

Supplementary File 7: Studies reporting proportion of devices contaminated at baseline with specific types of microbes (including pathogens)

AUTHOR, YEAR	DEVICE AND NUMBER	OUTCOME MEASURES	OVERALL BASELINE CONTAMINATION PREVALENCE	ALL S. AUREUS	MRSA	MSSA	ENTEROCOCCI: NON-VRE, OR NOT SPECIFIED	VRE	SKIN BACTERIA *	OTHER GRAM POSITIVES **	GRAM NEG. RODS/ BACILLI ***	ENTERO-BACTER	C. DIFF	COLIFORMS NON-LACTOSE FERMENTERS ****	OTHERS
ALBRECHT 2013	10 iPads	Total bacterial load	1842 total CFU found on iPads in the clinical setting (162 median CFU)						Micrococci: 25.7%						All staphylococci: 59.9%
ALI 2015	Unknown number of keyboards	Detection of C. diff	C.diff detected using Brazier's contact plate: 0/5 (0%) Using Sponge swab: 3/15 (20%)										3/15 (20%)		
ANASTASI ADES 2009	14 keyboards (K) and 14 mice (M)	Detection of CNS, Gram-positive bacilli, micrococci, fungi and S. aureus		Round 1 K: 0/14 (0%) Round 1 M: 1/14 (7.1%)					Round 1 K: 14/14 (100%) Round 1 M: 14/14 (100%)						
BURES 2000	10 keyboards *specific pathogen rates include 8 faucet handles (144 samples)	Total bacterial load	19/80 keyboard samples taken (24%)		16/144 (11.1%)		6/144 (4.2%)				7/144 (4.9%)	4/144 (2.8%)			
CATANO 2012	30 keyboards	Total bacterial load	39 isolations from 30 keyboards; 56.4%				3/39 (7.7%)		Bacillus: 17/39 (43.5%) MRSE:		3/39 (7.7%)				Either MSSE, MSSA, MSSW,

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DE GROOD 2012	230 keyboards	Total bacterial load	99.6% (229/230) positive for one of CNS, Micrococcus, diptheroids, Bacillus spp. or alpha strep. And: 67% positive with any one of: MSSA, MRSA, Enterococcus (non VRE and VRE), GNB, C. diff, Yeast, fungus		17/230 (7.4%)	21/230 (9.1%)	58/230 (25.2%)	9/130 (3.9%)	229/230 (99.6%)		68/230 (29.6%)		0 (0%)	21/230 (9.1%)	Yeast/ fungus: 5/230 (2.2%)
DEVINE 2001	25 terminals (keyboard + mouse + pad)	Detection of MRSA	MRSA: 24% (42% in hospital A and 8% in hospital B)		6/25 (24%)										
DUMFORD 2009	32 computers	C. diff	9/32 (28%) contaminated with C. diff										9/32 (28%)		
DUSZAK 2014	7 mice	Total bacterial load	100% had bacterial growth (mean colony counts: 46.1 ± 58.1)	5/7 (71.4%)					CNS: 2/7 (28.6%)		2/7 (28.6%)				
ENGELHART 2008	77 computer terminals in clinical areas	Total bacterial load	Not reported for keyboards separately	10/77 (13%)			7/77 (9.1%)			Viridans strepto cocci: 8/77 (10.4%)	13/77 (16.9%)				Molds: 17/77 (22.1%)

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FAIRES 2012	Unknown number of keyboards	Detection of MRSA or C Diff	<u>Medical wards:</u> MRSA: between 8.2% and 14.8% C.Diff: 0 to 3.9% <u>Surgical wards:</u> MRSA: 12.5% to 13.2% C.Diff: 1.5% to 6.2%		4 (6.4%)								3 (4.8%)		
FAIRES 2013	Unknown number of keyboards	Detection of MRSA or C. Diff (55 samples)			1/55 (1.8%)								3/55 (5.5%)		
FELLOWES 2006	44 keyboards	Detection of MRSA or MSSA	MSSA: 9/44 (20%) MRSA: 4/44 (9%)		4/44 (9%)	9/44 (20%)									
GERBA 2016	17 computer touch screens	Coliform bacterial growth	Average number of bacteria: 2,257 CFU					2/17 (12%)	S. epi: 6/17 (35%), Micrococc. luteus: 3/17 (18%), Micrococcus sp: 1/17 (6%), kytocooccus sedentarius 2/17 (12%), S. caprae: 1/17 (6%), Kocuria varians: 1/17 (6%)		Klebsiella: 2/17 (12%)		2/17 (12%)		

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GOSTINE 2016	40 keyboards (230 total samples)	Total bacterial load	193/203 (95.1%) of samples positive for bacteria, median of 120 CFUs per keyboard	12/203 (5.9%)	3/203 (1.5%)		8/203 (3.9%)	2/203 (1%)			Klebsiella 3/203 (1.5%)	6/203 (3%)		Pseudomonas: 1/203 (0.5%), Acinetobacter: 1/203 (0.5%)	
GRABSCH 2012	Unknown number of keyboards	Detection of VRE	1/9 (11%) swabs were VRE positive					1/9 (11%)							
GRAY 2007	7 mice (63 samples)	Total bacterial load	54/63 (85.7%) samples positive	2/63 (3%)					CNS: 52/63 (83%), Micrococcus: 36/63 (57%), Bacillus: 26/63 (41%)						Cocci-bacillus: 7/63 (9%)
HARTMAN N 2004	Unknown number of keyboards (K) and mice (M) 238 samples taken of each	Potentially pathogenic micro-organisms (2+ CFU)	(In patient rooms + central ward): <u>Keyboards:</u> 15/238 (6.3%) <u>Mice:</u> 13/238 (5.5%)	K: 3/238 (1.3%) M: 15/238 (6.3%)			K: 12/238 (5%) M: 2/238 (0.9%)		K: Micrococcus: 134/238 (56.3%), S. Epi: 205/238 (86.1%) Other Staph sp: 78/238 (32.8%) M: Micrococcus: 65/238 (27.3%),		K: 2/238 (0.8%) M: 0/238				Mold: K: 5/238 (2.1%) M: 2/238 (0.8%)

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									S. Epi: 182/238 (76.5%), Other Staph Sp: 60/238 (25.2%)						
HASSAN 2014	150 keyboards and 100 mice	Total bacterial load	242/250 (99.2%)	198 (79.2%)			93 (37.2%)		S. Epi 172 (68.8%)	Streptococcus 28 (11.2%)	GNB 201 (80.4%) E. Coli 45 (18%)				
HIRSCH 2014	30 iPads	Total bacterial load		22/30 (73.3%)	15/30 (50%)		30/30 (100%)	1/30 (3.3%)	CNS: 29/30 (96.7%)						
HONG 2012	112 items (56 keyboards and 56 mice)	Total bacterial load	103/112 (92.0%) Keyboards: 98.2% Mice: 85.7%		K: MRSA: 2/56 (1.8%)	K: MSSA: 2/56 (1.8%)			K: CNS: 51/56 (91.1%) Bacillus: 14/56 (25%) Micrococcus: 13/56 (23.2%) M: CNS: 45/56 (80.4%) Bacillus: 5/56 (8.9%) Micrococci: 6/56 (10.7%)		M: GNR: 1/56 (0.9%)				K: Molds: 3/56 (2.7%)

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KARBASIZ-ADE 2014	65 Keyboards	Total bacterial load	64/65 (98.5%)	15/65 (23.1%)	10/65 (15%)				Bacillus: 45/65 (69.2%), CNS: 16/65 (24.6%), Micrococcus: 5/65 (7.7%)	Actinomyces sp: 1/65 (1.5%)	E. coli: 1/65 (1.5%)	1/65 (1.5%)		Citrobacter: 2/65 (3.1%), A. baumannii: 3/65 (4.6%)	
KEERASUN TONPONG 2017	26 keyboards	Total bacterial load	25/26 (96.2%)						CNS: 25/26 (96.2%) Bacillus spp: 8/26 (30.8%)	Gram positive bacilli: 1/26 (3.8%)	NF-GNB: 3/26 (11.5%)				Fungi: 8/26 (30.8%)
KHAN 2015	106 portable electronic devices (93 were tablets)	Total bacterial load	100% had at least 1 positive culture from screen or cover	11/106 (10.4%)			3/106 (2.8%)				7/106 (6.6%)	1/106 (0.9%)		3/106 (2.8%)	
KIEDROWSKI 2013	20 iPads	Detection of C.diff, MRSA	3/20 (15%) iPads grew S aureus. No growth of C. diff. nor any gram-negative pathogens	3/20 (15%)							0		0		
LU 2009	282 stations (keyboard + mouse)	S. aureus, Pseudomonas sp, Acinetobacter sp.	49/282 (17.4%) positive for S. aureus, Acinetobacter spp. or Pseudomonas spp		3/282 (1.1%)	15/282 (5.3%)								29/282 (10.3%)	

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PHUMISAN TIPHONG 2009	30 computer terminals (keyboard + mice)	Detection of CRAB	keyboards/mice at nurse station had lowest contamination rate of A. baumannii (3.3%) of all the sampled locations. No CRAB identified.											3.3%	
PUGLIESE 2011	72 keyboards	Total bacterial load	10/72 (13.8%) colonized with 9 different bacteria		1/72 (1.4%)	1/72 (1.4%)		1/72 (1.4%)			9/72 (12.5%) include s E. coli, Pseudomonas, Sphing, Pantoea, and 2 without ID		0/72		
REEM 2014	16 keyboards (24 total samples)	MRSA /MSSA isolates	7/24 (29.2%) samples positive for MSSA, MRSA, or MRSP	7/24 (29.2%)	1/24 (4.2%)	5/24 (20.8%)									
RUTALA 2006	25 keyboards	Total bacterial load	100% had at least one potential pathogen	2/25 (8%)	ORSA 1/25 (4%)	OSSA 1/25 (4%)	3/25 (12%)	0	CNS 25/25 (100%) Diphtheroids 20/25 (80%) Micrococci 18/25 (72%) Bacillus 16/25 (64%) Propionib	Alpha streptococci 6/25 (21%) Viridans streptococci 2/25 (8%)				NF-GNR 9/25 (36%)	Fungi 6/25 (24%)

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									acteria 7/25 (28%)						
SCHULTZ 2003	100 keyboards	Total bacterial load	95/100 (95%) had growth of 1+ microorganisms	1/100 (1%)			3/100 (3%)	1/100 (1%)	CNS: 84/100 (84%) Bacillus sp: 44/100 (44%) Corynebact 8/100 (8%)	Strepto cocci: 9/100 (9%)	6/100 (6%)			2/100 (2%)	Clostridium perfringens: 4/100 (4%)
SHAIKH 2016	25 keyboards	Total bacterial load	20/25 (80%) contaminated with any potential pathogen	2/25 (8%)			15/25 (60%)				1/25 (4%)		2/25 (8%)		
SMITH 2006	60 notebook keys and grips	Total bacterial load	52/120 (43%) cultures positive, but significant pathogens were found in only 2/120 (1.7%) of cultures			1/120 (0.8%)			CNS 39/120, Diphtheroids-coryne bacterium 5/120, Micrococci 13/120	Alpha-hemolytic strep 4/120	Serratia 1/120 (0.8%)				
STAMBAUGH 2009	88 keyboards or mice	Detection of Multidrug-resistant organisms		8/88 (9%)			2/88 (2%)		Bacillus: 20/88 (23%) CNS: 78/88 (88.6%)		Lactose fermenting GNR: 22/88 (25%) Other GNR: 2/88 (2%)				

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SWEENEY 2009	68 computer terminals (keyboard + mice)	Total bacterial load	67/68 (98.5%) showed some growth			10/68 (14.7%)									
TAN 2013	Unknown number of keyboards (6 total samples)	Presence of MRSA, E. coli and K. pneumoniae resistant to third-gen cephalosporins, CRAB, VRE.	6/6 (100%)		6/6 (100%)			0/6 (0%)			Ceph-R Klebsiella spp. 0/6 (0%)			CRAB: 1/6 (17%)	
TROCHESSET 2012	Unknown number of keyboards and mice	Detection of S. aureus		K: 4/47 (8.5%) M: 0/4 (0%)											
WAGHORN 2005	48 keyboards	Total bacterial load (especially S. aureus, hemolytic streptococci, P. aeruginosa and C.diff)	100% grew organisms of some kind. 79% grew either moderate or heavy numbers of organisms.		1/48 (2%)				46/48 (96%)		12/48 (25%)		1/48 (2%)	0	Misc (including: Bacillus sp, fungal): 25/48 (52%)
WESTERWAY 2017	10 ultrasound keyboards	Total bacterial load	100% of samples had 10 or more colonies (highest level of contamination)				3/10 (30%)							7/10 (70%)	

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WILSON 2006	17 keyboards (51 total samples)	Total bacterial load	100% contaminated with at least one species.		11/51 (21%)	3/51 (5.9%)			CNS: 51/51 (100%) Bacillus: 47/51 (92%)		30/51 (59%)				
XU 2017	Unknown number of keyboards and mice	Detection of MRSA	7/19 (36.8%) swabs positive for MRSA.		7/19 (36.8%)										

* Skin bacteria includes: (S. epidermidis, CNS, S. Caprae, diptheroids, Micrococcus, Bacillus, Kytococcus, Corynebacter, Propionibacteria, kocuria varians)

** Gram positives: Alpha-hemolytic strep, Streptococci, Sphingomonas

***Gram negative rods/bacilli includes: (E.coli, Klebsiella, Serratia)

**** Coliforms non-lactose fermenters: (Pseudomonas, Proteus, Acinetobacter, Citrobacter)

Abbreviations: A. baumannii = Acinetobacter baumannii, ACC = Aerobic Colony Counts, C. Diff = Clostridium difficile, CFU = Colony forming units, CNS = Coagulase-negative staphylococcus, CRAB = Carbapenem-resistant Acinetobacter baumannii, E. Coli = Escherichia coli, GNB = Gram Negative Bacilli, MRSA = Methicillin-resistant Staphylococcus aureus, MRSP = Methicillin-resistant Staphylococcus pseudintermedius, MSSA = Methicillin-sensitive Staphylococcus aureus, MSSE = Methicillin-sensitive Staphylococcus epidermidis, MSSH = Methicillin-sensitive Staphylococcus hyicus, MSSW = Methicillin-sensitive Staphylococcus warneri, NF-GNR = Non-Fermenting Gram-Negative Rods, ORSA = Oxacillin-resistant Staphylococcus aureus, OSSA Oxacillin-sensitive Staphylococcus aureus, P. aeruginosa = Pseudomonas aeruginosa, PCA = Plate count agar, S. aureus = Staphylococcus aureus, S. caprae = Staphylococcus caprae, S.D. = Standard deviation, S. epi = Staphylococcus epidermidis, VRE = Vancomycin-resistant Enterococcus