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Supplemental Materials

for

The Microbial Contamination of Mobile Communication Devices

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Investigations into the Microbial Contamination of Mobile Phones

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Wash your hands, caller. Your mobile's dirtier than you think

YOUR mobile phone could be a major health hazard, research shows. The phones, an essential part of everyday life for 35million Britons, are crawling with potentially lethal bacteria.

With tens of thousands of microbes living on each square inch, they harbour more bacteria than a lavatory seat, the sole of a shoe or a door handle, microbiologists say

By Fiona MacRae
Science Reporter

the combination of constant handling and the heat generated by the phones creates a prime breeding ground for all sorts of bugs that are normally found on our skin.

They include Staphylococcus aureus, which can cause illnesses from pimples and boils to pneumonia and meningitis and is a close relative of the superbug MRSA.

Joanna Verran, professor of microbiology at Manchester Metropolitan University, said: "Mobile phones are stored in bags or pockets and are handled frequently and that is close to the skin.

"In other words, they come into contact with more parts of our body and a wider range of bacteria than toilet seats. The phones contained more skin bacteria than any other object. This could be due to the fact that this type of bacteria increases in high temperatures as our phones are perfect for breeding these germs as they are warm and cosy in pockets, handbags and briefcases.

Mobile firm Dial-a-Phone advised owners to use anti-bacterial wipes to keep their handsets germ-free.

HEALTH

Talking dirty

Mobile mad Brits are in for a shock thanks to new research just published which reveals that there's actually more filth on our phones than the average loo!

Mobile phone retailer Dial-a-Phone Pay-As-You-Go conducted the study taking swabs from everyday objects and analysing the bacteria found on them. The shocking results found that there's more muck on our mobiles than the average door handle, keyboard, and bottom of a shoe or even a toilet seat.

The study found that without cleaning and disinfecting your mobile phone and keyboard on a regular basis, more bacteria could spread, potentially causing illness.

The research confirmed the presence of skin bacteria including staphylococcus aureus on the phone, keyboard, toilet seat and door handle. The shoe in contrast had bacteria from the soil and air.

Joanne Verran - Professor of Microbiology at Manchester Metropolitan University who carried out the research comments: "Mobile phones, like many everyday objects such a telephones and computer keyboards, harbour bacteria. However, being 'mobile', they are stored in bags or pockets, are handled frequently, and held close to the face.

In other words, they come into contact with more parts of our body and a wider range of bacteria than toilet seats. The phones contained more skin bacteria than any other object. This could be due to the fact that this type of bacteria increases in high temperatures and our phones are perfect for breeding these germs as they're kept warm and cosy in our pockets, handbags and brief cases. This bacteria is toxic to humans, and can cause infections if it has the opportunity to enter the body."

With this is mind, Dial-A-Phone Pay-As-You-Go are ensuring that their customers clean up their act by recommending that mobile users change their handsets regularly and are even providing anti bacterial phone wipes with every new phone purchased".

Phone wipes spokesperson comments: "We take our phones everywhere, being in close contact with our mouths, hands and faces their bound to collect all sorts of nasty germs. The images may look scary but our advice to phone users is to ensure they clean them regularly with an antibacterial wipe - we're giving away free wipes to all our new customers to encourage mobile hygiene!"

Bacteria cultures taken from a toilet seat

Bacteria cultures taken from a mobile phone

Why is it nil by mobile?

References

Brady RR et al. 2006. Is your phone bugged? The incidence of bacteria known to cause nosocomial infection on healthcare workers' mobile phones. J Hosp Infect 62:123–5.

Bures S, Fishbain JT. Uyejara CFT, Parker JM, Berg BW. 2000. Computer keyboards and faucet handles as reservoirs of nosocomial pathogens in the intensive care unit. Amer J Infect Control 28: 465 – 470.

French G, Rayner D, Branson M, Walsh, M. 1998. Contamination of doctors' and nurses' pens with nosocomial pathogens. The Lancet 351: 213.

Singh D, Kaur H, Gardner WG, Treen LB. 2002. Bacterial contamination of hospital pagers. Infect Control and Hosp Epidemiol 23: 274-276.

Tunc K and Olgun U. 2006. Microbiology of public telephones. J. Infect. 53: 140 – 143.

Young JM, Naqvi M, Richards L. 2005. Microbial contamination of hospital bed handsets. Amer J Infect Control 33: 170 – 174.

Introduction

Mobile phones and other frequently handled inert items have been implicated in cross-infection in the hospital environment (see references). This practical investigation arose partly due to this scientific information, and also as a result of some media coverage.

The Medical Microbiology module is a final year option, primarily for students taking Honours degrees in Biology and Biomedical Sciences. In the 07-08 session, 65 students enrolled. Laboratory classes comprised 4 x 4h sessions, each separated by a week (thus more than one exercise is carried out in any given session). The classes were run twice. Student: staff ratio was around 1:10.

Aim :

To demonstrate the potential of inert, frequently handled items to facilitate cross-contamination, and to encourage students to consider such issues in the hospital setting.

Objectives:

To isolate and identify common contaminants on a mobile phone, and to consider their origin, focusing particularly on presumptive staphylococci, and comparing the identity of those isolated from the phone with those isolated from the skin.

Methods

The schedule was provided to students in advance of the class. Students record observations on the gapped schedule, and subsequently download new sheets from WebCT to produce the final report. The report was divided into two sections: the first required students to outline observations and explain underlying principles of microbiology via a 'gapped' question sheet; the second asked students to assess the source (skin flora?), and significance of contamination of inert objects in terms of cross-infection, particularly within the hospital setting.

A shortened version of the schedule follows:

WEEK 1: ISOLATION

Work individually.

Moisten a sterile swab in saline and swab your skin (eg hands, nose, ears, lips). Roll the swab firmly over the surface. Use the swab to inoculate a tryptone soy agar plate, using the isolation plate technique to ensure separation of colonies.

Draw a diagram to show how you inoculated the plate.

Firmly press your mobile phone (if you have one) onto a large agar plate OR if you have a flip phone, use a moistened swab to sample the suface (particularly those that come into contact with mouth, ears, fingers). Inoculate the plate with the swab to ensure maximum yield of colonies. Draw a diagram to show how you inoculated the plate.

Use the medicated wipes provided to clean your phone. Then resample (either by pressing onto agar, or by swabbing, as before). Wipe the phone again.

Incubate plates 37° 24 h

WEEK 2: PURIFICATION

1. Take digital pictures of the mobile phone plates which you inoculated last week.

   REPEAT THE PHONE SAMPLING – ie press or swab, before and after cleaning. (Wipe clean again after second sampling)
2. Looking at last week's plates, describe any differences between the microflora of the two sites (phone pre-clean, and skin) and explain why they occur.

   It is likely that some of these colonies will be staphylococci. Why might this be?

   Have you got any colonies which are 'presumptive staph' on both skin and phone?

   What are the typical colony morphologies of staphylococci (text book)?
3. Subculture one colony of each of your presumptive staphylococci onto mannitol salt agar and nutrient agar to obtain pure cultures on selective and non selective media for identification ('isolation plates').

   What is in mannitol salt agar, and why is it used?

   Why do you usually need a pure culture on a non-selective medium (as opposed to a selective medium) for identification?
4. What other colonies were present on your mobile phone and skin swabs?

   Do Gram stains, and suggest identification and sources of these organisms.

WEEK 3: IDENTIFICATION

1. Take digital pictures of the mobile phone plates which you inoculated last week.

   REPEAT THE PHONE SAMPLING – ie press or swab, before and after cleaning. Wipe clean after sampling.
2. Look at the isolation plates you set up last week. Check the cultures are pure. Do the colonies look like those you subcultured? Use the non-selective medium from now on.

   You must have pure cultures for the identification test.

   To confirm Staphylococcus genus, perform Gram stain and catalase test.

   For the following tests you must have a positive control (S.aureus). Lab cultures are provided.

   To identify species, perform

   -- latex aggulation test (for coagulase and protein A – confirmatory for S.aureus)

   -- API staph for coagulase negative staphylococci (CNS) only.

   Construct a table summarising the properties of your isolates, and state their identities.

   Paste in any API printouts (results week 4)
3. ANTIBIOTIC SENSITIVITIES Set up a plate to show antibiotic sensitivities of two of your isolates (eg one from skin and one from phone, with similar colony morphologies).

WEEK 4: FINAL WORK

Take digital pictures of the mobile phone plates which you inoculated last week.

Identify any isolates via API system.

Measure zones of inhibition for antibiotic sensitivities.

For your report:

Insert photos from the three cleaning protocols (agar plates before and after cleaning).

Comment on the experiment and the results you obtained. Can you comment on mobile phone contamination (extent, origin, type of microorganisms, ease of cleaning, importance of cleaning, buildup of contamination etc.)? Do you see any hygiene or cross-contamination issues in this context? Were there differences between phones/people? Compare drugs resistance and other results of your isolates and discuss implications. Are you concerned? Are you a carrier?

What other inanimate objects might pose comparable cross-contamination issues? Look for references illustrating similar work.

Discuss in the light of lectures and literature. State references.

Results

Of the 63 students who submitted work, marks were as follows:

Mark (%)	0 - 20	21 - 40	41 - 60	61 - 80	81 - 100
No. students	2	10	24	19	8

Low marks were awarded due to non-completion of the gapped questions and an absence of an exploratory/explanatory text.

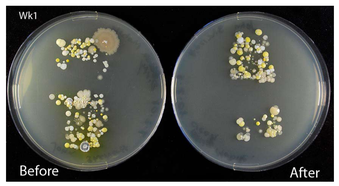
All students were able to demonstrate contamination of phones, and recognised the transient and nature of the contamination (variation from week to week; comparison with other students). [Fig 1 a–c].

Antimicrobial wipes reduced contamination, particularly on smooth areas of the phone. Not all wipes were antibacterial. [Fig 2].

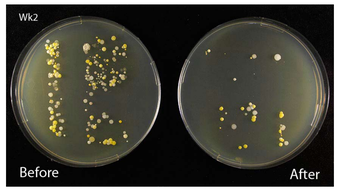
Some students were able to isolate similar species of staphylococci from phone and skin. Most isolated micrococci from their phones. Bacillus spp. were also isolated. None isolated *Staphylococcus aureus*.

Figure 1

a



b



c

Figure 2

Evaluation

The exercise was evaluated by written questionnaire, to which 38 responses were provided.

Responses to Question 1

(What did you think of the mobile phone practical overall?)

Positive	Negative
Good	Long and unorganised
It was interesting and simple	Not very good
Practical was good- learned how to identify colonies	
I really enjoyed the practical it was very interesting	
It was a good practical	In between
It was good, I enjoyed it, it was fun	Ok, too long
Interesting practical, fun, visual bacteria	Ok
Very good	
Exciting, enjoyed every bit of the practical	
It was a good idea, esp. since everybody has a mobile now	
Was good and informative	
It was well presented and easy to understand, the lecturers managed to convey their enthusiasm for the subject matter well	
Very interesting	
Good but very lengthy with lab report, was very interesting though. Practicals should have been worth more though	
Was good and interesting to do but was also quite all over the place with several parts not clearly outlined	
Quite interesting to actually see the flora present on an inanimate object instead of just being told they were there	
It was interesting to see the range of organisms that are carried on the skin and those which are picked up from the environment	
Informative	
Confusing, but overall interesting	
I enjoyed it but the timing was rubbish as we had our dissertation deadline then too	
Interesting, possibly best practical of my third year	
It was interesting though hard to get results	
Very interesting & enjoyable	
It was interesting, possibly not as challenging as the other practicals we were set. Instead of a write-up could do a worksheet?	
Very good as it linked in with what we were studying in the lectures and helped in learning	
Very positive	
Interesting, made it more fun to do, learnt more that way	
Very good- alerting, informative and interesting	

Responses to Question 2

(What was the best aspect?)

Practical based
Just seeing the sheer amount of different bacterial species that were on your phone
Its hands on and really does show that microbes are part of everyday life
Seeing what grew on the plate after week 1 (was pretty disgusting)
Finding how much bacteria was on your phone
The phone itself
Seeing what was on own item
Visualising the organisms
Realising just how much bacteria is present on the mobile
Seeing the pictures
Visualisation and isolation of organisms
Learning new diagnostic tests
Detecting the normal flora
Culturing imprint of mobile phone to see what is found on it
Getting to identify organisms on phone and compare with skin
Seeing the results
Seeing if I carried any potentially pathogenic organisms
Plates stamping
Eye-opener, made you question possible contaminants and what may be lurking. Personal- using own mobile phone gave a fun, personal approach
Practical
Seeing what organisms are found on a phone
Plating the phones
Discovering how contaminated phones can be, as well as the whole variety of contaminants possible
Realising how much my phone was contaminated!
API strips
Everything was really good, especially looking at the amount of germs present and relationship between phone and skin
All the staff in the unit were much more helpful than any other unit
It gave a good insight to microbial skin populations and their different types
Different, learnt stuff that applied to you- as you used your own mobile
Seeing what we were carrying, and how the phone became contaminated over the week

Responses to Question 3

(What parts could have been improved?)

Organisation
More time given. Three practical together was quite difficult. Needed to be slower/ more spaced out so that could understand what was going on! VERY RUSHED
It got a bit hectic some weeks doing 3 pracs all at the same time
I think the length of time but that can not be changed due to obvious incubation times
Not sure really I thought it was pretty well organised
All parts
Mine was really boring with a few dots
The lab reports are only worth 10% each and I think there was a lot of work needed for each report
Too many practical's on the go at once
More stringent controls on which wipes used. Perhaps setting up different groups and comparing the effectiveness of certain types of wipes. For example to find out if antibacterial wipes are worth paying extra for
More help identifying bacteria
Should be worth more % for detail required
The organisation and layout of work and experiments
Isolation/culturing of pure isolates proved tricky
I don't think it needed to be done every week
Write-up too difficult
Separation from other experiments/practicals been run, confusing to know why we were doing what we did
Not have such a huge write-up when other deadlines (dissertation) are due in
The queuing for photos
This year the practical was hectic, having 3 practicals on the go each week made it difficult
Time, number of students per prac decreased
I thought there was a bit too much going on in the practical at one time
A group demonstration at the end of the practical to see what everyone found and the changes
Too many things all added together- had to do other practicals too, could spread it out more not mix up different practicals in one day-confusing
Storage of the plates-some became lost. Also the last session was INCREDIBLY rushed- very stressful!!

Responses to Question 4

(Do you think the mobile phone practical would make a good exercise in future medical microbiology units?)

Positive	Negative
Yes	No
Yes, it was extremely interesting and a bit more fun	Definitely not
Definitely	
Yes. I learn things better if I enjoy them I'm sure that's true to others too	
Yes, it was interesting	
Yes I do	In between
Yes, because it demonstrates the fluidity of what's on different peoples phones	Possibly if results could be guaranteed
Yes. Its interesting to see the range of organisms we come into contact with everyday	
Yes- improved write-up theory	
Definitely! Once over the confusion, was great learning tool	
Possibly if results could be guaranteed	
Yes as I really enjoyed it	

Conclusions

As with all new lab classes, several improvements can be made to its efficient and effective operation. However, students clearly enjoyed the exercise, and it was apparent that learning had taken place.

The class will be run in 08-09, with an alteration in assessment emphasis (in-class assessment only of other concurrent experiments, with the mobile phone report as the key laboratory assessment)