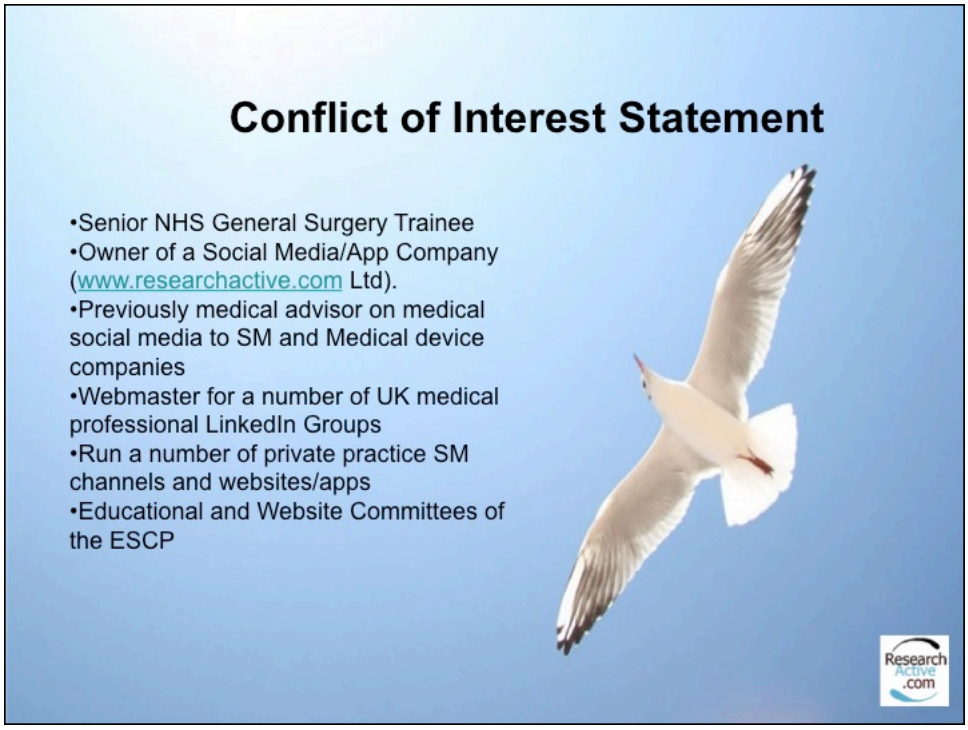
Is Your Phone Bugged? The Role of Mobile Technology in Infection Control
Richard Brady, NHS Registrar in General Surgery/Coloproctology
A Webber Training Teleclass

Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com

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



Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com

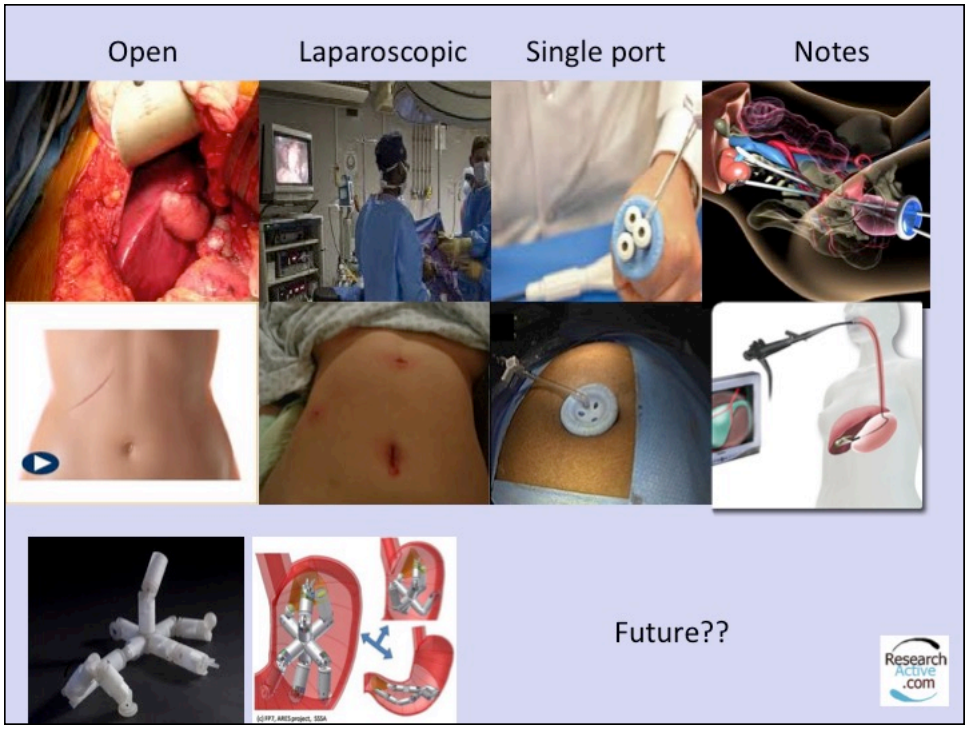
Structure of Teleclass

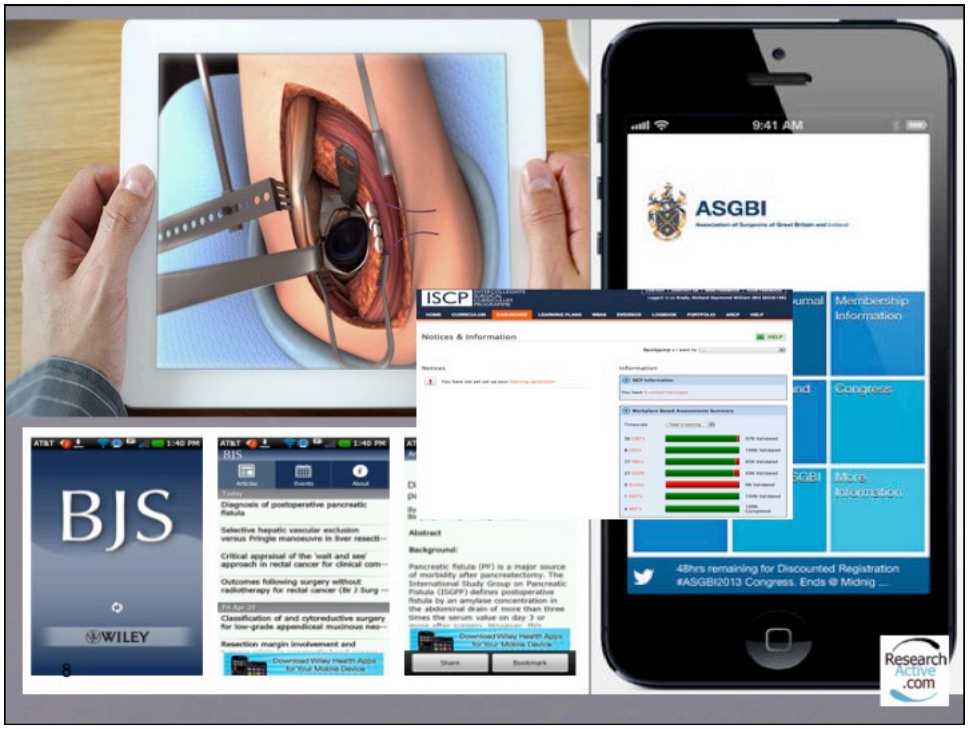
1. Mobile phone contemporary utilisation
2. Fomites and the doctor
3. Mobile phone contamination
4. Future adjuncts to decontamination
5. Microbiology apps
6. Apps and the 7 deadly sins
7. Opportunities and Innovation

5

Contemporary use

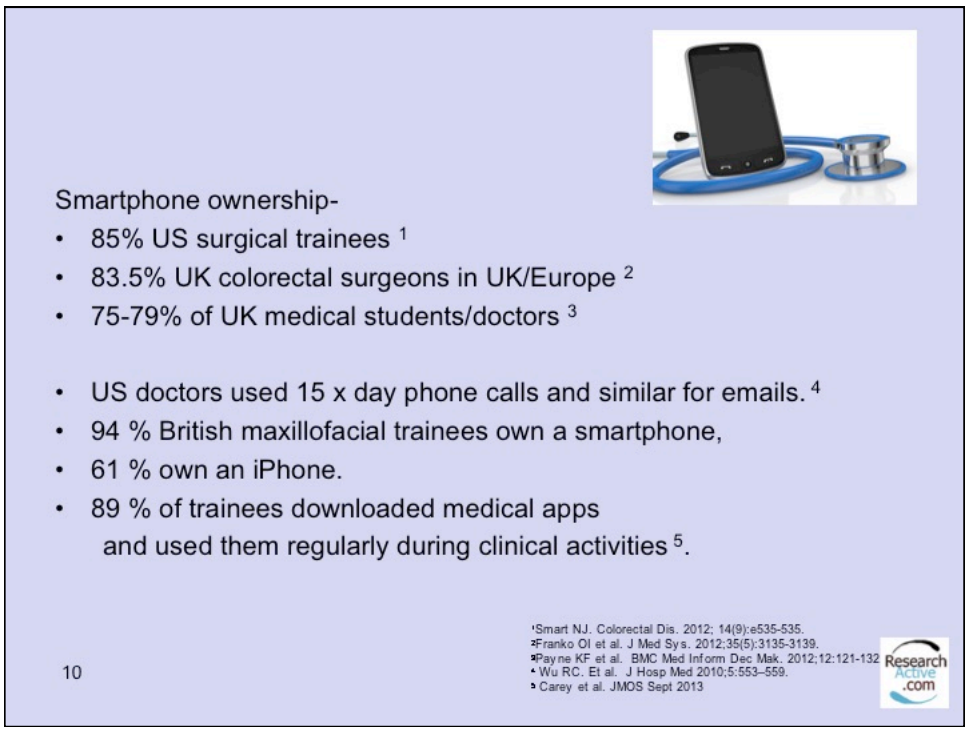
Is Your Phone Bugged? The Role of Mobile Technology in Infection Control
Richard Brady, NHS Registrar in General Surgery/Coloproctology
A Webber Training Teleclass





Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com

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



Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com

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

JMTM Journal of Mobile Technology in Medicine

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

COMMON

UTILISING APPS FOR CLINICAL CARE DELIVERY

TEND TO USE FREE OR CHEAPER APPS

11

12

Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com

Fomites & Doctors

Dr. Ignaz Semmelweis 1818-1865

13

Fomites & Doctors

- **Stethoscopes**
  - Am J Infect Control. 2002 Dec;30(8):499-502.
  - J Hosp Infect. 2003 Nov;55(3):236-7.
  - Med J Aust. 2003 May 5;178(9):468.
- **Pens**
  - Ann R Coll Surg Engl. 2004 Jan;86(1):51-2.
  - Lancet. 1998 Jan 17;351(9097):213.
- **Ties**
  - Intensive Care Med. 2000 Feb;26(2):250.
- **White coats**
  - J Hosp Infect. 2000 May;45(1):65-8.

14

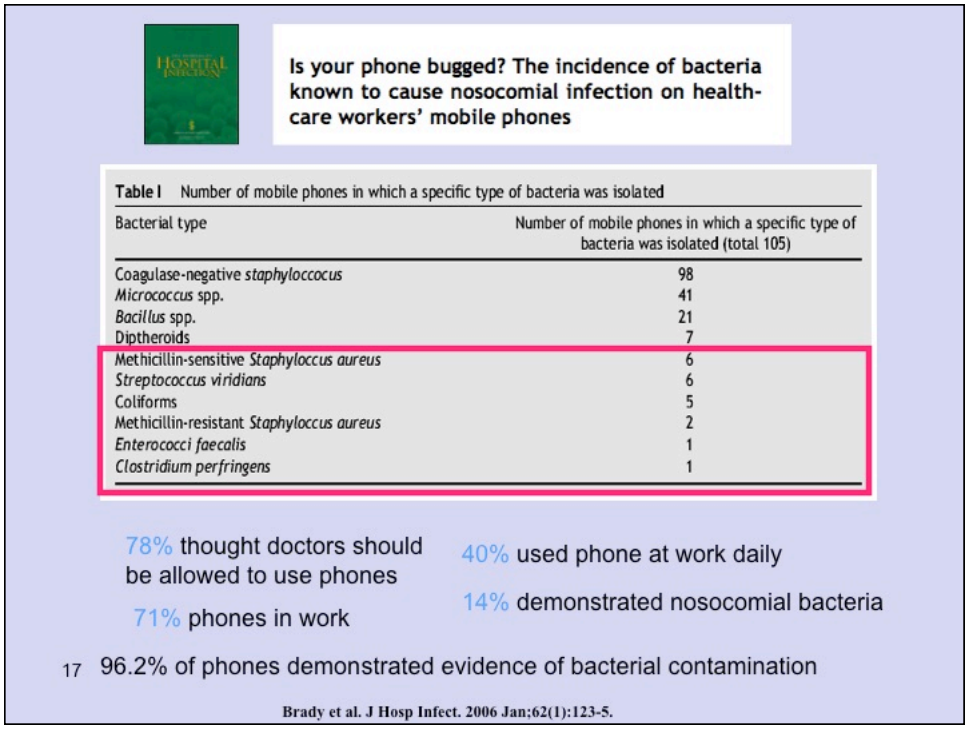
Mobile Phone Contamination

15

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

16



Is your phone bugged? The incidence of bacteria known to cause nosocomial infection on health-care workers' mobile phones

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

Bacterial type	Number of mobile phones in which a specific type of bacteria was isolated (total 105)
Coagulase-negative *staphyloccocus*	98
Micrococcus spp.	41
Bacillus spp.	21
Diptheroids	7
Methicillin-sensitive *Staphyloccus aureus*	6
Streptococcus viridians	6
Coliforms	5
Methicillin-resistant *Staphyloccus aureus*	2
Enterococci faecalis	1
Clostridium perfringens	1

78% thought doctors should be allowed to use phones

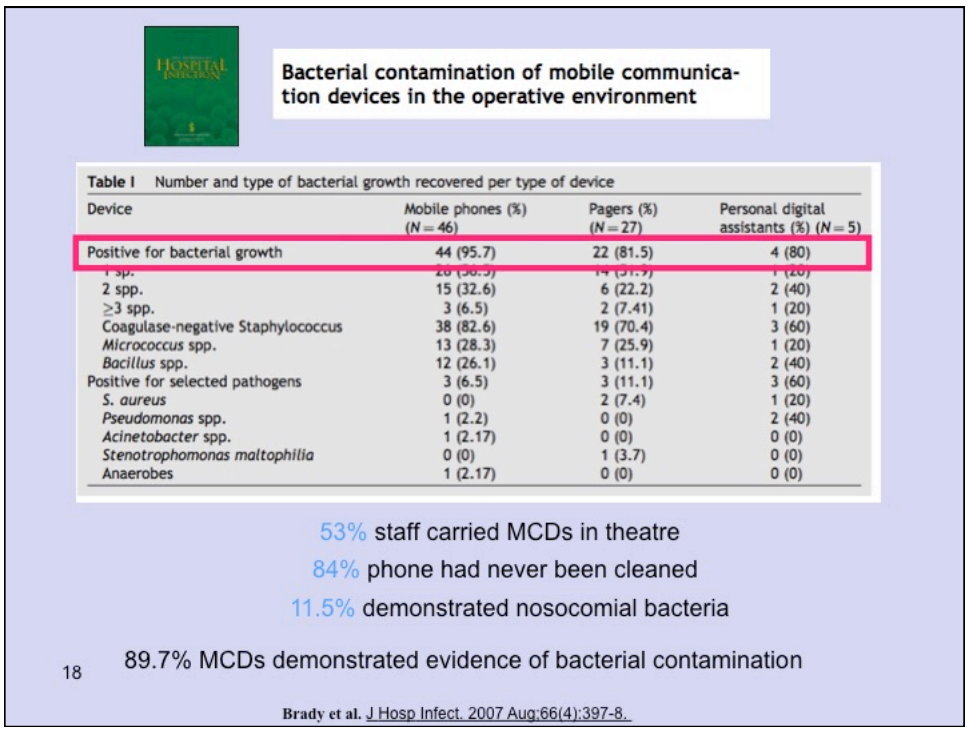
71% phones in work

40% used phone at work daily

14% demonstrated nosocomial bacteria

17 96.2% of phones demonstrated evidence of bacterial contamination

Brady et al. J Hosp Infect. 2006 Jan;62(1):123-5.



Bacterial contamination of mobile communication devices in the operative environment

Table I Number and type of bacterial growth recovered per type of device

Device	Mobile phones (%) ($N=46$)	Pagers (%) ($N=27$)	Personal digital assistants (%) ($N=5$)
Positive for bacterial growth	44 (95.7)	22 (81.5)	4 (80)
1 spp.	28 (60.9)	14 (51.9)	1 (20)
2 spp.	15 (32.6)	6 (22.2)	2 (40)
≥3 spp.	3 (6.5)	2 (7.41)	1 (20)
Coagulase-negative Staphylococcus	38 (82.6)	19 (70.4)	3 (60)
Micrococcus spp.	13 (28.3)	7 (25.9)	1 (20)
Bacillus spp.	12 (26.1)	3 (11.1)	2 (40)
Positive for selected pathogens	3 (6.5)	3 (11.1)	3 (60)
S. aureus	0 (0)	2 (7.4)	1 (20)
Pseudomonas spp.	1 (2.2)	0 (0)	2 (40)
Acinetobacter spp.	1 (2.17)	0 (0)	0 (0)
Stenotrophomonas maltophilia	0 (0)	1 (3.7)	0 (0)
Anaerobes	1 (2.17)	0 (0)	0 (0)

53% staff carried MCDs in theatre

84% phone had never been cleaned

11.5% demonstrated nosocomial bacteria

18 89.7% MCDs demonstrated evidence of bacterial contamination

Brady et al. J Hosp Infect. 2007 Aug;66(4):397-8.

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.

19

Brady et al. J Hosp Infect. 2009 Aug;72(4):373-4

ORIGINAL ARTICLE

Mobile phone technology and hospitalized patients: a cross-sectional surveillance study of bacterial colonization, and patient opinions and behaviours

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.

20

Brady et al. Clin Microbiol Infect. 2011 Jun;17(6):830-5.

ORIGINAL ARTICLE 10.1111/j.1469-0691.2011.03493.x

Mobile phone technology and hospitalized patients: a cross-sectional surveillance study of bacterial colonization, and patient opinions and behaviours

R. R. Brady[1], A. C. Hunt[2], A. Visvanathan[1], M. A. Rodrigues[1], C. Graham[2], C. Rae[2], P. Kalima[2], H. M. Paterson[1] and A. P. Gibb[2]
1) Department of Surgery, Western General Hospital, 2) Departments of Laboratory Medicine, Medical Microbiology and Infection Control, Lothian University Hospitals and 3) Epidemiology and Statistics Core, WTCRF, University of Edinburgh Western General Hospital, Edinburgh, UK

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)

21

Brady et al. Clin Microbiol Infect. 2011 Jun;17(6):830-5.

AJIC

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).

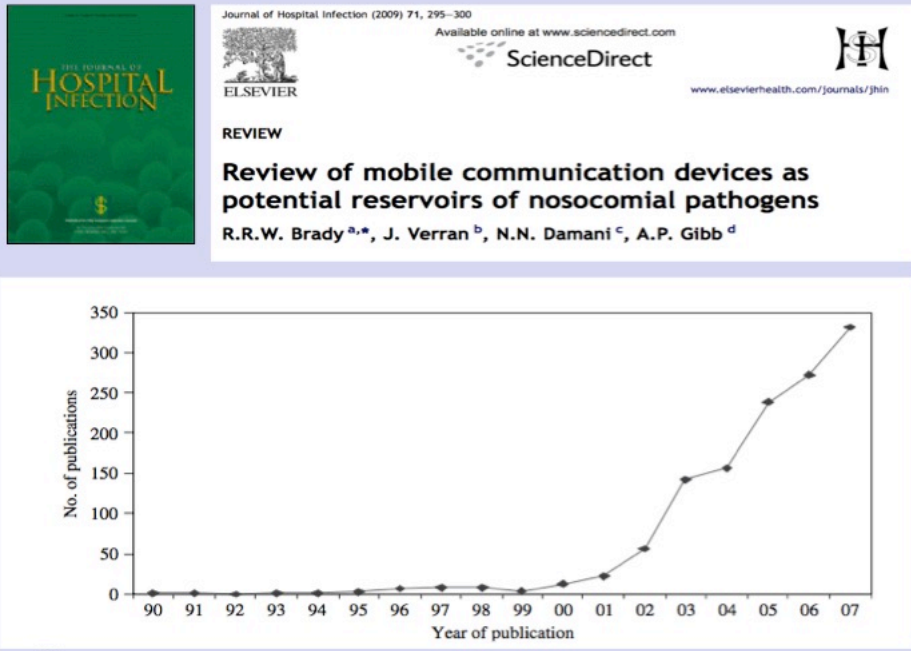
There were also more multidrug pathogens in the patents' MPs

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.

22

Tekerekoğlu et al. Am J Infect Control. 2011 Jun;39(5):379-81

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



Journal of Hospital Infection (2009) 71, 295–300

Available online at www.sciencedirect.com

ScienceDirect

www.elsevierhealth.com/journals/jhin

REVIEW

Review of mobile communication devices as potential reservoirs of nosocomial pathogens

R.R.W. Brady [a,*], J. Verran [b], N.N. Damani [c], A.P. Gibb [d]

23

Brady et al. J Hosp Infect. 2009 Apr;71(4):295-300.

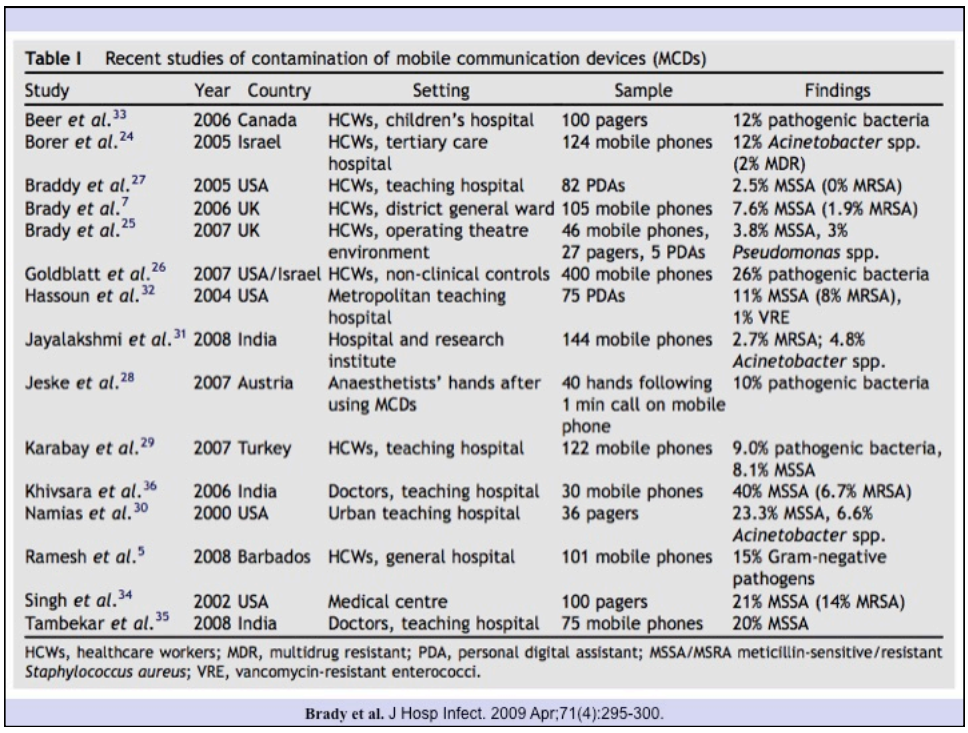


Table I Recent studies of contamination of mobile communication devices (MCDs)

Study	Year	Country	Setting	Sample	Findings
Beer *et al.*[33]	2006	Canada	HCWs, children's hospital	100 pagers	12% pathogenic bacteria
Borer *et al.*[24]	2005	Israel	HCWs, tertiary care hospital	124 mobile phones	12% *Acinetobacter* spp. (2% MDR)
Braddy *et al.*[27]	2005	USA	HCWs, teaching hospital	82 PDAs	2.5% MSSA (0% MRSA)
Brady *et al.*[7]	2006	UK	HCWs, district general ward	105 mobile phones	7.6% MSSA (1.9% MRSA)
Brady *et al.*[25]	2007	UK	HCWs, operating theatre environment	46 mobile phones, 27 pagers, 5 PDAs	3.8% MSSA, 3% *Pseudomonas* spp.
Goldblatt *et al.*[26]	2007	USA/Israel	HCWs, non-clinical controls	400 mobile phones	26% pathogenic bacteria
Hassoun *et al.*[32]	2004	USA	Metropolitan teaching hospital	75 PDAs	11% MSSA (8% MRSA), 1% VRE
Jayalakshmi *et al.*[31]	2008	India	Hospital and research institute	144 mobile phones	2.7% MRSA; 4.8% *Acinetobacter* spp.
Jeske *et al.*[28]	2007	Austria	Anaesthetists' hands after using MCDs	40 hands following 1 min call on mobile phone	10% pathogenic bacteria
Karabay *et al.*[29]	2007	Turkey	HCWs, teaching hospital	122 mobile phones	9.0% pathogenic bacteria, 8.1% MSSA
Khivsara *et al.*[36]	2006	India	Doctors, teaching hospital	30 mobile phones	40% MSSA (6.7% MRSA)
Namias *et al.*[30]	2000	USA	Urban teaching hospital	36 pagers	23.3% MSSA, 6.6% *Acinetobacter* spp.
Ramesh *et al.*[5]	2008	Barbados	HCWs, general hospital	101 mobile phones	15% Gram-negative pathogens
Singh *et al.*[34]	2002	USA	Medical centre	100 pagers	21% MSSA (14% MRSA)
Tambekar *et al.*[35]	2008	India	Doctors, teaching hospital	75 mobile phones	20% MSSA

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

Brady et al. J Hosp Infect. 2009 Apr;71(4):295-300.

Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com

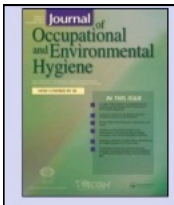
Geography

Borer et al. '05 (Isreal)	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%.

25

Brady et al. J Hosp Infect. 2009 Apr;71(4):295-300.



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,

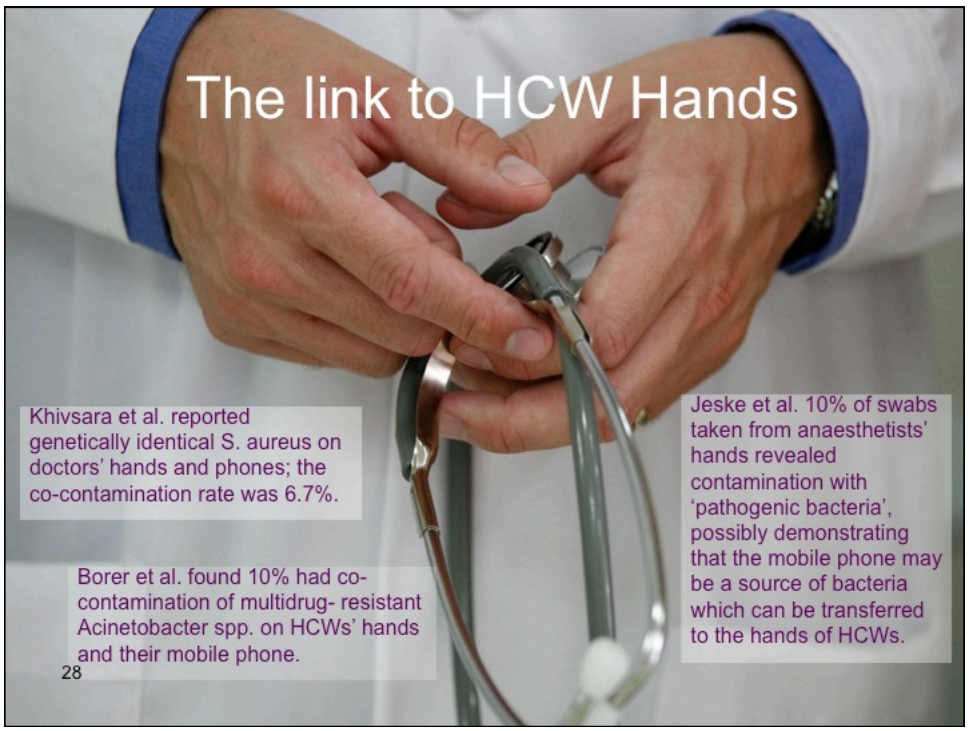
24.6% specimens were isolated from mobile phones of ICU workers, including two MRSA and nine ESBL-producing E. coli.

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

26

Ustun et al. J Occup Environ Hyg. 2012;9(9):538-42.


European Journal of Clinical Microbiology & Infectious Diseases
Eur J Clin Microbiol Infect Dis
DOI 10.1007/s10096-009-0718-4
BRIEF REPORT
A prevalence screen of MRSA nasal colonisation amongst UK doctors in a non-clinical environment
R. R. W. Brady · C. McDermott · C. Graham · E. M. Harrison · G. Eunson · A. P. Fraise · M. G. Dunlop · A. P. Gibb
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.
27
Brady et al Eur J Clin Microbiol Infect Dis. 2009 Aug;28(8):991-5.


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%.
Borer et al. found 10% had co-contamination of multidrug- resistant Acinetobacter spp. on HCWs' hands and their mobile phone.
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.
28

PeerJ Peer-Reviewed & Open Access

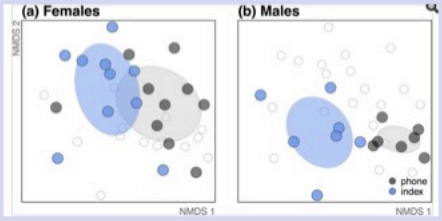
Latest Articles
For Authors
Editorial Board

PeerJ. 2014; 2: e447.
Published online 2014 Jun 24. doi: 10.7717/peerj.447
PMCID: PMC4081285

Mobile phones carry the personal microbiome of their owners

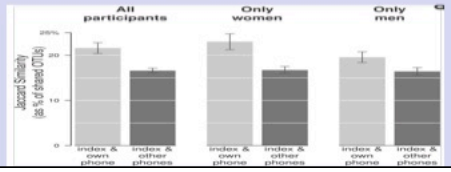
James F. Meadow,[✉1] Adam E. Altrichter,[1] and Jessica L. Green[1,2]

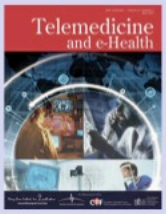
Women's index fingers were not significantly different from their phones (p = 0.327), but men's were (p = 0.001)



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

29





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% Staphyloccus 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).

30

Brady et al. Telemed J E Health. 2012 May;18(4):289-91.

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.

HCWs 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 work place.

31

Brady et al. Telemed J E Health. 2012 May;18(4):289-91.

Cleaning your Apple products

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

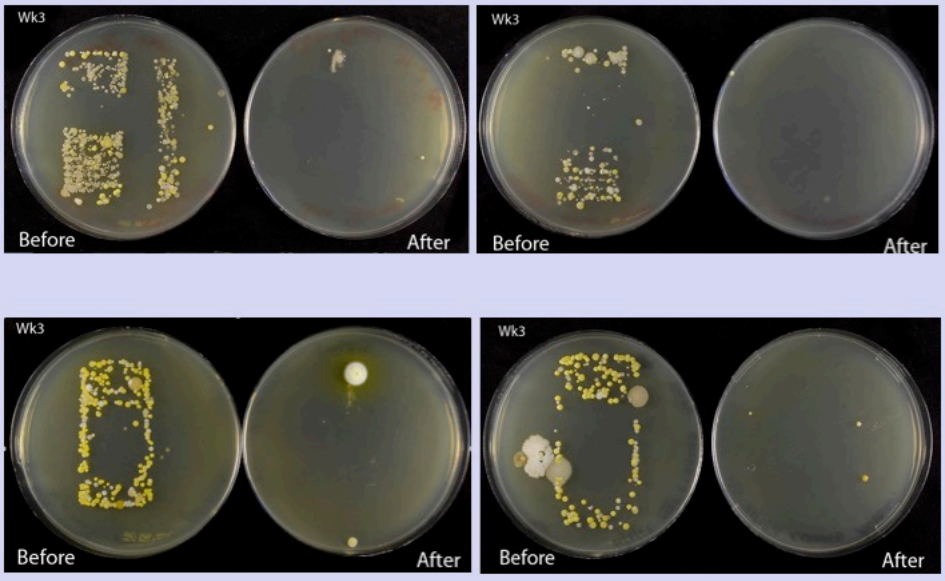
For information about how to disinfect your keyboard, trackpad, or mouse, refer to How to disinfect the Apple internal or external keyboard, trackpad, and mouse.

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).

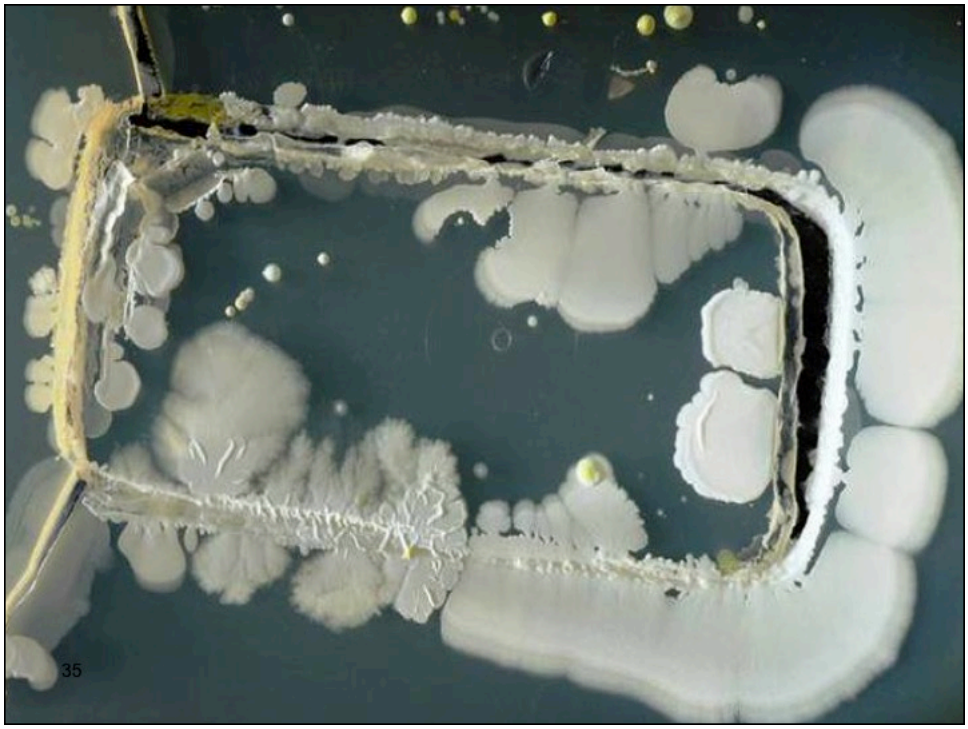
33

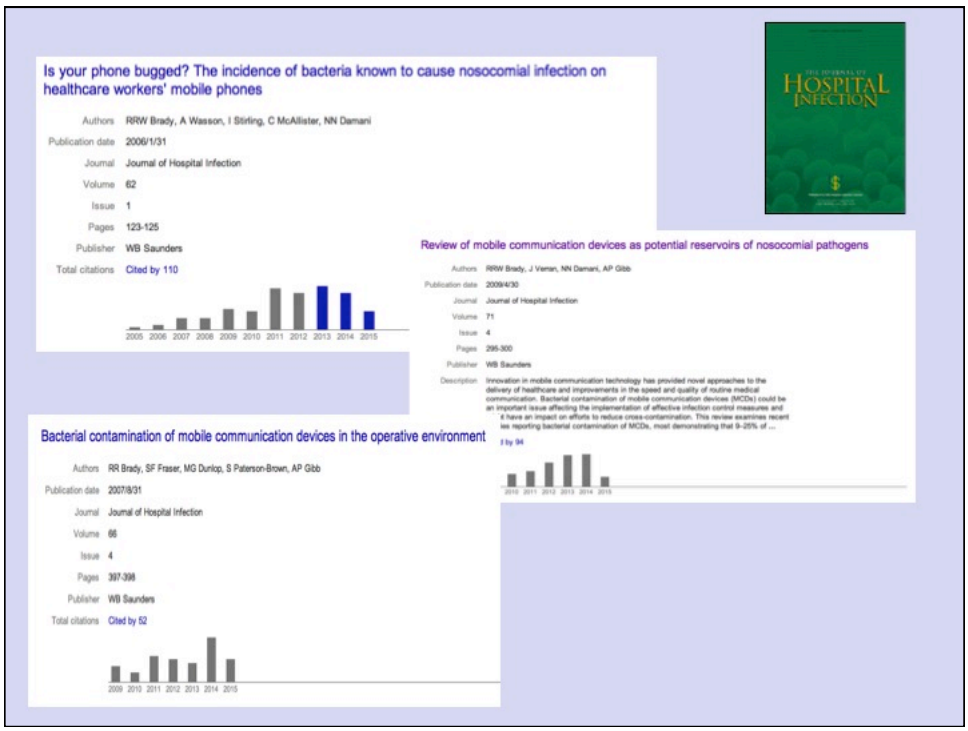


34

Manchester mETROPOLIAN UNIVERSI

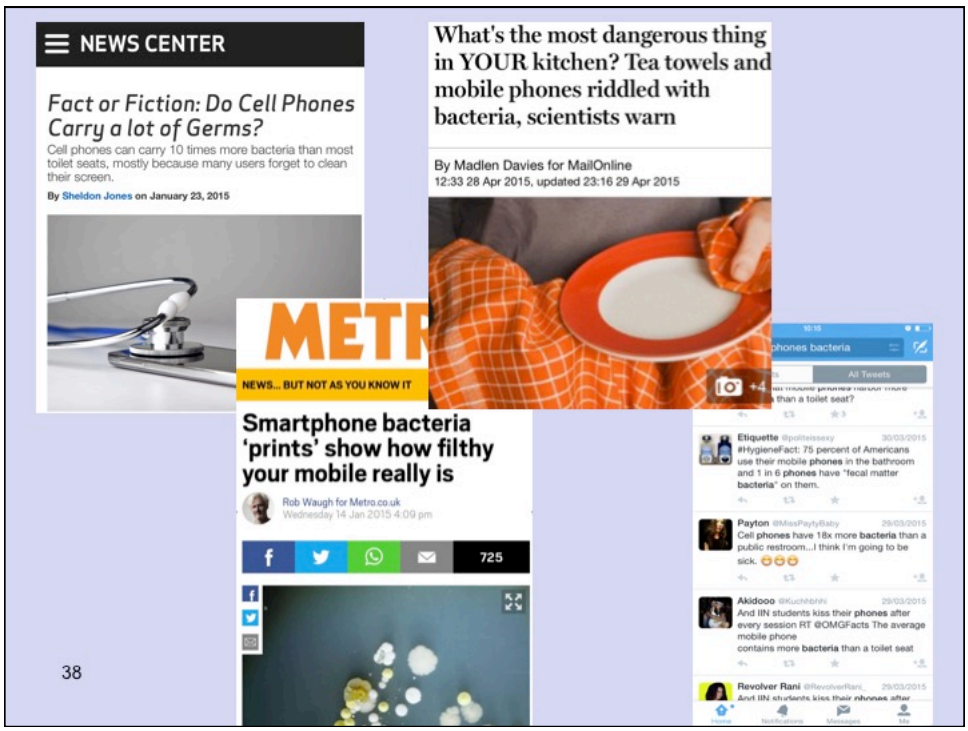
Is Your Phone Bugged? The Role of Mobile Technology in Infection Control
Richard Brady, NHS Registrar in General Surgery/Coloproctology
A Webber Training Teleclass





Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com

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



Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com

39

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 LI.

Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com

Decontamination adjuncts

41

Evidence, evidence, evidence …….

Communication Report

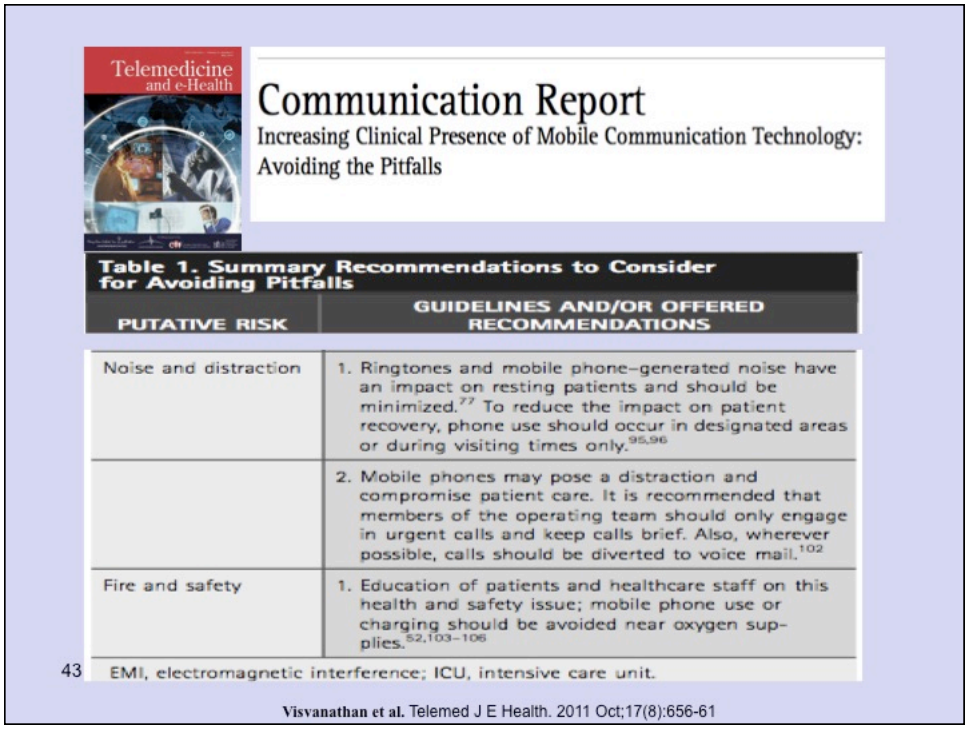
Increasing Clinical Presence of Mobile Communication Technology: Avoiding the Pitfalls

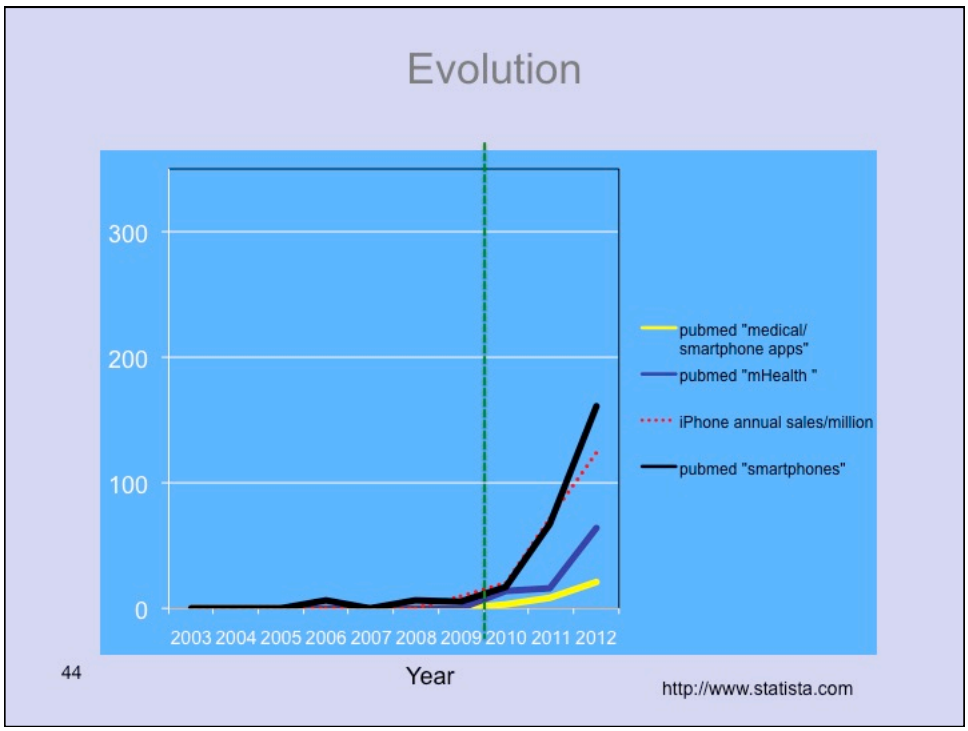
Table 1. Summary Recommendations to Consider for Avoiding Pitfalls

PUTATIVE RISK	GUIDELINES AND/OR OFFERED RECOMMENDATIONS
EMI	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.[77]
	2. Restriction on use of mobile phones within 2 m of certain sensitive equipment or in the ICU environment.[65–73]
Confidentiality	1. The use of camera phones in the clinical setting could compromise patient confidentiality and consent. Therefore, education of healthcare professionals on data storage[76] and confidentiality is required.[78]
Cross-contamination	1. Adequate surface decontamination and hand hygiene techniques should be emphasized to healthcare workers and patients.[91–93]
	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.[92]
	3. Consideration of restrictions regarding use of mobile phone technology in certain high-risk areas, for example, operating theaters, ICUs, and burns units.[1]
	4. Requirement for local guidelines on infection control measures.[83–86]

42

Visvanathan et al. Telemed J E Health. 2011 Oct;17(8):656-61


Telemedicine and e-Health
Communication Report
Increasing Clinical Presence of Mobile Communication Technology: Avoiding the Pitfalls
Table 1. Summary Recommendations to Consider for Avoiding Pitfalls
PUTATIVE RISK
GUIDELINES AND/OR OFFERED RECOMMENDATIONS
Noise and distraction
1. Ringtones and mobile phone–generated noise have an impact on resting patients and should be minimized.[77] To reduce the impact on patient recovery, phone use should occur in designated areas or during visiting times only.[95,96]
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.[102]
Fire and safety
1. Education of patients and healthcare staff on this health and safety issue; mobile phone use or charging should be avoided near oxygen supplies.[52,103–106]
EMI, electromagnetic interference; ICU, intensive care unit.
43
Visvanathan et al. Telemed J E Health. 2011 Oct;17(8):656-61


Evolution
300
200
100
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
pubmed "medical/ smartphone apps"
pubmed "mHealth "
iPhone annual sales/million
pubmed "smartphones"
Year
http://www.statista.com
44

JMTM Journal of Mobile Technology in Medicine

Contemporary findings

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 recommendation
5 Proven medical author input was rated by trainees as the third least important factor
6 Associated website and associated advertising were ranked last

USE PERSONAL CONTACTS TO INFLUENCE CHOICE

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.

45

AJIC

Review and analysis of existing mobile phone applications for health care–associated infection prevention

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.

46

Schnall & Iribarren.Am J Infect Control. 2015 ahead of print

CMI
CLINICAL MICROBIOLOGY AND INFECTION

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.

Number of apps as per categories in the different online app stores (n = 94)

Online App store	Reference material	Educational material	Antibiotic advice	Others
Apple	9	17	23	2
Google Android	6	11	15	4
Blackberry	2	0	3	0
Microsoft Windows Marketplace	1	0	1	0
Nokia Ovi	0	0	0	0
Samsung application store	0	0	0	0

Visvanathan et al. Clin Microbiol Infect. 2012 Jul;18(7):E218-20

CMI
CLINICAL MICROBIOLOGY AND INFECTION

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.

48

Type of app	Example	Brief description
Reference	Meningitis	Offers information to clinicians on meningitis; pathophysiology, symptoms and treatment
	Microbe world	Provides latest audio, video and news content in microbiology from the American Society for Microbiology
	John Hopkins'vaccines	Reference on administration and contraindications for various vaccines for registered users
	Sherris pathogenic parasites	This text provides information on aetiological agents, pathogenic processes, epidemiology and basis of therapy
Educational	USMLE Microbiology	400+ questions in microbiology
	Microbiology 101	Revision course in microbiology
	Bacteriology	Knowledge-based app about bacteria in relation to disease
Antibiotic	Sanford'sguide 2011 antimicrobial therapy	Provides information on treatment of infectious diseases
	Antibiotics a-pocketcards	Summary of empiric antibiotic regimens, antibiotic activity data, and other disease management information
Others	Thomson Reuters Clinical Xpert	Continuously aggregates data from disparate hospital information systems, providing real-time patient data
	Microbiology pronunciations	Audio of the pronunciations of microbes
	Healthapps-MRSA and C diff	Provides public with infection numbers for methicillin-resistant *Staphylococcus aureus* and *Clostridium difficile* in NHS hospitals across England
	Understanding Lyme disease	Provides information on Lyme disease for patients

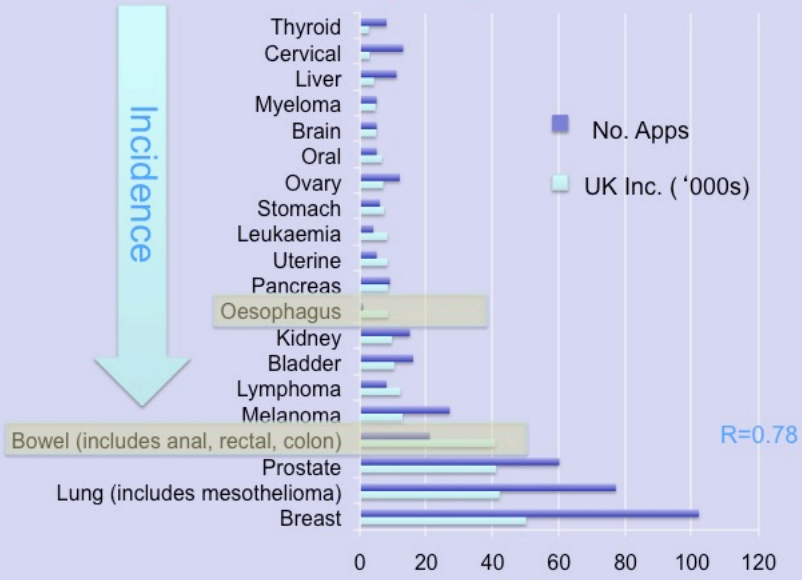
1. Inequity

Specialty	Author	Total number
Pharmacology	Haffey [1]	306
Cancer	Visvanathan	265
Pain	Rosser[2]	111
Microbiology	Visvanathan[3]	94
Dermatology	Hamilton[4]	79
Colorectal Surgery	O'Neill[5]	68
Bariatric	Connor[6]	60
Vascular	Carter[7]	49
Hernia surgery	Connor[8]	26

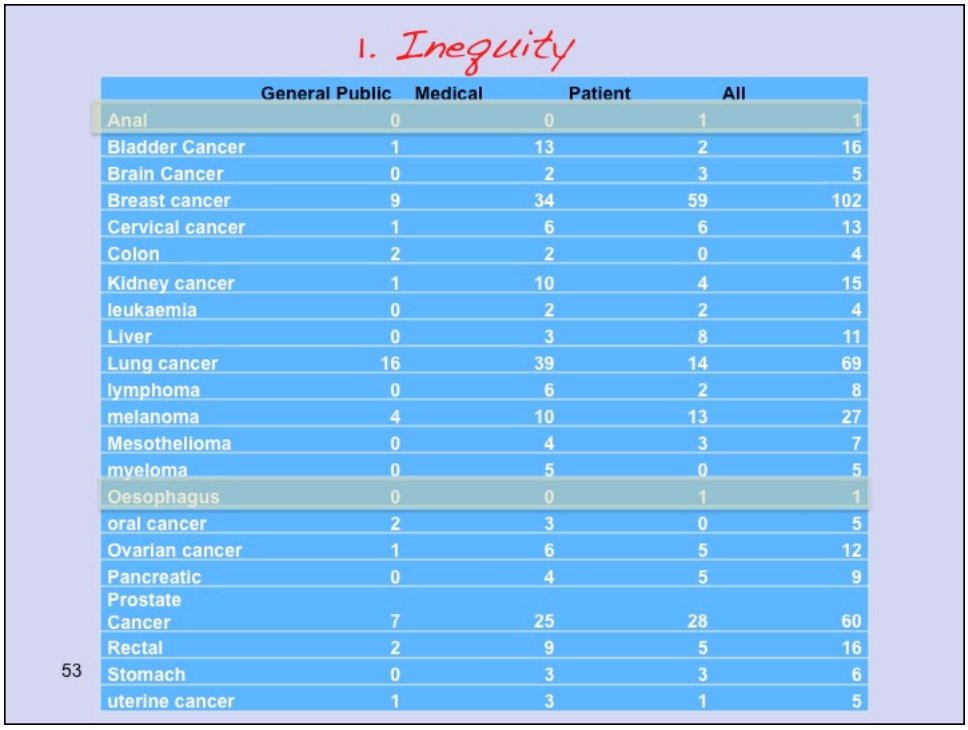
1. Br J Clin Pharmacol. 2013
2. J Telemed Telecare. 2011;17(6):308-12.
3. Clin Microbiol Infect. 2012 Jul;18(7):E218-20
4. Br J Dermatol. 2012 Jul;167(1):220-1
5. Colorectal Dis. 2012 Sep;14(9):e530-4.
6. Obes Surg. 2013 *in press*
7. Ann Vasc Surg. 2013 *in press*
8. Hernia 2013 *in press*

51

1. Inequity



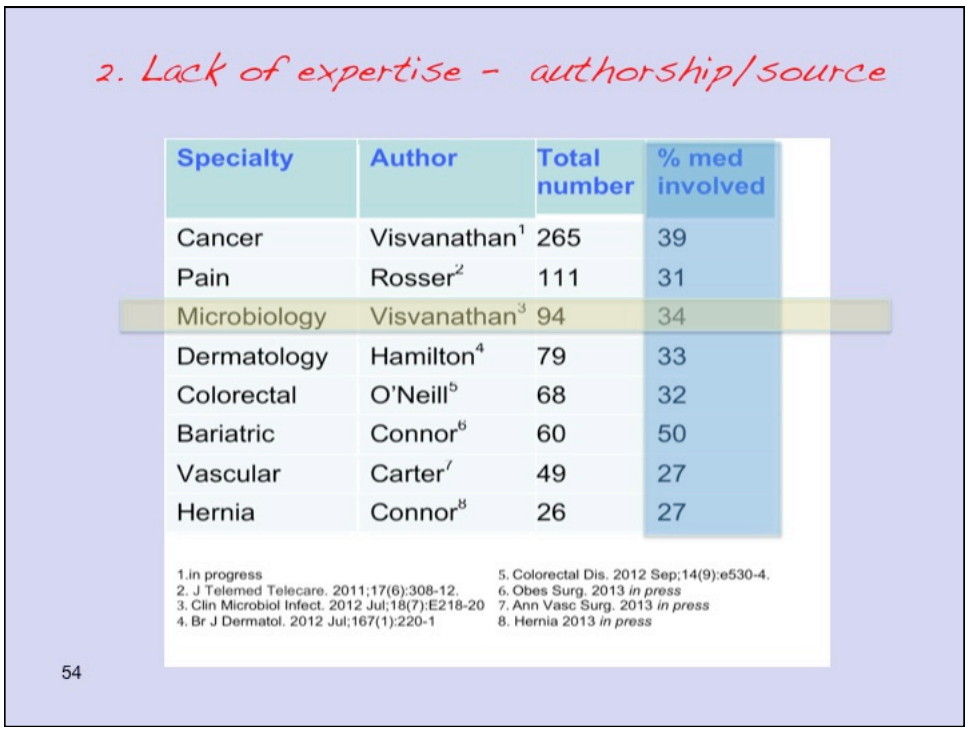
52



1. Inequity

	General Public	Medical	Patient	All
Anal	0	0	1	1
Bladder Cancer	1	13	2	16
Brain Cancer	0	2	3	5
Breast cancer	9	34	59	102
Cervical cancer	1	6	6	13
Colon	2	2	0	4
Kidney cancer	1	10	4	15
leukaemia	0	2	2	4
Liver	0	3	8	11
Lung cancer	16	39	14	69
lymphoma	0	6	2	8
melanoma	4	10	13	27
Mesothelioma	0	4	3	7
myeloma	0	5	0	5
Oesophagus	0	0	1	1
oral cancer	2	3	0	5
Ovarian cancer	1	6	5	12
Pancreatic	0	4	5	9
Prostate Cancer	7	25	28	60
Rectal	2	9	5	16
Stomach	0	3	3	6
uterine cancer	1	3	1	5

53



2. Lack of expertise - authorship/source

Specialty	Author	Total number	% med involved
Cancer	Visvanathan[1]	265	39
Pain	Rosser[2]	111	31
Microbiology	Visvanathan[3]	94	34
Dermatology	Hamilton[4]	79	33
Colorectal	O'Neill[5]	68	32
Bariatric	Connor[6]	60	50
Vascular	Carter[7]	49	27
Hernia	Connor[8]	26	27

1.in progress
2. J Telemed Telecare. 2011;17(6):308-12.
3. Clin Microbiol Infect. 2012 Jul;18(7):E218-20
4. Br J Dermatol. 2012 Jul;167(1):220-1
5. Colorectal Dis. 2012 Sep;14(9):e530-4.
6. Obes Surg. 2013 *in press*
7. Ann Vasc Surg. 2013 *in press*
8. Hernia 2013 *in press*

54

2. Lack of expertise - authorship/source

- *"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

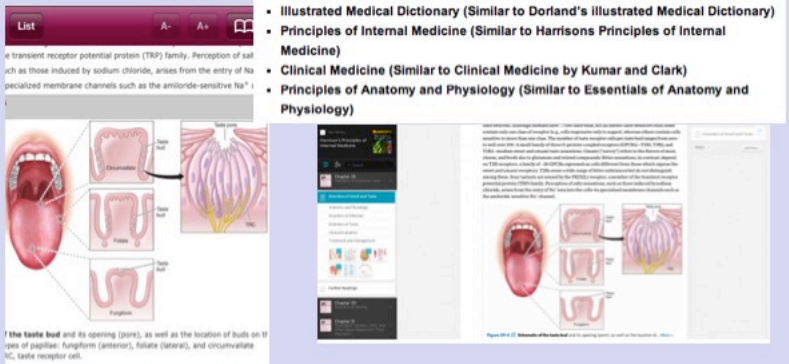
55

3. Plagerism

Tom Lewis

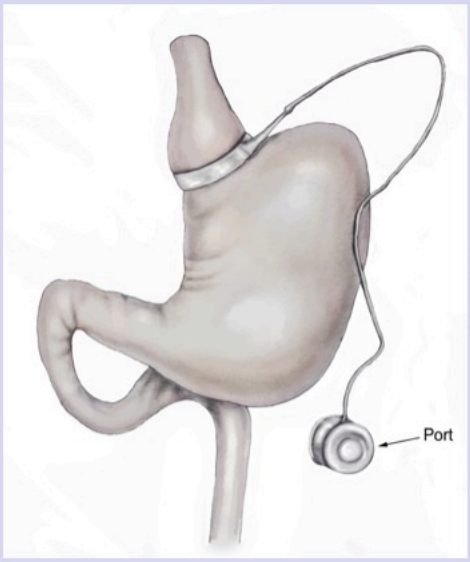
iMedicalApps
The leading Physician review of medical & healthcare apps

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



56

4. Bias / Commercial Interests



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

57

4. Bias / Commercial Interests

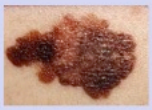
Hernia apps (26)
27% Medical involvement
96% commercial interests/links
Commercial interests
- apps requiring purchase (62%)
- product promotion (8%)
- i.e. trusses/stockings
- private surgery (8%)
- online shops (4%).

62% No consumer reviews

58

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 unconcerning.
- *"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."*

59

Wolf JA et al, Jama Dermatol. 2013;16:1-4

5. Inaccuracy & errors

Case Study 2 – Opioid switching convertors

- 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.*

60

Haffey F et al. Drug Safety 2013

5. Inaccuracy & errors

Table 3 Conversion of 1-mg oral morphine by opioid

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

apps applications, *PO* oral, *IV* intravenous, *IM* intramuscular, *SC* subcutaneous

61

5. Inaccuracy & errors

Case Study 3 – Cardiac Arrest Risk Calculators

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

- Moriarty et al. (Leeds)

62

5. Inaccuracy & errors

Case Study 4 –Rheumatology calculators

Pfizer — Worldwide Biopharmaceutical Busine

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 on 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)[1]. It gives on average a 10-15% lower score for DAS28-CRP compared to a score calculated using the published DAS28-CRP formula[2]. 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

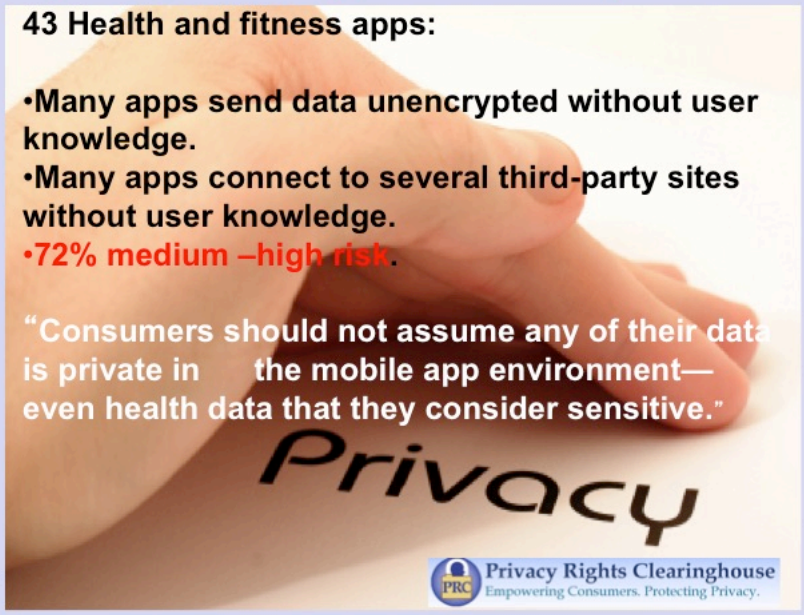
Evaluation of the accuracy of smartphone medical calculation apps

- 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 3;16(2):e32.

64

6. Lack of Security & Confidentiality



65

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."*

66

Free C et al. 2013 PLoS Med 10(1)

7. 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

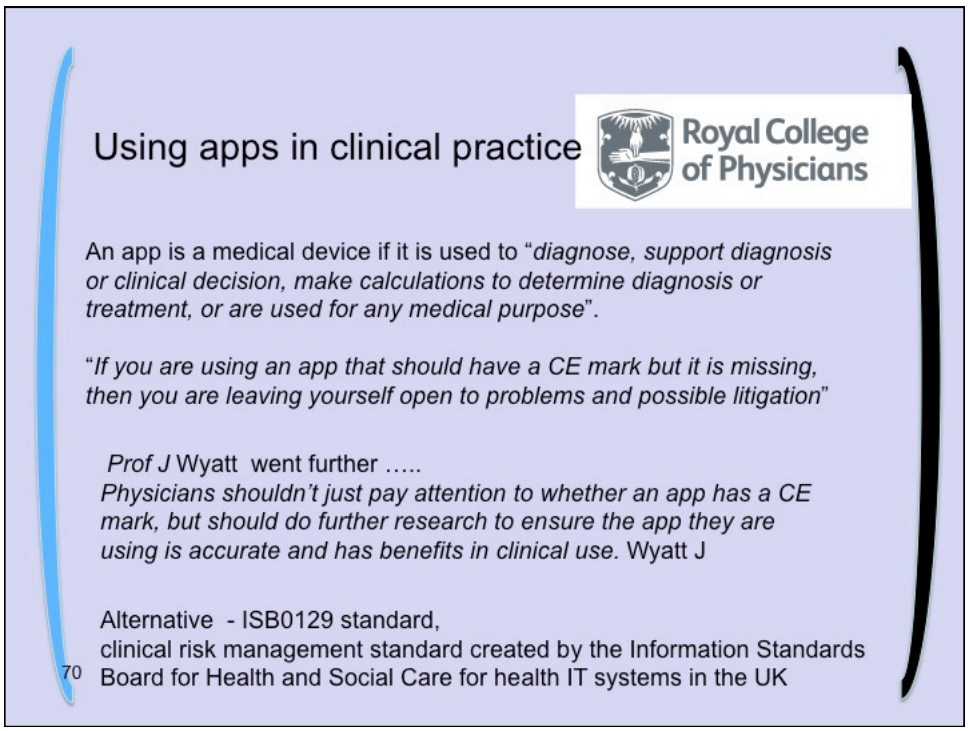
Evidence of consumer use of app to manage blood pressure

"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.
69


Using apps in clinical practice
Royal College of Physicians
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 - ISB0129 standard,
clinical risk management standard created by the Information Standards Board for Health and Social Care for health IT systems in the UK
70

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.

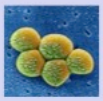
71

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

72

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.

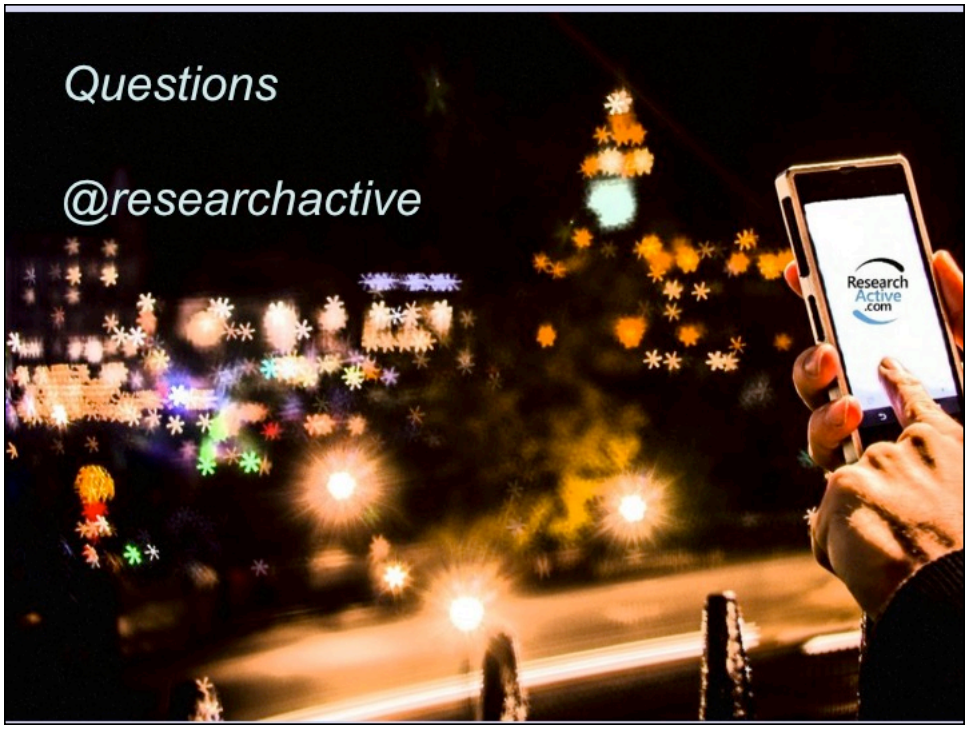
73

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.

74

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



Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com

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