both benefit and harm. J .Hosp. Infect. 70: 160-165.

- 23- **Tambekar, D.H., Dhanorkar, D.V., Gulhane, S. R. and Dudhane, M. N. (2008):** Prevalence and Antimicrobial susceptibility pattern of *Methicillin resistant Staphylococcus aureus* from health care and commu associated sources. Afr. J. Infect. Dis. 1: 52 - 56.
- 24- **Kokate SB, More R S, Gujar V, Mundhe S, Zahiruddin SJ. (2012):** Microbiological flora of mobile phones of resident doctors J. Biomedical Science and Engineering 5: 696-698.
- 25- **Singh S, Acharya S, Bhat M, Rao SK, Pentapati KC (2010):** Mobile phone hygiene: potential risks posed by use in the clinics of an Indian dental school. J. Dent. Educ. 74(10):1153-8.
- 26- **Ulger F, Dilek A, Esen S, Sunbul M, Leblebicioglu H. (2015):** Are healthcare workers' mobile phones a potential source of nosocomial infections? Review of the literature. J Infect Dev. Ctries. 9 (10):1046-1053.
- 27- **Chawla, K., Mukhopadhyay, C., Gurung, B., Bhate, P. and Bairy, I. (2009):** Bacterial „Cell“ Phones: Do cell phones carry potential pathogens? J. Hlth Appli Sci. 8:8-19.
- 28- **Heyba M, Ismaiel M, Alotaibi A, Mahmoud Baqer H, Safar A , et al.(2015):** Microbiological contamination of mobile phones of clinicians in intensive care units and neonatal care units in public hospitals in Kuwait. BMC Infect Dis.; 15(1):434.
- 29- **Trivedi, H. R., Kairavi, J. D., Lopa, P. T., Saklainhaider, S. M. and Tanuja, B. J. (2011):** Role of Mobile Phone in Spreading Hospital Acquired Infection: A

Study in Different Group of Health Care Workers. National J. Inte. Res. Med., 2: 61-66.

- 30- **Osman M, Omer S, Almugadam B & Ahmed H. (2018):** Frequency of MRSA Isolates in Mobile Phones, Ears and Hands of Healthcare Workers. Journal of Antimicrobial Agents, 4:1 DOI: 10.4172/2472-1212.1000161.
- 31- **Sanjib A, Sujan K, Sanjeep S, and Pabitra S. (2018):** Methicillin-Resistant Staphylococcus aureus Associated with Mobile Phones. SOJ Microbiology & Infectious Diseases, 6 (1):1-6.
- 32- **Pal K, Chatterjee M, Sen P, and Adhya S. (2015):** Cell Phones of Health Care Professionals: A Silent Source of Bacteria. Nat J Lab Med. 4(4):33-38.
- 33- **Badr RI, Ibrahim B H, Ali NM (2012):** Mobile phones and nosocomial infections. International Journal of Infection Control. Mar 26; 8(2).
- 34- **Rachna T, Mridu D, Saltanat J (2015):** Mobiles and Pens of Hospital Staff, Patients and Visitors Found to Carry MRSA. National Journal of Laboratory Medicine. 4(4): 19-23



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