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MOBILE PHONE AS A POTENTIAL RESERVOIR OF VARIOUS MICROFLORA

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ABSTRACT

Mobile phones are increasingly used by professionals, university/college staff and students as well as health care personnel for communication. These mobile phones act as reservoir of microbial flora. The objective of the study was to determine microbiological load of mobile phones collected from microbiology laboratory students and staff members as well as healthcare personnel. Swabs were rubbed on mobile phones and were inoculated on nutrient agar plates and microbial isolates obtained were analyzed by Gram staining. The result obtained showed total 98 isolates from 20 samples; out of them 78 were Gram positive and 20 were Gram negative bacterial isolates. Gram negative isolates were further selected for biochemical characterization and antibiotic susceptibility profile assessment. Identification was done by basic online identification method which showed % wise results and showed Escherichia coli as potent organism spread via mobile phones. This study highlights the fact that mobile phones are potential threat in the dissemination of infectious pathogens.

KEY WORDS

Mobile phones, bacterial contamination, antibiotic susceptibility assessment

INTRODUCTION:

The present study was aimed at investigating the bacterial contamination of mobile phones of students/staff and healthcare personnel. Today, mobile phones have become one of the most indispensable accessories of professional and social life. Although they are usually stored in bags or pockets, mobile phones are handled frequently and held close to the face (Sepehri G. *et al* 2009). It was also focused to show the necessity of cleanliness in handling personnel objectives like cell phones carefully with proper cover which would prevent the multiplication of microorganisms both pathogenic and non-pathogenic (Bhat, S. S., Hegde, S. K., & Salian, S. 2011). Therefore, it is necessary to search for the methods of safe disinfection. This data will further be used to build awareness about the health risks not only for students but also for teachers, doctors and other people carrying mobile phones (Shahaby, A. F. *et al* 2012). Hand washing may not usually be performed often enough and many people may use personnel mobile phone in the course of a working day, the potential act of mobile phones as a source of microbial transmission is considerable. Research has shown that the mobile phone could constitute a major health hazard. Microbiologists say that the combination of constant handling and the heat generated by the phones creates a prime breeding ground for all sorts of microorganisms that are normally found on our skin. Therefore, appropriate hand and body hygiene is very important. Telephones provide the conditions favorable to the growth of microorganisms as they emit heat and their body has numerous slits where dirt and sweat accumulate. Therefore, it is necessary to search for the methods of safe disinfection. The activity of isopropyl alcohol was only tested so far, and also the attention to the disinfection of surfaces and hands was pointed out (Nowakowicz-Dębek, B., *et al*. 2013). Hence the present

study was undertaken with objectives to screen mobile phones of various people for the presence of microorganisms, to isolate and identify the microorganisms with the help of standard laboratory techniques and to study their antibiotic susceptibility profiling.

MATERIALS AND METHODS:

Material used:

Sample: swabs obtained from mobile phone rubbing; Media (sterile): Nutrient agar plates and slants, MacConkey's agar plates, Eosin Methylene Blue agar plates (EMB), Peptone water, reagents for Gram's staining, Different sterile biochemical media, Antibiotic discs:Gentamycin (10µg), Amoxicillin (10µg), Erythromycin (15µg), Tetracycline (30µg); Other: sterile cotton swabs, distilled water, normal saline, sanitizer, sterile test tubes & Petri plates, slides.

Methods:

The study was conducted in microbiology laboratory. A total of 20 mobile phones were randomly sampled from the following groups: 5 microbiology laboratory students, 4 microbiology staff members, 5 doctors, 3 nurses', 3 microbiology laboratory peons. The samples were collected aseptically using sterile swabs moistened with sterile normal saline. Samples were collected by rotating the swabs over the surface of the both sides of the mobile phones. The swab stick was put quickly into sterile distilled water tube and sealed. Swabs were streaked on Nutrient agar plates and all plates were incubated at 37°C for 24 hours (Kawo, A. H., & Musa, A. M. 2013). Plates were observed for growth after incubation. Colony morphology and Gram's staining characteristics of isolates were recorded (Kokate, S. B. *et al* 2012). Gram negative isolates were taken into account for forward study. Isolates were purified on nutrient agar plates and aseptically streaked onto selective and differential media (MacConkey's agar, EMB agar media). All plates were incubated at 37°C for 24 hours and results were noted. Biochemical tests like oxidase test, catalase test, indole test, methyl red test, Voges-Proskauer's test, citrate utilization test, H_2S production test, urea utilization test, triple sugar iron agar were carried out. For antibiotic susceptibility profiling disc diffusion assay was used. A bacterial Suspension was prepared in sterile distilled water. A cotton swab was dipped into the suspension and streaked across the surface of nutrient agar and allowed to dry for 5 minutes after which sterile forcep was used to remove disc from pack and gently pressed onto the agar surface. The plates were incubated at 37°C for 24 hours. The diameter of zone of inhibition (clearance) was measured using Hi-media zonometer scale. The results were recorded and interpreted (Kawo, A. H., & Musa, A. M. 2013). Selected unknown bacteria were identified by basic online identification method using results of biochemical tests (Dahab, R. A., *et al* 2017).

RESULTS:

All samples showed bacterial growth on nutrient agar plates. The overall bacterial counts of 20 samples and the distribution according to the morphology and Gram's reaction are shown in Table 1. Total 98 isolates were obtained, from which 20 isolates were Gram negative and 78 were Gram positive. Later the study was focused on Gram negative isolates only as they are potent pathogens and can cause many diseases to humans in compare to gram positive bacteria. Total 20 Gram negative isolates, no.1-10; 11-19 and 20 were obtained respectively from students, doctors and nurses mobile phones illustrated in Figure 1.

As shown in figure 2, 72% isolates were able to grow on MacConkey's agar plate, whereas 28% isolates did not grow properly. There were 45% isolates grow well on EMB agar plates whereas 55% isolates did not grow properly. Results of biochemical characterization of the Gram-negative bacterial isolates are shown in Table 2. Results of the antibiotic susceptibility profiling of the isolates are shown in figure 3, 4 & 5. Presence of light growth of isolate (Figure 3) within inhibition zone was indicative of few antibiotic resistant microbial cells in population (in isolates no. 3, 7, 16 and 17). They may be pathogenic organisms. These organisms may be *Enterobacter aerogenes, Salmonella paratyphi A* and *Escherichia coli*.

Table 1: Numbers of total isolates obtained from swabs of 20 mobile samples

Sample no.	Isolates no.			Sample no.	Isolates no.		
	A	B	Total		A	B	Total
S1	1	4	5	D10	2	2	4
S2	3	2	5	D11	3	5	8
S3	3	6	9	D12	-	5	5
S4	1	4	5	D13	2	7	9
S5	2	6	8	D14	2	7	9
Total	**10**	**22**	**32**	**Total**	**9**	**26**	**35**
SM6	-	10	10	N15	-	2	2
SM7	-	2	2	N16	1	4	5
SM8	-	3	3	N17	-	2	2
SM9	-	2	2	**Total**	**1**	**8**	**9**
Total	**-**	**17**	**17**	P18	-	1	1
Grand Total	**20**	**78**	**98**	P19	-	2	2
				P20	-	2	2
				Total	**-**	**5**	**5**

(A- Gram negative, B- Gram positive, S- Student, SM- Staff member, D- Doctor, N- Nurse, P- Peon)

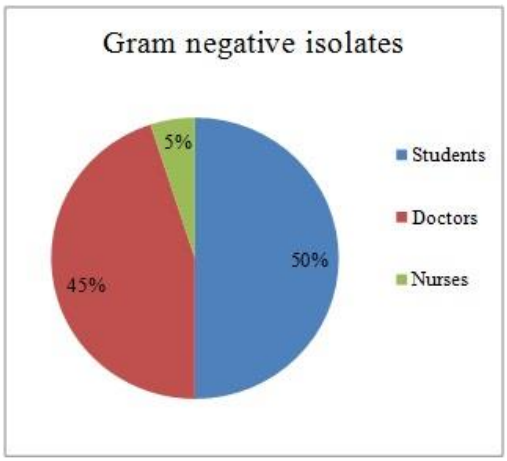

Figure 1: Distribution of total Gram-negative isolates

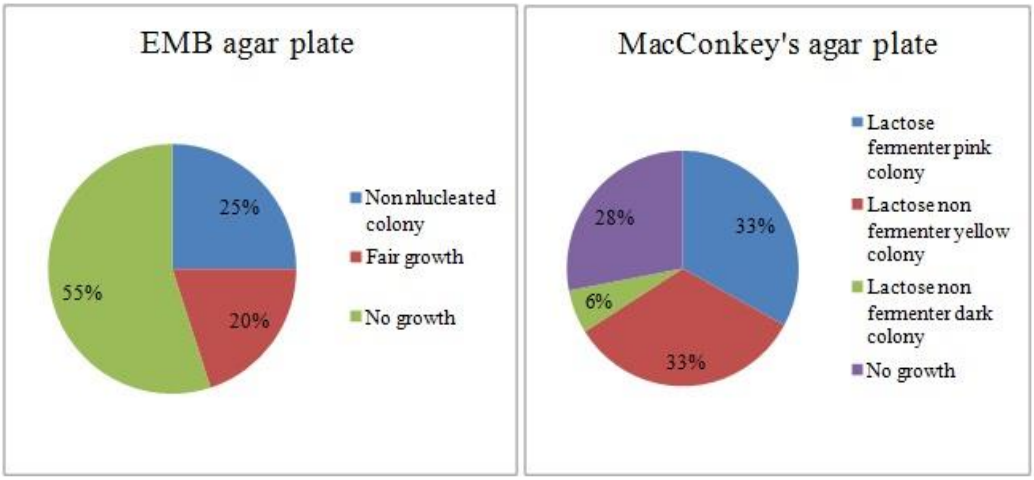

Figure 2: Results of growth on selective media

Table 2: Biochemical characterization of Gram negative isolates

Tests name / Isolate no.	Indole test	MR test	VP test	Citrate Utilization test	H_2S Production test	Urea Hydrolysis test	TSI Slant test: Sugar fermented (H_2S)	Catalase test	Oxidase test
1	-	-	+	-	-	-	Glu	-	-
2	-	+	+	-	-	-	Glu	+	+
3	-	+	+	-	-	-	Glu	+	+
4	-	-	-	-	-	-	Glu	+	+
5	-	+	+	-	-	-	Glu	-	+
6	-	+	-	-	-	-	Glu, Lac (H_2S)	+	+
7	-	+	-	-	-	-	Glu, Lac	+	-
8	-	+	+	-	-	-	Glu, Lac	+	+
9	-	-	+	-	-	-	Glu, Lac	+	+
10	-	-	+	-	+	-	Glu, Lac	+	+
11	-	-	-	+	-	-	Glu, Lac	+	+
12	-	-	-	-	-	-	Glu, Lac	+	+
13	-	-	-	-	-	-	Glu, Lac	+	-
14	-	+	-	-	-	-	Glu, Lac	+	+
15	-	-	-	-	-	-	Glu, Lac	+	+
16	-	-	-	-	-	-	Glu, Lac	+	+
17	-	-	-	-	-	-	Glu, Lac	+	+
18	-	-	-	-	-	-	Glu, Lac	+	-
19	-	+	-	-	-	-	Glu, Lac	+	-
20	-	-	-	+	-	-	(H_2S)	+	-

(MR= Methyl red test, VP= Voges Proskauer's test, TSI= Triple Sugar Iron agar slant test, Glu= glucose, Lac= lactose, (H_2S) = H_2S production)

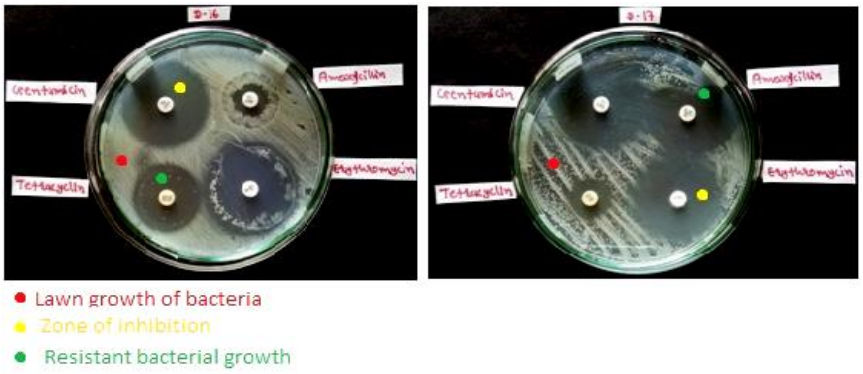

Figure 3: Antibiotic susceptibility test

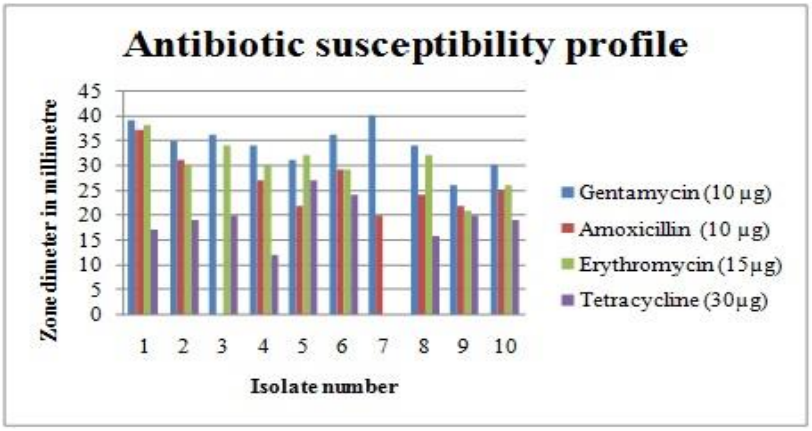

Figure 4: Antibiotic susceptibility profile of Gram negative isolates (1 to 10)

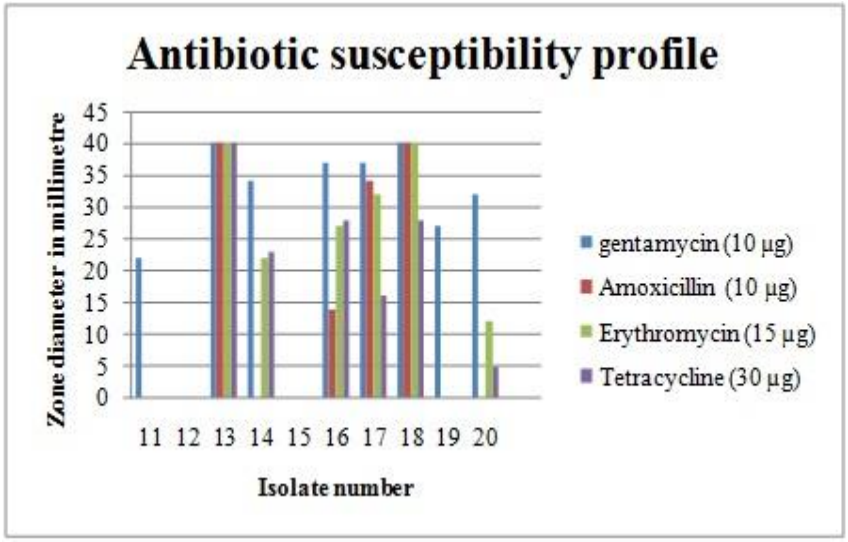

Figure 5: Antibiotic susceptibility profile of Gram negative isolates (11 to 20)

In other words, it may also be suggestive of mix population with antibiotic resistance and sensitive strain. Results showed that out of 20 isolates, 8 isolates were resistant against one or many antibiotics, in brief it is as follows: Isolate no. (Antibiotic): 3 (AMX), 7 (E & TE), 11 (AMX, E & TE), 14 (AMX), 16 (AMX, E & TE), 17 (AMX), 19 (AMX, E & TE), 20 (AMX). Most of the isolates were resistant against Amoxicillin (in isolate no. 3, 11, 14, 16, 17, 19 and 20). The study was focused on doctors & nurses' mobile phones where many isolates were resistant which may be pathogenic. Overall results are described in Figure No. 4 & 5.

An effort was made to identify gram negative isolates by online basic identification method. In which the percentage possibility of the bacteria was calculated and given by software (Table 3).

Table No. 3: Identification of Gram-negative isolates obtained from students, doctors and nurses mobile phones based on basic online identification method (% possibility wise)

Isolate no.	Organism name (%)	Isolate no.	Organism name (%)
1	*Serratia marcescens 99.99%*	11	*Serratia marcescens 90.48%*
2	*Enterobacter aerogenes 92.96%*	12	*Escherichia coli 94.51%*
3	*Enterobacter aerogenes 92.96%*	13	*Escherichia coli 94.51%*
4	*Escherichia coli 92.96%*	14	*Salmonella paratyphi A 70.31%*
5	*Serratia marcescens 90.6%*	15	*Escherichia coli 94.51%*
6	*Shigella sonnei 59.52%*	16	*Escherichia coli 94.51%*
7	*Salmonella paratyphi A 70.31%*	17	*Escherichia coli 94.51%*
8	*Proteus mirabilis 74.94%*	18	*Escherichia coli 94.51%*

9	*Serratia marcescens 97.51%*	19	*Salmonella paratyphi A 70.31%*
10	*Proteus mirabilis 100%*	20	*Escherichia coli 53.07%*

DISCUSSION:

In one study it was found that proportion of contamination of mobile phones of male resident doctors was more than female resident doctors. Mobile phones may act as a potential source of microorganisms and spread nosocomial infections. Hence proper infection control practices should be routinely practiced (Kokate, S. B., *et al*. 2012). In present study students and doctor's mobiles were also found to be contaminated with Gram negative organisms. In one research, authors obtained 62% contaminated mobile phones and found *Staphylococcus aureus*, *Pseudomonas aeruginosa, Escherichia coli* and *Enterococcus faecalis* etc. where, *Escherichia coli was* resistant against Amoxicillin antibiotic (Akinyemi, K. O., *et al*. 2009). In this study also mostly *Escherichia coli* isolates were obtained and most of the isolates were resistant against Amoxicillin antibiotic. Zakai S. during one research examined 2/3 of the cell phones that had never been decontaminated. That rate was less than that of the previous reported study, which showed that 80-92% of staff had never decontaminated their phones (Brady RR, et al. 2006). The ability of pathogens to survive on the surface of cell phones, the survival time, and the risk of transmitting these pathogens to patients should be examined (Zakai S., et al. 2016). In the present study most of the mobile phones of doctors and nurses were also found contaminated with resistant organisms.

CONCLUSION:

Study of micro flora present on the mobile phone's surfaces were successfully carried out. According to all results obtained it was proved that the mobile phones were reservoir of bacterial contamination. They were also able to transmit micro flora through the daily use. It defines that bacteria present on surfaces may be pathogenic or not. 20-gram negative isolates were obtained in this study indicates potential role of mobile phones as a fomite, which can carry and transmit large number of pathogenic cum resistant bacteria. Therefore, it is essential to wash hands thoroughly prior to use of mobile phones especially for medical personnel to avoid transmission of pathogens. Mobile phones of parents are often used by their children and propose potential risk for child health, if not handled properly. So that the study concluded that mobile phones are excellent source for transmission of non-harmful as well as harmful or pathogenic bacteria.

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