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Research Article

Social Habits of Health Professionals and their Mobile Phones as Source of MDR Nosocomial Bacteria in Cameroon, Sub Saharan Africa

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ABSTRACT

Health professional mobile phone can be the vehicle bacteria transmission from one caregiver to another. Despite the ubiquity of mobile phones among health professionals as tool for mobile phone-based Health, there is limited literature on general social habits related to manipulation of this technological tool by health practitioner and the risk of bacterial contamination within hospital in Cameroon. Cross-sectional study on personal mobile phone of health care professionals was carried out from three major hospitals in Yaounde Cameroon. A self-administration questionnaire was given to obtain demographic data on some mobile phone related social habits and potential exposed individuals to the isolated micro flora. Sterile swab was used to collect sample from each personal mobile phone of the enrolled health professionals. For each sample, culture and antimicrobial susceptibility tests were performed in bacteriological Laboratory of the Medical Research Center. Of the 163 mobile phone swabs, 156 (95.7%) have grown while 7 (4.3%) had sterile culture. For these 156 positive cultures 55.8% of them displayed bacteria count greater than 10 colony forming units. Amount of bacteria isolated Coagulase negative Staphylococcus were most prevalent (75.9%), followed by Staphylococcus aureus (16.1%). However low prevalence was registered for Gram negative bacteria: Enterobacter cloacae (4.6%), Acinetobacter spp (2.3%) and Pseudomonas aeruginosa (1.1%). Prevalence of multidrug resistance of pathogens recorded in our study was 71.4% for Staphylococcus aureus and for Gram negative bacteria the MDR represented 100%, 75% and 50% of Pseudomonas aeroginosa, Entrobacter cloacae and Acinetobacter spp respectively. Using phone at the hours of work, moving around patients with phone, lacking of hand hygiene of health professional were identified as high risk of dissemination of MDR in our society. Health professional's social habits with their mobile phones might be risk factors of no social bacterial infection and the MDR distribution.

Keywords: Mobile phones; Multidrug resistance; Nosocomial bacteria; Social habits; Health professional

INTRODUCTION

Mobile phone-based Mobile health (m Health) interventions is gradually becoming evident and promising in Sub Saharan Africa. The vast availability of these personal mobile phones makes them ideal for technologies that can be used in the health sector to change the face of global health [1]. These personal mobile phones could either be smartphones that makes it easy to access the internet or the feature phones (popularly known as choronko in Cameroon), an earlier-generation phones used mainly for calls and messaging. Many of health professionals use mobile phone for the better support to make clinical decision and increase patient outcome [2-5]. The advantages offered by this technology bring them an increasingly indispensable personal health service [6]. The use of the phone at the time of work is constantly increase in the medical practitioners [2,7]. Besides, these mobile phones have been used for education, help comprehension of certain disease states and improve patient prognoses. Most recently, they were investigated as a tool that aid in the efforts to combat many diseases plaguing less developing countries like malaria and neglected tropical diseases. The applications that can be made available on these mobile phones like Auto-Visual AFP Detection and Reporting (AVADAR) have been hailed as one of the top five technological tools and are at the center of the success of the wild type polio eradication in Africa [8]. However these benefits do not exclude the risk that the

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mobile phones serving as potential vehicles of hospital-acquired infections (nosocomial infection) which are sometimes due to multidrug resistant bacteria [2, 9-11]. Family member, community and even the health professional themselves are prone to the devastating effects of these microbes [12,13]. The cost of multidrug resistance contributes substantially to the rising cost of health care for patients with resistant infections, higher than care for patients with non-resistant infections due to longer duration of illness, additional tests and use of more expensive drugs [14].

Despite the ubiquity of mobile phones amongst health care professionals as tool for mobile phone-based mHealth, in Cameroon there is limited literature on general social habit impacts associated with mobile phones use amongst health professionals and the consequences on patient health. Furthermore mobile phones also serve as vehicles to multidrug resistant nosocomial bacteria from health care professionals to the community. In this study we are going to assess possible social risk factors associated with mobile phone contamination, identified bacteria involved and their antimicrobial profile.

MATERIALS AND METHODS

Study design and setting

This study was a cross-sectional study conducted from august to October, 2019 on randomly personal mobile phones of health professionals working at three reference hospitals in the town of Yaounde Cameroon. These public reference hospitals include: the University Yaounde Teaching Hospital (YTH), the Central Hospital of Yaounde (CHY) and the Yaounde Emergency Center (YEC). These hospitals have different specialist health professionals, who provide health care services to a great number of Cameroonians from all ten regions daily.

Sample size and sampling technics

The calculated sample size of enrolled health professional was 163 and was determined by a single population proportion formula using the prevalence of bacterial contamination (nosocomial infection) from a study conducted by Jall in Douala [15]. On the other hand the sample size for the personal mobile phones corresponded to the number of the enrolled health professional. Large amount of health professionals had more than one phone, only the most used phone was considered for specimen collection.

Data collection methods

The questionnaire was developed from different literature review [16-19]. It was made of socio-demographic variables and some habits health professionals have developed around their personal mobile phone at the work place. The generated questionnaire was pretested for comprehension and objectivity. The validated questionnaire was given to each health professional for self-administration. After completion of questionnaires, a sterile cotton swab, moisten with drops of sterile normal saline, was used to collect specimen from each enrolled study participant's most used personal mobile phone. The health professional held their phone out and the researcher swabbed (screen, keypad, sides and back) the phone from a distance to prevent contaminations [20]. Then each swab was placed immediately into sterile container and transported to the human biology laboratory of the medical research Center/ Institute of medical research and medicinal plants studies.

Bacteria culture

Collected samples were inoculated on to Blood Agar, Chocolate with polyvitex, Eosin Methylen Blue Agar (Oxoid, LTD, UK) and Mannitol salt Agar (Bio Rad, France) in respect of the standard streak plate technique [21]. The inoculated plates were incubated aerobically at 37°C for 24–48 h for Mannitol salt and Eosin Methylen blue and in anaerobic area for Blood Agar and Chocolate.

The cultured plates that had grew less than 10 CFU was considered negative while colonies greater than or equal to 10 CFU was considered positive. These were subjected to further analyses. The identification was done in case of growth in the first 24 h, if not the incubation were prolonged for 48 h. Primary isolation of bacteria was made based on their colony characteristics and Gram stain reaction visualized microscopically. Different tests like triple sugar iron agar, indole, citrate, oxidase, urease, mobility, Mannitol, catalase, coagulase, Dnase and Api20E (Biomérieux, France) were used for biochemical identification.

All culture media were prepared by following manufacturer's instructions. Sterility was checked by incubating 5% of the prepared culture media at 37°C for 24 h and checked for growth of contaminants.

Antimicrobial susceptibility testing

Antimicrobial susceptibility test was done according to the Clinical Laboratory Standards Institute guidelines [22] using the Kirby-Bauer disc diffusion method. In brief, the pure isolate (four to five colonies) was added to a sterile tube containing 5 ml of normal saline water and mixed gently with vortex until it forms a homogeneous suspension. The turbidity of bacterial suspension was standardized by using 0.5 McFarland standards. A sterile cotton swab was dipped into the suspension and inoculated the bacterial suspension over the entire surface of Muller Hinton agar (Oxoid Ltd., UK) and left at room temperature for 3 to 5 min. Then, antimicrobial drug discs were placed by using a disc dispenser on to the Muller Hinton agar and incubated at 37 °C for 18–24 h. At the end of the incubation period, the diameter zone of inhibition was measured by using a digital caliper. Growth inhibition zone was interpreted as Susceptible (S), Intermediate (I) or Resistant(R) after comparison with standard guidelines giving by the CASFM 2019 [23]. Bacteria resistant to three or more antimicrobial classes were considered as MDR bacteria [24].

Data analysis

Data were entered into Excel, cleaned, and exported to SPSS version 20 for analysis. Descriptive statistics like mean, frequency and percentage were performed on different variables. Categorical variables were tested for statistical significance of distributions using the chi square. $P<0.05$ was considered significant. Figures were generated by Graph Pad prism 5. Binary logistic regression was performed to identify the factors associated with mobile phone contamination.

Ethical consideration

All study participants provided informed consent. Ethical clearances were obtained at the Regional ethic committee of the Center Region Cameroon (No00818/AP/MINSANTE/SG/DRSPC/CRERSH). Administrative clearances were also obtained from the three directors of the reference hospitals.

RESULTS

Social habits, phone manipulation frequency and associated risk bacterial contamination in hospitals

A total of 163 health professionals were interviewed and 163 swabs collected from their most used mobile phone from three reference hospitals in Yaounde: University Yaounde Teaching Hospital 65 participants (39.9%), Central Hospital of Yaounde 45 (27.6%) and 53 (32.5%) for Yaounde Emergency Center. Overall we had 138/163 (81.5%) females compared to 25/163 (18.5%) males. The mean age of enrolled participants was 37.03 ± 8.49 years. Mean of medical practitioner years of service was 8.62 ± 6.82 years ranged from 1-35 years. Almost all of personnel declared using their phone at the time of work (94.5%), 38.7% of them received more than 5 calls at work time daily. The phones were most often manipulated by health professionals while taking care of patients (93.3%). Furthermore 64.4% of staff did not wash their hands after using phone (Table 1).

Table 1: COVID-19 cases and deaths worldwide and in the USA, India, Brazil and Russia.

Characteristics of mobile phone users (without precision n=163)	Groups	N (%)
Professional level	Medical doctor	13 (8)
	Specialist doctor	32 (19.6)
	Senior nurse	29 (17.8)
	Nurse	32 (19.6)
	Assistant nurse	33 (20.2)
	Lab scientist	14 (8.6)
	Assistant lab scientist	10 (6.1)
Type of phone	Smart phone	138 (84.7)
	Analogue	25 (15.3)
Use of mobile phones during working hours	Yes	154 (94.5)
	No	9 (5.5)
Reasons for manipulating MP during working hours n=154	Professional reasons	38 (24.7)
	Entertainment	61 (39.6)
	Others	6 (3.9)
	All the above	49 (31.8)
Average number of calls during working hours n=154	01-Mar	66 (40.5)
	04-May	25 (15.3)
	More than 5	63 (38.7)
Carrying mobile phone during working hours	Yes	152 (93.3)
	No	11(6.7)
Keeping MP when working (n=152)	Personal attire	5 (3.3)
	Labjacket	145 (95.4)
	Mobile phone bag	2 (1.3)
Receiving calls when attending to sick	Yes	116 (71.2)
	No	47 (28.8)
Washing hands after MP usage	Yes	58 (35.6)
	No	105 (64.4)
MP use in the toilet	Yes	104 (63.8)
	No	59 (36.2)
Exposed individuals at home to possible phone contamination	Children under the age of 5	107 (65.6)
	Elderly (age above 80)	9 (5.5)
	Both elderly and children under 5	7 (4.3)
	Immuno compromised individuals	2 (1.2)
	None of the above	38 (23.3)
Means of transport from house to hospital	Public transport	130 (79.8)
	Personal car	23 (14.1)
	Both public and personal transportation	10 (6.1)

Table 1 gives the details on the demographics and some potential associated contamination risk factors of personal mobile phones of health professionals.

Most medical professionals who reported manipulate phones for entertainment had the highest contamination rate (39.6%). Using phone at the hours of work, moving around the patients with phone, lacking of hand hygiene of health professionals were identified as associated high risk factors of bacteria dissemination.

Professional like Medical doctors, nurses who are mostly involved in patients care, have the highest rate of contamination. Most of them who reported manipulate phones from entertainment had the most important contamination level (Table 2).

Table 2: Association of mobile phone contamination with behavioural habits and demographic data.

Characteristics of mobile phone users (Without precision n=154)	Groups	<10 CFU (%)	>10 CFU (%)	Level of significance
Professional level	Medical doctor	4 (33.3)	8 (66.7)	χ^2=3.751 P=0.734
	Specialist doctor	15 (48.4)	16 (51.6)	
	Senior nurse	13 (44.8)	16 (55.2)	
	Nurse	13 (44.8)	16 (55.2)	
	Assistant nurse	18 (54.5)	15 (45.5)	
	Lab scientist	4 (30.8)	9 (69.2)	
	Assistant lab scientist	3 (33.3)	6 (66.7)	
Gender	Female	59 (45)	72 (55)	χ^2= 0.018 P=1.000
	Male	11 (44)	14 (56)	
Hospital services	Laboratory	8	16	χ^2=3.284 P=0.512
	Hospitalisation	50	53	
	Welcome and orientation	10	12	
	Consultation	1	1	
	Imaging	1	4	
Type of phone	Smart	56	75	χ^2=1.354 P=0.277
	Analogue	14	11	
Use of mobile phones during working hours	Yes	66	81	χ^2=0.002 P=1.00
	No	4	5	
Reasons for manipulating MP during working hours n=147 (154-7 sterile cultures)	Professional reasons	20	17	χ^2=11.960 p=0.006
	Entertainment	18	42	
	Others	1	5	
	All the above	25	20	
Average number of calls during working hours n=147	01-Mar	26	37	χ^2=1.004 p=0.629
	04-May	10	13	
	More than 5	31	30	
Carrying mobile phone during working hours	Yes	63	82	χ^2= 1.67 P= 0.229
	No	7	4	
Receiving calls when attending to sick	Yes	50	59	χ^2= 0.476 P=0.365
	No	21	26	
Washing hands after MP usage	Yes	24	34	χ^2=0.037 P= 0.866
	No	43	55	

MP use in the toilet	Yes	46	53	χ^2=0.318 P=0.618
	No	24	33	
Exposed individuals at home to possible phone contamination	Children under the age of 5	46	57	χ^2=1.103 P=0.986
	Elderly (age above 80)	3	4	
	Both elderly and children under 5	3	4	
	Immuno compromised individuals	0	1	
	None of the above	16	22	
Means of transportation from house to hospital	Public transport	55	68	χ^2=3.450 P=0.175
	Personal car	8	15	
	Both public and personal transportation	7	3	

Using phone during working hours, moving around patients with phones, lacking of hand hygiene of health professionals were identified as important risk factors of contamination of health professional related to MP.

Prevalence and type of bacteria isolated

Of the 163 mobile phone swabs, 156 (95.7%) have grown while 7 (4.3%) had sterile cultures. From 156 positives cultures, 87 (53.4%) of them displayed more than 10 CFU bacteria growth (Figure 1A). Bacteria isolated were: Coagulase Negative Staphylococcus (CoNS) which were most prevalent 66/87 (75.9%), followed by Staphylococcus aureus 14/87 (16.1%) (Figure 1B); while low prevalence was registered for Gram negative bacteria: Enterobacter cloacae 4/87 (4.6%), Acinetobacter spp 2/87 (2.3%) and Pseudomonas aeruginosa 1/87 (1.1%) (Figure 1B).

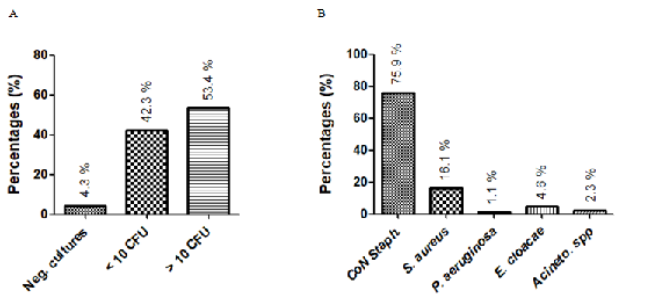

Figure 1: Mobile phones' contamination pattern. A) Bacteria growth profile; B) Bacteria species isolated.

Antimicrobial susceptibility pattern of bacteria isolated

A total of 13 antibiotics were tested for the isolated Staphylococcus aureus. Novobiocin was also tested each time as control of sensitivity to validate S. aureus antimicrobial susceptibility test. The results showed resistance to Vancomycin, Cotrimoxazole, Tetracyclin and Fusidic Acid at 78.6%, 57.1%, 42.9% and 35.7% respectively. While Ciprofloxacin (85.7%), Ofloxacine (78.6%), Gentamicin (71.4%) were the most sensitive (Table 3). Antibiotic were not tested for Coagulase negative Staphylococci.

For the Gram negative antimicrobial susceptibility pattern, we tested 12 antibiotics different from the previous ones. Enterobacter cloacae (n=04) displayed 75% resistance to Amoxicillin, Cefixim, Cefoxitin and Fosfomycin; and 100% resistance to Azthreonam. However these strains were fully sensitive (100%) to Ceftazidim, Norfloxacin, Netilmicin and Azythromycin. Cefotaxim and Azthreonam exhibited no efficiency against Acinetobacter spp (n=02 ; 100% resistant), whereas these isolates showed 100% susceptibility to Ceftazidim, Norfloxacin and Imipeneme. For the last Gram negative, the sole Pseudomonas aeruginosa isolated (n=01) were resistant to Amoxicillin, Cefoxitin, Azthreonam and Fosfomycin. Five antibiotics (Ceftazidim, Norfloxacin, Imipeneme, Netilmicin and Azthreonam) were efficient against the only P. aeruginosas isolated. Overall, all of Gram negative bacteria isolated from medical practionner phones were resistant to Azthreonam (100%) followed by Amoxicillin and Cefoxitin. However Ceftazidim, Norfloxacin (100%), then Netilmicin, Azythromycin and Imipeneme were highly sensitive (Table 4).

Multidrug resistance (MDR) of bacteria isolated

The prevalence of multidrug resistance (≥ 3 antibiotic classes) of identified bacteria (S. aureus and gram negative bacteria) was 71.4%. S. aureus multiresistant strains represented 64.3%. Overall only one (1/14) S. aureus strain displayed susceptibility to all antimicrobials tested. Three (03/14) of isolates were resistant to only one antibiotic and one (1/14) strain was resistant to two antibiotic group. As for Gram negative bacteria the MDR depicted 85.7% in general detailed as 100%, 75% and 50% Pseudomonas aeruginosa (1), Enterobacter cloacae (4) and Acinetobacter spp (2) respectively.

DISCUSSION

We found out that among the 163 health professionals' MP enrolled in the study, 84.7% of them were smart phones over the analogue phones. Smart phones were the most used mobile phones. The easy accessibility to information on these smart phones might have accounted to this numbers. The health professional behaviours around their phones varied. The predominant MP carriers (94.5%) were reported to use their phones during working hours with unfortunately majority using it mostly for entertainment (39.6%) and for entertainment and professional searches (31.8%). Besides, participants confessed receiving at least 1-3 calls during active hours (40.5%), with 71.2% acknowledged receiving calls while attending to patients and 95.4% of the health professionals carrying the phones in their lab jacket during working hours. These findings are alarming given that the health professionals randomly selected include both specialists and technicians as MD, lab scientists and nurses actively involved in patient care. These observations indicate some level of carelessness and lapses in the professional ethics that warrant administrative reinforcement to curb such behavioural patterns that do not put the health of patients as priority. In addition, before patient care, 64.4% of participants do not wash their hands after MP usage and 63.8% declared use MP in the toilet. These charactestics make room for MP to be perfect vehicle for microbes from patients to the attending health professionals as well as from the health professionals to patients. Poor hygiene habits promoted possible fecal contaminations from health professionals and might either increase the nosocomial infections within patients or among health personnel. The majority of the MP owners admitted having children aged under 5 years (65.6%), some

of them lived with elderly above the age of 80 (5.5%). However few of the participants lived with both young children (under 5 years) and elderly (above 80 years) (4.3%). Hence the threat of MP being potential vehicle of infections is not only limited to those in the hospital, but also extended to those who live with health personnel and the general community. Beside use of public transport on a regular basis by health professionals (79.8%) enhances the risk of contamination and microbes spreading. Multiple contacts during travel times and transfers enable microbes passing on from person to person.

This study revealed that overall of the three hospitals 95.7% of the professional mobile phones were contaminated with bacteria. The global rate of contamination obtained were not too different to those obtained by Bodena et al. in Ethiopia [25], Bisht et al. [26] and many others studies [27-30]. This observation might be due to lack of regular phones' disinfection. However, lower rate of contamination were reported by Missri et al. [31] and Al-Mudares et al. [32]. The difference observed might be due to the hand hygiene observation in the hospital, frequencies of mobile phone utilization at the work time, and diverse movements around with the phones may be also concern.

Among bacteria isolated, CoN Staphylococcus were most represented (75.9%), approximately the same value (76.5%) was found by Bhardwaja et al. [33] and Brady et al. [34]; followed by Staphylococcus aureus (16.1%), nearly same result was reported by Bodena et al.[25] and others authors [35-37]. The proportion of Staphylococcus aureus (16.1%) identified in this study was not too different from data reported by Bodena et al. (14.4%) in Ethiopia [25]; while higher rate was reported in Italy (58.9%) [38] and Nigeria (25%) [11]. Predominance of CoNS and Gram positive bacteria in general could be explained by their transfer from hands to phones considering their high proportion on normal skin flora [39]. Barely 6.7% of Gram negative bacteria were recorded in this study. These Gram negative bacteria were represented by three types of bacteria: Enterobacter cloacae (n=04), Acinetobacter spp (n=02) and Pseudomonas aeruginosa (n=01) [11, 37]. The 1.1% of Pseudomonas aeruginosa obtained was lower than 6.7% fund by Rahangdale et al. [40]. As for Acinetobacter spp (2.3%) same value were obtained by Heyba et al. (2.8%) [41]. Enterobacter cloacae proportion (4.6%) was around same value obtained by Brady et al. [34]. Gram negative bacteria might originated from fecal contamination due to lack of hand wash after have been to toilet. Beside, Pseudomonas aeruginosas and Acinetobacter spp the two bacteria have the particularity to remain viable for long time on inanimate surfaces [42].

In general, CoNS where not mostly considered in physiopathology considering their presence on normal skin flora. Although surveillance of CoNS spread is highly recommended in hospital areas because it can be responsible of severe nosocomial infections [42].

Contamination of mobile phone workers was associated to different factors. In this study, female phone were more contaminated, same result obtained by Pal et al. [43]. The finding were different from Bodena et al. study in Ethiopia [25] and Kokate et al. in India [44]. The town of Yaounde is the political capital of Cameroon and have many workers. Female workers' MP were the most contaminated because of the elevated numbers of female gendered amongst medical staff especially nurses.

We recorded high rate of multidrug resistance in this study (71.4%). Lower value were reported by Gashow et al. [45] and Khadka et al. [46]. While almost same high value (69.9%) was reported in Ethiopia by Bodena et al. [25]. Staphylococcus aureus showed high rate of resistance to Vancomycin, Cotrimoxazole, Tetracyclin and Fusidic Acid, approximatively same result was reported by Vaishali et al. [40]. Gram negative bacteria displayed high resistance to Amoxicillin, Aztreonam, about same value was found by Loyola et al. [47]. This difference of antibiotics susceptibility might be due to bacterial strains, hospitals milieu and treatment practice. Indeed the disponibility and accessibility of drugs without prescription in our country can be listed as one of the main reasons. On this list we can add irrational and unnecessary use of antibiotics by health professionals [48].

CONCLUSION

Our study showed that mobile phones of health professionals are highly contaminated by several bacteria. Among these bacteria, Staphylococcus aureus was predominant pathogen identified, followed by Enterobacter cloacae, Acinetobacter spp and Pseudomonas aeroginosa. Antibiotics were tested for these bacteria, results revealed that S. aureus were resistant to Vancomycin, Cotrimoxazole, Fusidic acid and Amoxillin plus Clavulanic acid. While Gram negative bacteria showed high resistance rate to Amoxicillin and Azthreonam. The majority of bacteria were multiresistant. In Yaounde University Teaching Hospital we found the highest rate of resistance follow by the Central Hospital. Female were most represented in this study. The phones of Laboratory working personnel were most contaminated. The use of mobile phone at the time of work, moving with the phone around patients, lacking of hands washing habit after phone use were the mains factors associated to mobile phones contamination. We also assume that hygiene in the work environment could be highly considered as associate factor.

Base on the result obtained in this study, to inverse the situation observed, we advise the health professionals to: frequently clean their mobile phone after use, most often wash their hands before and after work, avoid moving with their mobile phone around patients. To the authorities, we ask to implement the guidelines of mobile phones use in hospitals. Further studies should be conducted with large hospital and regions, large sample size including other associated factors and actual habits of health professional to understand and to have better general rules of mobile phones use regulation in our hospitals.

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CONFLICT OF INTEREST STATEMENT

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