Is Your Phone Bugged? The Role of Mobile Technology in Infection Control
Richard Brady, NHS Registrar in General Surgery/Coloproctology
A Webber Training Teleclass

Is your phone bugged? The role of mobile technology in infection control

Mr Richard Brady FRCSEd MD
NHS Registrar in General Surgery/Coloproctology
Owner - ResearchActive.com

www.webbertraining.com

Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Conflict of Interest Statement

• Senior NHS General Surgery Trainee
• Owner of a Social Media/App Company (www.researchactive.com Ltd).
• Previously medical advisor on medical social media to SM and Medical device companies
• Webmaster for a number of UK medical professional LinkedIn Groups
• Run a number of private practice SM channels and websites/apps
• Educational and Website Committees of the ESCP

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Structure of Teleclass

1. Mobile phone contemporary utilisation
2. Fomites and the doctor
3. Mobile phone contamination
4. Future adjuncts to decontamination
5. Microbiology apps
6. Apps and the 7 deadly sins
7. Opportunities and Innovation

Contemporary use

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<table>
<thead>
<tr>
<th>Open</th>
<th>Laparoscopic</th>
<th>Single port</th>
<th>Notes</th>
</tr>
</thead>
</table>

Future??

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Surgeons forced to carry out open heart surgery by MOBILE PHONE light after blackout plunges operating theatre into darkness

By Lizzie Parry for MailOnline

Smartphone ownership-
- 85% US surgical trainees
- 83.5% UK colorectal surgeons in UK/Europe
- 75-79% of UK medical students/doctors
- US doctors used 15 x day phone calls and similar for emails.
- 94% British maxillofacial trainees own a smartphone.
- 61% own an iPhone.
- 89% of trainees downloaded medical apps and used them regularly during clinical activities.

Smartphone ownership-
- 85% US surgical trainees
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Carter et al.
Journal MTM 3:2:2–10, 2014
76 Scottish surgical trainees
• 88% used mobile phone in work
• 92% owned a smartphone.
iPhone™ most popular (80%).
Functionalities—
• Email was the most utilised (96%).
• calls (85%)
• SMS/MMS (81%)
• Internet browsing (76%).

App usage
• 85% >1 medical app
• Accessing on daily basis 55%.
Type of app
• 70% Clinical guidelines
• 59% medical calculators
• 50% medical textbooks
• 50% revision/study aids
• 32% drug references
• 30% diaries/surgical logbooks
• 30% procedural instruction.
Payment
• 61% had paid for at least one app
• 19% of paid apps > £10

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Fomites & Doctors

Dr. Ignaz Semmelweis 1818-1865

Fomites & Doctors

- **Stethoscopes**

- **Pens**

- **Ties**

- **White coats**

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Mobile Phone Contamination

Fomites & Doctors

- MCDs, including mobile phones, pagers and personal digital assistants (PDAs), are often expensive objects and permit direct communication in emergency situations.
- Close proximity to medical personnel, wherever they are located in the hospital environment, allowing the transportation of bacteria contaminating the device to many different clinical environments.
- Warm environment - pocket\regularly in touch with hands and face

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Table 1: Number of mobile phones in which a specific type of bacteria was isolated

<table>
<thead>
<tr>
<th>Bacterial type</th>
<th>Number of mobile phones in which a specific type of bacteria was isolated (total 105)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coagulase-negative Staphylococcus</td>
<td>98</td>
</tr>
<tr>
<td>Micrococci spp.</td>
<td>41</td>
</tr>
<tr>
<td>Bacteroides spp.</td>
<td>21</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>7</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>6</td>
</tr>
<tr>
<td>Streptococcus viridans</td>
<td>6</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>6</td>
</tr>
<tr>
<td>Enterococci spp.</td>
<td>2</td>
</tr>
<tr>
<td>E. coli</td>
<td>1</td>
</tr>
</tbody>
</table>

78% thought doctors should be allowed to use phones
40% used phone at work daily
71% phones in work
96.2% of phones demonstrated evidence of bacterial contamination

Bacterial contamination of mobile communication devices in the operative environment

<table>
<thead>
<tr>
<th>Device</th>
<th>Mobile phones (%)</th>
<th>Pagers (%)</th>
<th>Personal digital assistants (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positve for bacterial growth</td>
<td>44 (95.7)</td>
<td>22 (81.3)</td>
<td>4 (80)</td>
</tr>
<tr>
<td>S. aureus</td>
<td>100 (100)</td>
<td>100 (100)</td>
<td>100 (100)</td>
</tr>
<tr>
<td>2 spp.</td>
<td>15 (32.6)</td>
<td>6 (22.2)</td>
<td>2 (40)</td>
</tr>
<tr>
<td>3 spp.</td>
<td>3 (6.5)</td>
<td>2 (7.4)</td>
<td>1 (20)</td>
</tr>
<tr>
<td>Coagulase-negative Staphylococcus</td>
<td>38 (82.6)</td>
<td>19 (70.4)</td>
<td>3 (60)</td>
</tr>
<tr>
<td>Micrococci spp.</td>
<td>13 (28.3)</td>
<td>7 (25.9)</td>
<td>1 (20)</td>
</tr>
<tr>
<td>Bacteroides spp.</td>
<td>12 (26.1)</td>
<td>3 (11.1)</td>
<td>2 (40)</td>
</tr>
<tr>
<td>Positive for selected pathogens</td>
<td>3 (6.5)</td>
<td>3 (11.1)</td>
<td>3 (60)</td>
</tr>
<tr>
<td>S. aureus</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Pseudomonas spp.</td>
<td>1 (2.2)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Acinetobacter spp.</td>
<td>1 (2.17)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Stenotrophomonas maltophilia</td>
<td>0 (0)</td>
<td>1 (3.7)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Anaerobes</td>
<td>1 (2.17)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

53% staff carried MCDs in theatre
84% phone had never been cleaned
11.5% demonstrated nosocomial bacteria
89.7% MCDs demonstrated evidence of bacterial contamination

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Healthcare workers' mobile phones are rarely contaminated by MRSA in the non-clinical environment.

Non-clinical environment
Nasal and phone swabs contamination
Due to expense focused on MRSA swabs

173 (37.5%) BMA ARM attendees volunteered for screening.
1% were positive for MRSA.
154 (89.0%) volunteers provided a mobile phone for bacteriological sampling.
No swab taken from a mobile phone was found to be positive for the presence of MRSA.
Both MRSA-positive nasal swabs were matched to MRSA-negative phone swabs.


Clinical environment
Patient Nasal and phone swabs
Wider screen

102 inpatients
92.4% support utilization of mobile phones by inpatients
24.5% stated that mobile phones were vital to their inpatient stay.
Young were more likely to possess a phone in hospital (p < 0.01) but there was no gender association.
50.9% stated that they had never cleaned their phone outside hospital.


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84.3% patients’ mobile phone positive for microbial contamination.
11.8% grew bacteria known to cause nosocomial infection.
6.9% phones and 31.4% nasal swabs demonstrated Staphylococcus aureus.

MSSA/MRSA contamination of phones was associated with concomitant nasal colonization

85.7% patients with mobile phones demonstrating S. aureus had concurrent nasal S. aureus (PGFE patterns)


Do mobile phones of patients, companions and visitors carry multidrug-resistant hospital pathogens?

A cross-sectional study mobile phones of patients, patients’ companions, visitors, and health care workers (HCWs).

Higher rates of pathogens (39.6% vs 20.6%, P = .02) were found in MPs of patients’ (n = 48) vs HCWs’ (n = 12).

There were also more multidrug pathogens in the patients’ MPs

Our findings suggest that mobile phones of patients, patients’ companions, and visitors represent higher risk for nosocomial pathogen colonization than those of HCWs. Specific infection control measures may be required for this threat.


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**Review**
Review of mobile communication devices as potential reservoirs of nosocomial pathogens
R.R.W. Brady, J. Verran, N.N. Damani, A.P. Gibb

### Table I: Recent studies of contamination of mobile communication devices (MCDs)

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Country</th>
<th>Setting</th>
<th>Sample</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beer et al. 23</td>
<td>2006</td>
<td>Canada</td>
<td>HCWs, children’s hospital</td>
<td>100 pagers</td>
<td>12% pathogenic bacteria</td>
</tr>
<tr>
<td>Borer et al. 24</td>
<td>2005</td>
<td>Israel</td>
<td>HCWs, tertiary care hospital</td>
<td>124 mobile phones</td>
<td>12% Acinetobacter spp. (2% MDR)</td>
</tr>
<tr>
<td>Briddy et al. 27</td>
<td>2005</td>
<td>USA</td>
<td>HCWs, teaching hospital</td>
<td>82 PDAs</td>
<td>2.5% MSSA (0% MRSA)</td>
</tr>
<tr>
<td>Brady et al. 7</td>
<td>2006</td>
<td>UK</td>
<td>HCWs, district general ward</td>
<td>105 mobile phones</td>
<td>7.6% MSSA (1.9% MRSA)</td>
</tr>
<tr>
<td>Briddy et al. 25</td>
<td>2007</td>
<td>UK</td>
<td>HCWs, operating theatre environment</td>
<td>46 mobile phones</td>
<td>3.8% MSSA, 3% Psuedomonas spp.</td>
</tr>
<tr>
<td>Goldblatt et al. 26</td>
<td>2007</td>
<td>USA/Israel</td>
<td>HCWs, non-clinical controls</td>
<td>400 mobile phones</td>
<td>26% pathogenic bacteria</td>
</tr>
<tr>
<td>Hassoun et al. 22</td>
<td>2004</td>
<td>USA</td>
<td>Metropolitan teaching hospital</td>
<td>75 PDAs</td>
<td>11% MSSA (8% MRSA), 1% VRE, 2% MRSA</td>
</tr>
<tr>
<td>Jayalakshmi et al. 31</td>
<td>2008</td>
<td>India</td>
<td>Hospital and Research Institute</td>
<td>144 mobile phones</td>
<td>2.7% MRSA; 4.8% Acinetobacter spp. 10% pathogenic bacteria</td>
</tr>
<tr>
<td>Jeske et al. 28</td>
<td>2007</td>
<td>Austria</td>
<td>Anaesthetists’ hands after using MCDs</td>
<td>40 hands following</td>
<td>1 min on mobile phone</td>
</tr>
<tr>
<td>Karabab et al. 29</td>
<td>2007</td>
<td>Turkey</td>
<td>HCWs, teaching hospital</td>
<td>122 mobile phones</td>
<td>9.0% pathogenic bacteria, 8.1% MSSA</td>
</tr>
<tr>
<td>Khivara et al. 26</td>
<td>2006</td>
<td>India</td>
<td>Doctors, teaching hospital</td>
<td>30 mobile phones</td>
<td>40% MSSA (6.7% MRSA)</td>
</tr>
<tr>
<td>Namas et al. 30</td>
<td>2000</td>
<td>USA</td>
<td>Urban teaching hospital</td>
<td>36 pages</td>
<td>23.3% MSSA, 6.6% Acinetobacter spp.</td>
</tr>
<tr>
<td>Ramesh et al. 5</td>
<td>2008</td>
<td>Barbados</td>
<td>HCWs, general hospital</td>
<td>101 mobile phones</td>
<td>15% Gram-negative pathogens</td>
</tr>
<tr>
<td>Singh et al. 14</td>
<td>2002</td>
<td>USA</td>
<td>Medical centre</td>
<td>100 pagers</td>
<td>21% MSSA (16% MRSA)</td>
</tr>
<tr>
<td>Tambekar et al. 33</td>
<td>2008</td>
<td>India</td>
<td>Doctors, teaching hospital</td>
<td>73 mobile phones</td>
<td>20% MSSA</td>
</tr>
</tbody>
</table>

HCWs: healthcare workers; MDR: multidrug resistant; PDA, personal digital assistant; MSSA/MRSA meticillin-sensitive/resistant Staphylococcus aureus; VRE, vancomycin-resistant enterococci.
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Geography

Borer et al. '05 (Israel) 12% acinobacter spp.
Selim et al '15 (Egypt) 53% MRSA
Khivsara et al. '06 (India) 6.7% MRSA; 40% MSSA
Brady et al. 2006 (North. Ireland) 1.9% MRSA, 7.6% MRSA
Brady et al. 2007 (Scotland) 0% MRSA; 3.8% mssa;
Ramesh et al. 2008 (Barbados) 15% Gram Neg

Despite wide variability in level & type of bacteria, overall MCD contamination rate, with bacteria known to cause HAI, of 9-25%.


Health Care Workers' Mobile Phones: A Potential Cause of Microbial Cross-Contamination Between Hospitals and Community

Does it depend where a HCW works?

183 mobile phones (51.4%) from nurses, (17.5%) from laboratory workers, and (31.1%) from health care staff.

97.8% culture-positive specimens were isolated including 9.5% MRSA & 11.2% ESBL-producing Escherichia coli,

24.6% specimens were isolated from mobile phones of ICU workers, including two MRSA and nine ESBL-producing E. coli.

(p = 0.02) sig. difference in the isolation of ESBL-producing E. coli between ICU workers and non-ICU workers.


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173 (67%) British Medical Association’s Annual Representatives Meeting
87 (33%) Association of Surgeons in Training conference.

Six (2%) MRSA nasal carriage (BMA=1%, ASIT= 5%; p = 0.099).
Participants from a surgery(4.8%) more likely to be MRSA positive (p=0.039).

No association with gender, seniority or country of employment and MRSA status.
MRSA nasal carriage rates within this cross-sectional study are lower than studies reporting carriage rates in HCWs within the clinical environment.

---

The link to HCW Hands

Khivsara et al. reported genetically identical S. aureus on doctors’ hands and phones; the co-contamination rate was 6.7%.

Jeske et al. 10% of swabs taken from anaesthetists’ hands revealed contamination with ‘pathogenic bacteria’, possibly demonstrating that the mobile phone may be a source of bacteria which can be transferred to the hands of HCWs.

Borer et al. found 10% had co-contamination of multidrug-resistant Acinetobacter spp. on HCWs’ hands and their mobile phone.
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Mobile phones carry the personal microbiome of their owners
James F. Meadow,1,2 Arlen F. Albritt,1 and Jessica L. Owen1,2

Women’s index fingers were not significantly different from their phones (p = 0.327), but men’s were (p = 0.001)

People shared more bacterial OTUs with their own phones than with phones belonging to other people.

Original Research
NHS Connecting for Health: Healthcare Professionals, Mobile Technology, and Infection Control

87 on-call doctors’ mobile phones were sampled prior to, and 12h after, a cleaning intervention involving 70% isopropyl alcohol.

78% pathogenic bacteria, 8% cleaned their phones regularly.
8% Staphylococcus aureus; 44.8% Gram- positive cocci.

Bacterial contamination was not associated with gender, specialty, or seniority of the phone user (p > 0.05).

The cleaning intervention reduced the number of phones that grew bacteria by 79% (55% [48 of 87] before versus 16% [14 of 87] after cleaning).


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Original Research
NHS Connecting for Health: Healthcare Professionals, Mobile Technology, and Infection Control

Simple cleaning interventions can reduce the surface bioburden of hospital- provided doctors’ mobile phones and therefore the potential for cross-contamination.

This cleaning intervention is:
• inexpensive,
• easily instituted,
• and effective.

HCPs should:
• carry the minimum number of electronic devices on their person
• maintain good hand hygiene,
• and clean their device appropriately in order to minimize the potential for cross-contamination in the workplace.


Cleaning your Apple products

Read recommendations and guidelines for cleaning your Apple computer, iPad, iPhone, iPod, display, or peripheral device.

For information about how to disinfect your keyboard, trackpad, or mouse, refer to How to disinfect the Apple internal or external keyboard, trackpad, and mouse.

The materials used to make Apple products vary; in some cases each product might have specific cleaning requirements, which might vary by the part you are cleaning. Here are some tips that apply to all products to get you started:

• Use only a soft, lint-free cloth. Avoid abrasive cloths, towels, paper towels, and similar items that might cause damage.
• Unplug any external power sources, devices, and cables.
• Keep liquids away from the product.
• Don’t get moisture into any openings.
• Don’t use aerosol sprays, solvents, or abrasives.
• Don’t spray cleaners directly onto the item.

If liquid does make its way inside your Apple product, seek assistance from an Apple Authorized Service Provider or Apple Retail Store as soon as possible. Liquid damage is not covered under the Apple product warranty or AppleCare Protection Plans. If you plan to visit an Apple Retail store, make a reservation at the Genius Bar using http://www.apple.com/retail/geniusbar/(available in some countries only).

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Decontamination adjuncts

BMJ. 2012 Feb 7;344:e871. doi: 10.1136/bmj.e871.
Might wipe clean covers for mobile phones reduce risk of spread of pathogens?
Osborne JD, Phull JS, Matone L, I.
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Decontamination adjuncts

Evidence, evidence, evidence ...........

Communication Report
Increasing Clinical Presence of Mobile Communication Technology: Avoiding the Pitfalls

Table 1. Summary Recommendations to Consider for Avoiding Pitfalls

<table>
<thead>
<tr>
<th>PUTATIVE RISK</th>
<th>GUIDELINES AND/OR OFFERED RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMI</td>
<td>1. Mobile phones should be switched off near critical care or life support equipment or only used in designated areas. Hence, they should not be used in intensive therapy units or special care baby units.</td>
</tr>
<tr>
<td></td>
<td>2. Restriction on use of mobile phones within 3 m of certain, sensitive equipment or in the ICU environment.</td>
</tr>
<tr>
<td>Confidentiality</td>
<td>1. The use of camera phones in the clinical setting could compromise patient confidentiality and consent. Therefore, education of healthcare professionals on data storage and confidentiality is required.</td>
</tr>
<tr>
<td>Cross-contamination</td>
<td>1. Adequate surface decontamination and hand hygiene techniques should be emphasized to healthcare workers and patients.</td>
</tr>
<tr>
<td></td>
<td>2. Patients should be informed of the risk of cross-contamination and educated to prevent sharing of mobile phones or chargers to reduce risk of cross-contamination.</td>
</tr>
<tr>
<td></td>
<td>3. Consideration of restrictions regarding use of mobile phone technology in certain high-risk areas, for example, operating theaters, ICUs, and burns units.</td>
</tr>
<tr>
<td></td>
<td>4. Requirement for local guidelines on infection control measures.</td>
</tr>
</tbody>
</table>


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<th>GUIDELINES AND/OR OFFERED RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise and distraction</td>
<td>1. Ringtones and mobile phone-generated noise have an impact on resting patients and should be minimized. To reduce the impact on patient recovery, phone use should occur in designated areas or during visiting times only.</td>
</tr>
<tr>
<td></td>
<td>2. Mobile phones may pose a distraction and compromise patient care. It is recommended that members of the operating team should only engage in urgent calls and keep calls brief. Also, wherever possible, calls should be diverted to voice mail.</td>
</tr>
<tr>
<td>Fire and safety</td>
<td>1. Education of patients and healthcare staff on this health and safety issue; mobile phone use or charging should be avoided near oxygen supplies.</td>
</tr>
</tbody>
</table>

*EMI, electromagnetic interference; ICU, intensive care unit.


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Carter et al.
Journal MTM 3:2:2–10, 2014
Factors that influenced their choice of app:
1. Friend/peer recommendation
2. Senior recommendation
3. Online reviews
4. Journal recommendations
5. Proven medical author input was rated by trainees as the third least important factor
6. Associated website and associated advertising were ranked last

There was no statistically significant association between sex, age, or seniority, and mobile phone usage in the clinical environment, number of medical application downloads or payment for medical application downloads.

3 online mobile app stores searched using the following terms: infection prevention, prevention, hand hygiene, hand washing, and specific HAI terms

2,646 apps, 17 met criteria. Almost all of the apps (70.6%) had a maximum of two functions.

CONCLUSION:
Mobile apps may help reduce HAI by providing easy access to guidelines, hand hygiene monitoring support, or step-by-step procedures aimed at reducing infections at the point of clinical care.

Given the dearth of available apps and the lack of functionality with those that are available, there is a need for further development of mobile apps for HAI prevention at the point of care.

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Smartphone apps in microbiology—is better regulation required?

- 6 relevant apps stores (Apple, Blackberry Mobile Market, Google Android Market, Nokia Ovi, Samsung, Microsoft windows Marketplace) were searched using major microbiological terms (microbiology, microbes, antibiotics, antimicrobials, MRSA, Clostridium difficile).
- 94 microbiology-themed apps in total.

<table>
<thead>
<tr>
<th>Online App store</th>
<th>Reference material</th>
<th>Educational material</th>
<th>Antibiotic advice</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>9</td>
<td>17</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>Google Android</td>
<td>6</td>
<td>11</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Blackberry</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Microsoft Windows MarketPlace</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Nokia Ovi</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Samsung application store</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Vivekanathan et al. JMI Microbiol Infect. 2012.10;1(3):e1-e20

Smartphone apps in microbiology—is better regulation required?

Medical professional involvement (microbiologists, doctors, pharmacists, specialist nurses) was reported in the publicity material of 32/94 (34%)

A number of authors of apps providing critical information (e.g. medicine dosing) explicitly stated that the accuracy of information provided could not be guaranteed.

Much potential but a regulatory framework be established to ensure that the information provided on app store websites are complete, accurate and reliable; thus enabling purchasers to make an informed decision before using medical smartphone apps.

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Richard Brady, NHS Registrar in General Surgery/Coloproctology
A Webber Training Teleclass

<table>
<thead>
<tr>
<th>Type of app</th>
<th>Example</th>
<th>Brief description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>Meningitis</td>
<td>Offers information to clinicians on meningitis: pathophysiology, symptoms and treatment</td>
</tr>
<tr>
<td></td>
<td>Microbe world</td>
<td>Provides latest audio, video and news content in microbiology from the American Society for Microbiology</td>
</tr>
<tr>
<td></td>
<td>John Hopkins Vaccines</td>
<td>Reference on administration and contraindications for various vaccines for registered users</td>
</tr>
<tr>
<td></td>
<td>Sherris Pathogenic parasites</td>
<td>This text provides information on antiseptics agents, pathogenic processes, epidemiology and basis of therapy</td>
</tr>
<tr>
<td>Educational</td>
<td>USMLE Microbiology</td>
<td>400+ questions in microbiology</td>
</tr>
<tr>
<td></td>
<td>Microbiology 101</td>
<td>Revision course in microbiology</td>
</tr>
<tr>
<td></td>
<td>Bacteriology</td>
<td>Knowledge-based app about bacteria in relation to disease</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>Sanford’s guide 2011 antibiotic therapy</td>
<td>Provides information on treatment of infectious diseases</td>
</tr>
<tr>
<td></td>
<td>Antibiotics and pocket guides</td>
<td>Summary of empiric antibiotic regimens, antibiotic activity data, and other disease management information</td>
</tr>
<tr>
<td></td>
<td>Thomson Reuters Clinical Xpert</td>
<td>Continuously aggregating data from disparate hospital information systems, providing real-time patient data</td>
</tr>
<tr>
<td></td>
<td>Microbiology pronunciations</td>
<td>Audio of the pronunciations of microbes</td>
</tr>
<tr>
<td></td>
<td>HealthTree-MRSA and C. diff</td>
<td>Provides public with infection numbers for methicillin-resistant Staphylococcus aureus and Clostridium diff in NHS hospitals across England</td>
</tr>
<tr>
<td></td>
<td>Understanding Lyme disease</td>
<td>Provides information on Lyme disease for patients</td>
</tr>
</tbody>
</table>

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1. Inequity

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Author</th>
<th>Total number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmacology</td>
<td>Haffey</td>
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<tr>
<td>Cancer</td>
<td>Visvanathan</td>
<td>265</td>
</tr>
<tr>
<td>Pain</td>
<td>Rosser</td>
<td>111</td>
</tr>
<tr>
<td>Microbiology</td>
<td>Visvanathan</td>
<td>94</td>
</tr>
<tr>
<td>Dermatology</td>
<td>Hamilton</td>
<td>79</td>
</tr>
<tr>
<td>Colorectal Surgery</td>
<td>O’Neill</td>
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<tr>
<td>Bariatric</td>
<td>Connor</td>
<td>60</td>
</tr>
<tr>
<td>Vascular</td>
<td>Carter</td>
<td>49</td>
</tr>
<tr>
<td>Hernia surgery</td>
<td>Connor</td>
<td>26</td>
</tr>
</tbody>
</table>

1. BJ Clin Pharmacol. 2013
8. Hernia 2013 in press

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1. Inequity

<table>
<thead>
<tr>
<th>General Public</th>
<th>Medical</th>
<th>Patient</th>
<th>All</th>
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</thead>
<tbody>
<tr>
<td>Anal</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bladder Cancer</td>
<td>1</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Brain Cancer</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>9</td>
<td>34</td>
<td>58</td>
</tr>
<tr>
<td>Cervical cancer</td>
<td>1</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Colon</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Kidney cancer</td>
<td>1</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Leukemia</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Liver</td>
<td>0</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>16</td>
<td>39</td>
<td>14</td>
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<tr>
<td>Lymphoma</td>
<td>9</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Melanoma</td>
<td>4</td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>Mesothelioma</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Myleoma</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Oesophagus</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Oral cancer</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Ovarian cancer</td>
<td>1</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Pancreatic</td>
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<td>0</td>
</tr>
<tr>
<td>Prostate cancer</td>
<td>7</td>
<td>25</td>
<td>28</td>
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<tr>
<td>Rectal</td>
<td>2</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Stomach</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Uterine cancer</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

2. Lack of expertise - authorship/source

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Author</th>
<th>Total number</th>
<th>% med involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td>Visvanathan†</td>
<td>265</td>
<td>39</td>
</tr>
<tr>
<td>Pain</td>
<td>Rosser‡</td>
<td>111</td>
<td>31</td>
</tr>
<tr>
<td>Microbiology</td>
<td>Visvanathan†</td>
<td>94</td>
<td>34</td>
</tr>
<tr>
<td>Dermatology</td>
<td>Hamilton³</td>
<td>79</td>
<td>33</td>
</tr>
<tr>
<td>Colorectal</td>
<td>O’Neill⁴</td>
<td>68</td>
<td>32</td>
</tr>
<tr>
<td>Bariatric</td>
<td>Connor⁶</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>Vascular</td>
<td>Carter⁷</td>
<td>49</td>
<td>27</td>
</tr>
<tr>
<td>Hernia</td>
<td>Connor⁸</td>
<td>26</td>
<td>27</td>
</tr>
</tbody>
</table>

1. in progress
8. Hernia 2013 in press

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2. Lack of expertise - authorship/source

Only 56% cancer apps provided scientifically validated data but most difference in those for general public.

- "There is lack of cancer-related applications with scientifically backed data. There is a need to improve the accountability and reliability of cancer-related smart phone applications and encourage participation by health-care agencies to ensure patient safety."
  Pandey et al., J Cancer Ed. 2013; 28(1):138-142

3. Plagiarism

Tom Lewis

Are unauthorized copies of popular medical textbooks being sold in Apple App Store?

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4. Bias / Commercial Interests

Bariatric apps (60)
50% Medical involvement
20% advertise private practice
77% Commercial links
60% had no consumer reviews

57

Hernia apps (26)
27% Medical involvement
96% commercial interests/links
Commercial interests
apps requiring purchase (62%)
product promotion (8%)
i.e. trusses/stockings
private surgery (8%)
online shops (4%)
62% No consumer reviews

58

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5. Inaccuracy & errors

Case Study 1 – Melanoma

- 4 apps evaluating photographs.
- Tested pictures of 60 Melanomas/128 benign lesions - histologically proven
- Sensitivity (7%-98%); specificity (30%-94%).
  *app sending to certified dermatologist

- 3 of 4 apps incorrectly classified 30% or more of melanomas as uncerning.
- “Reliance on these applications, which are not subject to regulatory oversight, in lieu of medical consultation can delay the diagnosis of melanoma and harm users.”


Case Study 2 – Opioid switching converters

- 23 apps Opioid conversion apps
- 52% no medical involvement
- 48% reference source
- Conversion 1 mg morphine/codeine (3.333-12 mg).
- Conversion 1 mg morphine/methadone (0.05-0.67 mg).
- Difference in output for some apps with and without medical professional involvement (p=0.038).

- …significant concerns with regard to the reliability of information provided by apps offering opioid dose conversion… lack of information regarding evidence-based content and peer review.

Haffey F et al. Drug Safety 2013

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Table 3  Conversion of 1-mg oral morphine by opioid

<table>
<thead>
<tr>
<th>Conversion (route of administration; units)</th>
<th>No. of apps</th>
<th>Median (mg)</th>
<th>Range (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codeine (PO; mg)</td>
<td>21</td>
<td>6.67</td>
<td>3.333–12</td>
</tr>
<tr>
<td>Morphine (IV/IM/SC; mg)</td>
<td>23</td>
<td>0.33</td>
<td>0.3–0.5</td>
</tr>
<tr>
<td>Fentanyl (IV; µg)</td>
<td>16</td>
<td>3.33</td>
<td>3–3.333</td>
</tr>
<tr>
<td>Oxycodone (PO; mg)</td>
<td>23</td>
<td>0.67</td>
<td>0.5–1</td>
</tr>
<tr>
<td>Hydromorphone (PO; mg)</td>
<td>23</td>
<td>0.25</td>
<td>0.13–0.27</td>
</tr>
</tbody>
</table>


Case Study 3 – Cardiac Arrest Risk Calculators

- 19 “heart attack” risk calculators evaluated
- Medical student project (Hyatt, Leeds)
- Tested with scenarios
- Range of 1-75% risk in 10 years apps Opioid conversion apps

- Moriarty et al. (Leeds)

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5. Inaccuracy & errors
Case Study 4 – Rheumatology calculators

Pfizer

Worldwide Biopharmaceutical Business

14 October 2011

“Pfizer Rheumatology Calculator” iPhone / Android Application - important information

Dear Doctor,
Pfizer Ltd. would like to inform you of an error within a “Pfizer Rheumatology Calculator”
iPhone / Android application which was available for download from the Apple App Store
and the Google Android Market since April 2011.
The “Pfizer Rheumatology Calculator” allows physicians to measure the disease activity
of patients with various inflammatory diseases, in particular of patients with rheumatoid arthritis.
The disease scores included in this application are internationally well accepted by the
scientific community.
Pfizer very recently became aware that the application gives incorrect values for the DAS28
calculation, and immediately withdrew the application from the respective online stores.
In particular, the Apple iPhone application gives an average a 15-20% higher score
for DAS28-ESR compared to a score calculated using the published DAS28-ESR formula (with
higher or lower incorrect scores in certain cases). It gives on average a 10-15% lower score
for DAS28-CRP compared to a score calculated using the published DAS28-CRP formula.
Incorrect values are also obtained for the ASDAS-CRP score (scores are on average 15-25%
lower) and for the PASI score (scores are up to 50% lower). There may also be minor errors
in the Framingham scores.

5. Inaccuracy & errors

Evaluation of the accuracy of smartphone medical calculation apps

• Tested 14 apps/1240 tests.
• Only 43% apps had 100% accuracy.
• Half of the errors resulting in change in prognosis

Bierbrier et al., J Med Internet Res. 2014;16(2):e32.

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6. Lack of Security & Confidentiality

43 Health and fitness apps:

• Many apps send data unencrypted without user knowledge.
• Many apps connect to several third-party sites without user knowledge.
• 72% medium—high risk.

“Consumers should not assume any of their data is private in the mobile app environment—even health data that they consider sensitive.”

7. Lack of testing & evidence to support effect

Effectiveness of Mobile-Health Technologies to Improve Health Care Service Delivery

• Meta-Analysis 42 Trials — all had risk of bias / poor design
• Statistically significant reductions in correct diagnoses using mobile technology photos compared to gold standard.
• Appointment attendance using text message (short message service or SMS) reminders was increased but cancellations not effected

• “Future trials need to be of high quality, they should be undertaken in resource-limited settings as well as in high-income countries, and they should consider interventions that combine mHealth and conventional approaches.”

Free C et al. 2013 PLoS Med 10(1)
Lack of testing & evidence to support effect

Instant Blood pressure app “lets you measure your blood pressure - no cuff required”
Monitors blood pressure from picture of finger pulse against camera and sound of heart beat
No disclaimers
Evidence of consumer use of app to manage blood pressure “for entertainment purposes only”
Untested/without literature

Husain July 2014 iMedicalapps
“Top 10 downloaded iPhone Health app
Can cause significant patient harm”
Suggestions

- Medical apps: clarity of purpose, evidenced-base and transparent authorship/sources –
- PRE-REQUISITE CRITERIA FOR LISTING AS A MEDICAL APP ON MAJOR APP STORES
- Robust clinical testing/regulatory oversight if aid diagnosis, disease management or drug dosage.
- Establish repository of “safe/approved” apps on national/local basis - New NHS apps library or expansion of mental health apps library
- The current regulatory system is opaque and undermining the “good” mHealth app ecosystem
- HCOs/HCP should search for quality, peer-reviewed E.B medical apps already available before commissioning new ones.

Using apps in clinical practice

An app is a medical device if it is used to “diagnose, support diagnosis or clinical decision, make calculations to determine diagnosis or treatment, or are used for any medical purpose”.

“If you are using an app that should have a CE mark but it is missing, then you are leaving yourself open to problems and possible litigation.”

Prof J Wyatt went further ….
Physicians shouldn’t just pay attention to whether an app has a CE mark, but should do further research to ensure the app they are using is accurate and has benefits in clinical use. Wyatt J

Alternative - IS0129 standard, clinical risk management standard created by the Information Standards Board for Health and Social Care for health IT systems in the UK.
Suggestions

1. Medical apps: clarity of purpose, evidenced-base and transparent authorship/sources
2. Pre-requisite criteria for listing as a medical app on major app stores.
3. Robust clinical testing/regulatory oversight if aid diagnosis, disease management or drug dosage.
4. Establish repository of “safe/approved” CE apps on inter/ national/local basis - New NHS apps library or expansion of NHS mental health apps library
5. The current regulatory system is opaque and undermining the “good” mHealth app ecosystem
6. All medical apps should have a “self destruct:“
7. HCOs/HCP should search for quality, peer-reviewed E.B medical apps already available before commissioning new ones.

Conclusions

1. Hospital policies on apps and smart-phones, BYOD need urgently updated as do the lines of responsibility regarding mobile phone use in clinical care.
2. Higher quality interventional trails required to assess the effectiveness and accuracy of medical apps and mobile telephone interventions.
3. With research; potential opportunities for correcting inequity of provision could be identified
4. The current “frontier/wild-west” ecosystem of mHealth app design and provision, together with lack of proactive, international/national/local regulation, make medical mobile app-related mortality and morbidity (MM&M) ™ an inevitability

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Conclusions

- There is a failure in the infection control policy of hand hygiene.

- Re-institute/educate staff – hand hygiene.

- Guidelines on mobile phone usage and cleaning should be introduced to reduce this factor in the transmission of bacteria that cause nosocomial infection.

Conclusions

- 5%–21% of HCWs’ mobile phones provide a reservoir of bacteria known to cause nosocomial infections.

- The potential for the cross-contamination of such bacteria on hands and mobile communication devices of healthcare workers to many different clinical settings is a viable concern.

- Staff and patients do not regularly clean their mobile phone and indeed many have never cleaned their phone at all.

- The use of 70% isopropyl alcohol for bacterial decontamination has been recommended.
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Questions
@researchactive

May 27 (South Pacific Teleclass)
FOOD SAFETY CULTURE – FROM FARM TO FORK
Dr. Douglas Powell, Powell Food Safety, Australia

June 02 (Free British Teleclass ... Denver Russell Memorial Teleclass Lecture)
PHAGE THERAPY IN A POST-ANTIBIOTIC ERA
Dr. Martha Clokie, University of Leicester, UK

June 03 (Free Broadcast live from the 2015 IPS congress of The French Society for Hospital Hygiene)
PREVENTING INFECTIONS IN HEALTHCARE WORKERS: STRATEGIES AND CHALLENGES
Bruce Gamage, President, IPAC Canada

May 24 (South Pacific Teleclass)
PATIENT EMPOWERMENT AS PART OF AN ASIAN HAND HYGIENE PROGRAMME
Prof. Yee Chun Chen, National Taiwan University Hospital and College of Medicine

www.webbertraining.com/schedule1.php

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