Supplementary information

Biofilms in Shower Hoses

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Table S1: News items concerning *Legionella pneumophila*, all published in the first half of 2017.

Article title	Description	Link	Screenshot Page (After Table S9)
Legionella detected in water systems at two Kane centers (March 10, 2017)	Legionella was detected at two nursing home facilities in Pennsylvania. The centers switched to bottled water and activities like showering were restricted.	http://www.wpxi.com/news/top-stories/legionella-detected-in-water-systems-at-two-kane-centers/501536863	1 of 16
Ocoee gym being examined after 3 sickened by Legionnaire's disease, officials say (April 19, 2017)	Three people linked to one gym/athletic center in Florida contracted Legionnaire's disease. Testing is underway at the facilty, and before results are returned, the gym closed showers, changed fixtures, and took other measures to reduce risk.	http://www.wftv.com/news/local/ocoee-gym-being-examined-after-3-sickened-by-legionnaires-disease-officials-say/514286196	2 of 16
Parisian Macao battling Legionnaire's Disease outbreak (April 25, 2017)	A casino in China may have been involved in 3 cases of Legionnaire's disease for elderly visi. Before test results are in, the casino is doing precautionary measures like closing the swimming pools, jacuzzis, and fountains. The article speculated about possible drops in tourism to the casino.	https://calvinayre.com/2017/04/25/casino/parisian-macao-legionnaires-disease-outbreak/	3 of 16
Legionnaires sickened four people, one fatally, at cancer facility: suit (April 9, 2017)	Several victims in a 2015 outbreak of Legionnaires disease at a cancer lodge (free temporary housing for patients between treatments) in New York are suing the nonprofit which runs the cancer lodge	http://nypost.com/2017/04/09/legionnaires-sickened-four-people-one-fatally-at-cancer-facility-suit/	4 of 16
Walton pool and gym reopen almost three months after legionella bug outbreak (February 24, 2017)	A gym/athletic center in the UK involved in a late 2016 Legionella outbreak, with tests of shower water coming back positive for the bacteria, was forced to close for three months in order to modify the water system and eliminate *Legionella*. The period was hard to estimate and reopening was frequently pushed back.	http://www.clactonandfrintongazette.co.uk/news/15115947.Pool_and_gym_reopen_almost_three_months_after_legionella_bug_outbreak/	5 of 16
Legionnaires' disease diagnosed in Fresno nursing home patient (January 13, 2017)	A nursing home in California started using bottled water and point-of-use filters for showers, and stopped using ice machines after a resident was diagnosed with Legionnaires'. They also planned to use hyper-chlorination or super-heat treatment.	http://www.fresnobee.com/news/local/article126494379.html	6 of 16

Table S2: Additional information about shower hoses used in global survey.

Country (# of samples)	Location (Number of samples)	Chlorine use	Notes on water	Estimated minimum age (years)	# people using shower	Household type
Belgium (8)	Ghent, East Flanders (7)	Chlorinated	Low residuals	5	2	house
				8	2	townhouse
				2	2	apartment
				2	2	house
				2	9	house
				16	4	townhouse
				?	4	house
	Laarne, East Flanders (1)			4.5	4	house
Denmark (10)	Greater Copenhagen area (various municipalities) (10)	None	None	n/a	n/a	apartment
				2	1	apartment
				1	4	apartment
				5	1	apartment
				0.5	1	apartment
				n/a	n/a	apartment
				2	5	apartment
				7	4	apartment
				n/a	2	apartment
				1.5	2	apartment
Germany (4)	Kempten, Bavaria (1)	None	Emergency use only	14	2	apartment
	Sonthofen, Bavaria (1)			1.5	2	apartment
	Wiggensbach, Bavaria (2)			3	2	apartment
				3	2	apartment
Latvia (7)	Riga (7)	Chlorinated	Residual often fails	4	2	apartment
				5	2	apartment
				4	4	apartment
				5	2	apartment
				0.125	2	apartment
				2	1	apartment
				n/a	n/a	apartment
Portugal (7)	Greater Lisbon area (various municipalities) (7)	Chlorinated	Residual used	2	2.5	apartment
				6.5	3	apartment
				6.5	3	apartment
				0.5	2	apartment
				1	3	apartment
				12	4	apartment
				6	3	apartment
Serbia (4)	Novi Sad (4)	Chlorinated	Limited residuals	2	2	apartment
				3	3	apartment
				5	3	apartment
				1	2	apartment

(Table S2 continued)

Country (# of samples)	Location (Number of samples)	Chlorine use	Notes on water	Estimated minimum age (years)	# people using shower	Household type
South Africa (3)	Pretoria (3)	None	Private bore holes	35 1 35	2 2 2	house house house
Spain (1)	Bolnueva, Murica (1)	Chlorinated	residual	n/a	n/a	house
Switzerland (21)	Zürich canton (various municipalities) (19)	None	None	0.5 0.75 2 0.25 6 5 1 1.5 8 8 n/a 4 2 4 5 5 5 5	2 2 3 3 3 3 4 1 2 2 1 2 2 2 4 X * X * X * X *	townhouse apartment apartment apartment apartment apartment apartment apartment apartment apartment apartment apartment apartment apartment apartment **Office *** **Office *** **Office *** **Office ***
	Bern canton (1)			5	4	apartment
	Ticino canton (1)			n/a	2	apartment
United Kingdom (9)	Greater Newcastle area (various municipalities) (5)	Chlorinated	Residual used	n/a n/a 2 n/a 4	n/a n/a 2 n/a 1	apartment apartment apartment apartment apartment
	Greater Glasgow area (various municipalities) (4)			n/a 2 2 3.5	n/a 2 1 4	apartment apartment apartment apartment
United States (4)	Columbus, Ohio (1)	Chlorinated	Residual used	5	3	townhouse
	Carrboro, North Carolina (1)			1	4	house
	Franklin County, Pennylvania (2)			16 0.75	2 2	house house

* Locker room in an office building. Use-patterns are variable, but as these showers were also used in the controlled study, more information about use patterns is available in Table S6.

Table S3: Elemental Analysis Method Details

Element		Target isotope	Reaction mode	LOD	Recovery of certified values (%)	
		(m/z)	(1=no gas, 2=H, 3=He)	(ug/l)	Sediment	Rice Flour
Mg	Magnesium	24	2	2	109	72
Ca	Calcium	44	1	9	109	96
Mn	Manganese	55	2	65	102	89
Fe	Iron	56	2	81	96	138
Cu	Copper	65	2	0.5	77	72
Pb	Lead	206	1	0.05	98	

Table S4: qPCR method details

Reaction Chemistry			Reaction timing			Source
Primer/Probe	Sequence	Volume (per 10 uL reaction)	Time (seconds)	Temperature		
Legionella pneumophila* – *mip						
LmipF (5µM)	AAA GGC ATG CAA GAC GCT ATG	0.5	denaturation			(Wang, 2012)
LmipR (5µM)	GAA ACT TGT TAA GAA CGT CTT TCA TTT G	0.5	120	95	°C	
Lmip Probe (10µM)	FAM-TGG CGC TCA ATT GCG TTT AAC CGA	0.2	40 cycles			(Nazarian, 2008)
water		2.8	15	95	°C	
Probes supermix	SsoFast Probes Supermix (Bio-Rad)	5	30	60	°C	
Template		1				
***Acanthamoeba* spp. – 18S rRNA**						
ACF1 (5µM)	CGACCAGCGATTAGGAGACG	0.5	denaturation			(Wang, 2012)
ACR1 (5µM)	CCGACGCCAAGGACGAC	0.5	120	95	°C	
Taq ACProbe (5µM)	FAM-TGAATACAAAACACCACCATC GGCGC	0.2	40 cycles			(Rivière, 2006)
water		2.8	15	95	°C	
Probes supermix	SsoFast Probes Supermix (Bio-Rad)	5	30	60	°C	
Template		1				
***Vermamella vermiformis* – 18S rRNA**						
Hv1227F (5µM)	TTA CGA GGT CAG GAC ACT GT	0.7	denaturation			(Wang, 2012)
Hv1728R (5µM)	GAC CAT CCG GAG TTC TCG	0.7	120	95	°C	
water		2.1	40 cycles			(Kuiper, 2006)
Evagreen	EvaGreen Supermix (Bio-Rad)	4.5	8	98	°C	
Template		2	30	72	°C	
***Mycobacterium avium* – 16S rRNA**						
MYCGEN-F (5µM)	AGA GTT TGA TCC TGG CTC AG	0.8	denaturation			(Wang, 2012)
MYCAV-R (5µM)	ACC AGA AGA CAT GCG TCT TG	0.8	120	95	°C	
water		2.4	40 cycles			(Wilton, 1992)
Evagreen	EvaGreen Supermix (Bio-Rad)	5	8	98	°C	
Template		1	30	68	°C	

Table S5: Details for Illumina sequencing

Amplicon PC Primers	**Primer**			**Sequence**	**Reference**
	Bakt_341F (S-D-Bact-0341-b-S-17)			CCTACGGGNGGCWGCAG	Klindworth, 2013
	Bakt_805R (S-D-Bact-0785-a-A-21)			GACTACHVGGGTATCTAATCC	
	Nextera adapter tail before forward			TCG-TCG-GCA-GCG-TCA-GAT-GTGTAT-AAG-AGA-CAG-GA	
	Nextera adapter tail before reverse			GTC-TCG-TGG-GCT-CGG-AGA-TGTGTA-TAA-GAG-ACA-GAG	
PCR Details	**Assay**	**Holding**	**Cycling Reps**	**Cycling**	**Kti/Mix and Reaction Chemistry**	**Template/Notes**
	Amplicon PCR	95 °C 5:00	19 X	95 °C 0:30 54 °C 0:30 72 °C 0:30	1U KAPA 2G robust HotStart Polymerase (KAPA Biosystems, Boston, USA), 1 x reaction buffer B, and 0.4 µM of each primer in a final volume of 25 µL. Sensoquest Labcycler Basic used.	2 µL DNA template (0.8-50 ng) Two sets of frame-shifted primer sets were used on each replicate extraction per sample: Sets 0 and 2 for replicate A and sets 1 and 3 for replicate B
	Index PCR	95 °C 3:00	10 X	95 °C 0:30 55 °C 0:30 72 °C 0:30	1 X KAPA HiFi HotStart Ready Mix and 5 µl of each of the respective Nextera index primers in a total reaction volume of 50 µl	Pooled amplicon PCR product
Additional Steps	**Step**				**System**	**Protocol**
	Purification of Amplicon PCR product **Purification of Index PCR product**				Agencort AMPure beads XP sytem (Beckman Coulter)	Supplier's protocol
	Quality Control of Index PCR product				Agilent Bioanalyzer	Supplier's protocol
	Quantification of Index PCR product				KAPA library quantification kit	Supplier's protocol

Table S6: Details for Illumina sequencing data processing

	Step	Algorithm/ Version	Parameters	Citation
Bioinformatics Details	**Quality Control**	FastQC v.0.10.1		
	Merge Reads	FLASH v1.2.9	minimum overlap: 40 maximum overlap: 100 max mismatch density: 0.2	(Magoc and Salzberg, 2011)
	Trim adaptor sequences and sort frame shifts	Cutadapt v1.4	error rate: 0	(Martin, 2011)
	Quality Filtering	PRINSEQ-lite v0.20.4	size range: 450-550 bp minimum mean quality score: 25 no ambiguous nucleotides GC range: 20-80	(Schmieder and Edwards, 2011).
	OTU clustering	usearch v7.0.1090	identity cutoff: 97% abundance sorting: 2 chimera filtering	(Edgar, 2010)

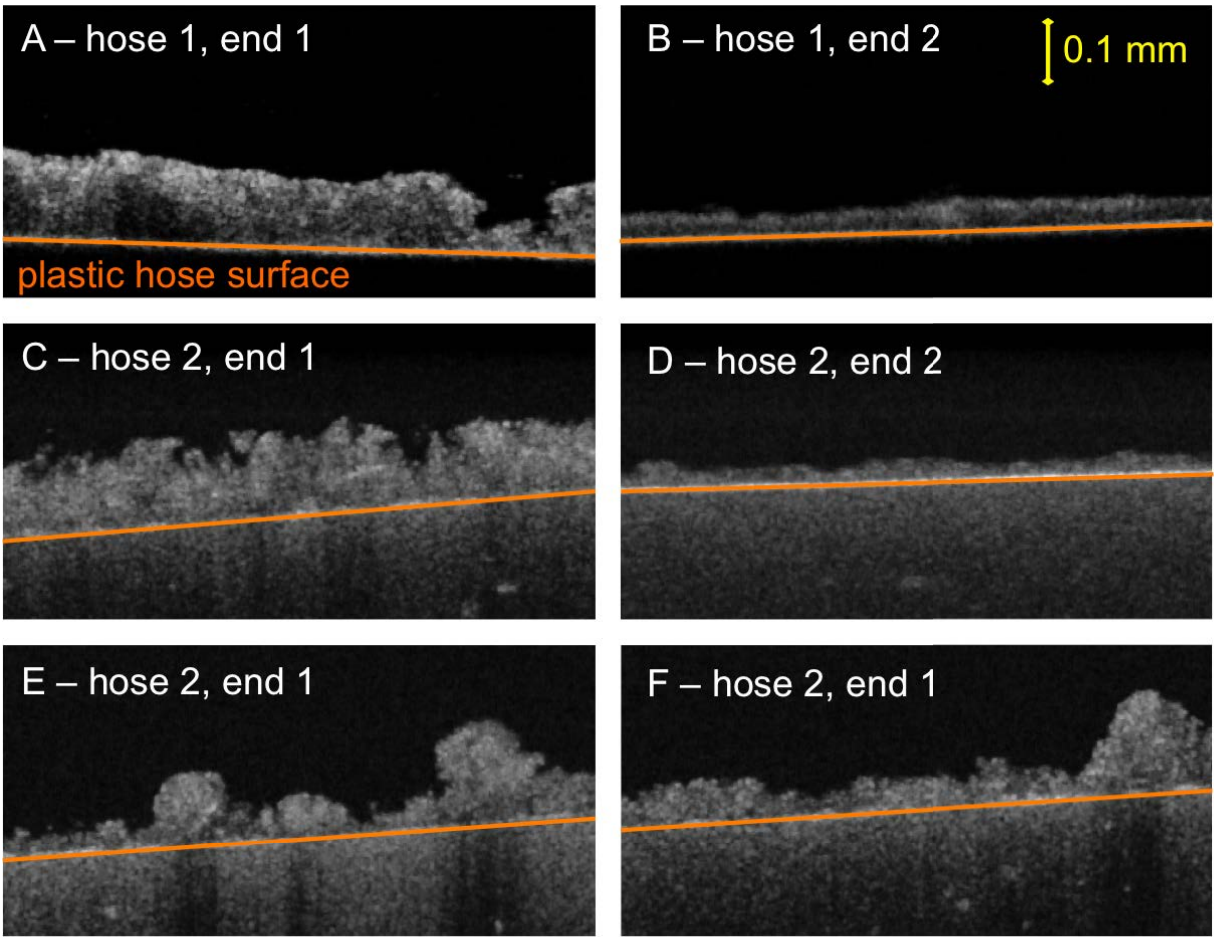

Figure S1: Optical Coherence Tomagraphy (OCT) images of biofilms from 2 hoses from Belgium (Hose 1) and Switzerland (Hose 2). All are on an equal scale. A and B are from opposite ends of the same hose (Hose 1). C, E, and F are from one 5 cm piece on one end of a hose, while D is from the opposite end of the same hose (Hose 2).

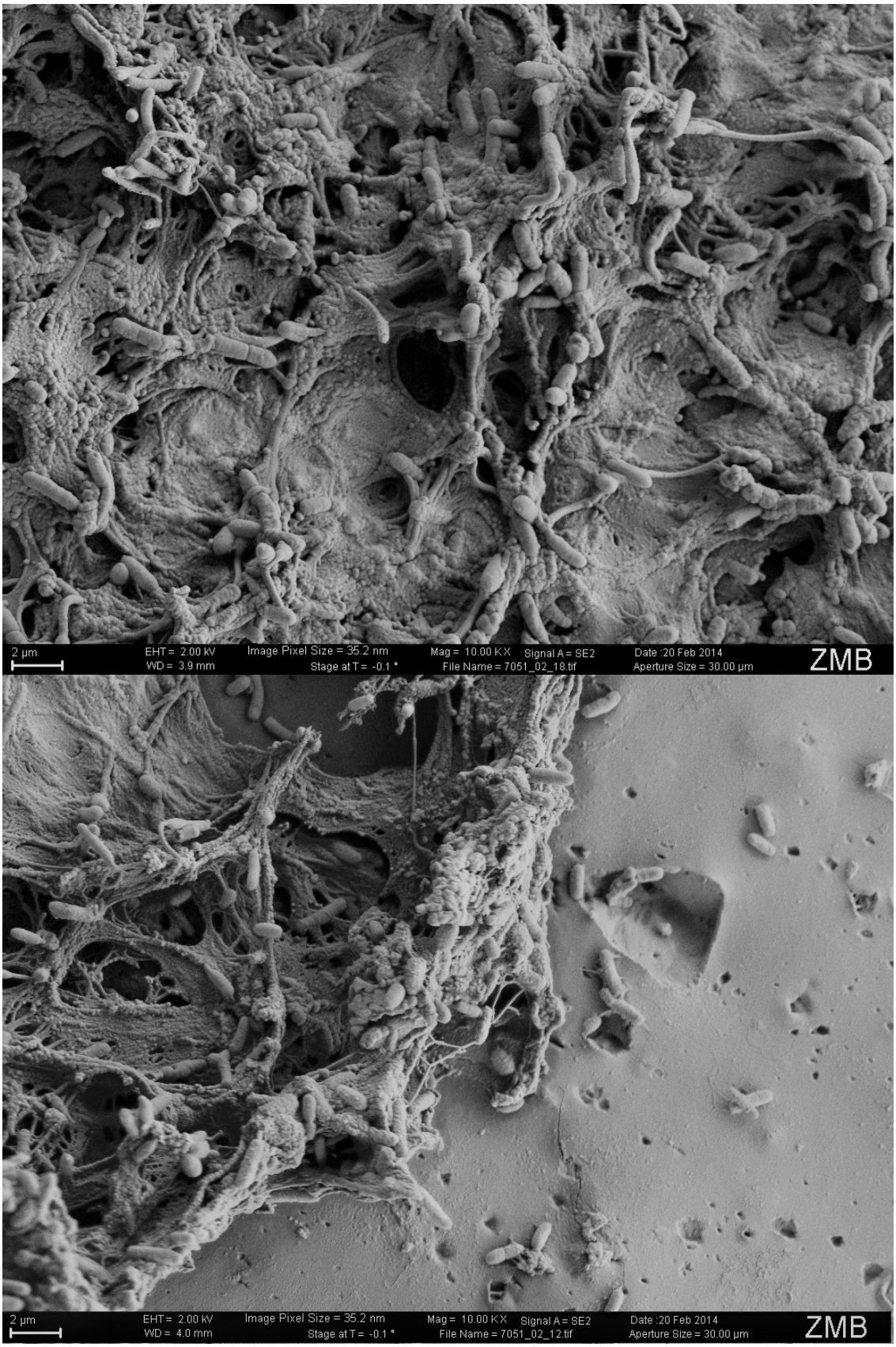

Figure S2: Original black and white images (zoomed out) of biofilms on shower hoses, corresponding to Figure1E (top) and 1F (bottom). In Figure1, only particular sections were shown in order to focus attention. Color was also added artificially to highlight key biofilm elements.

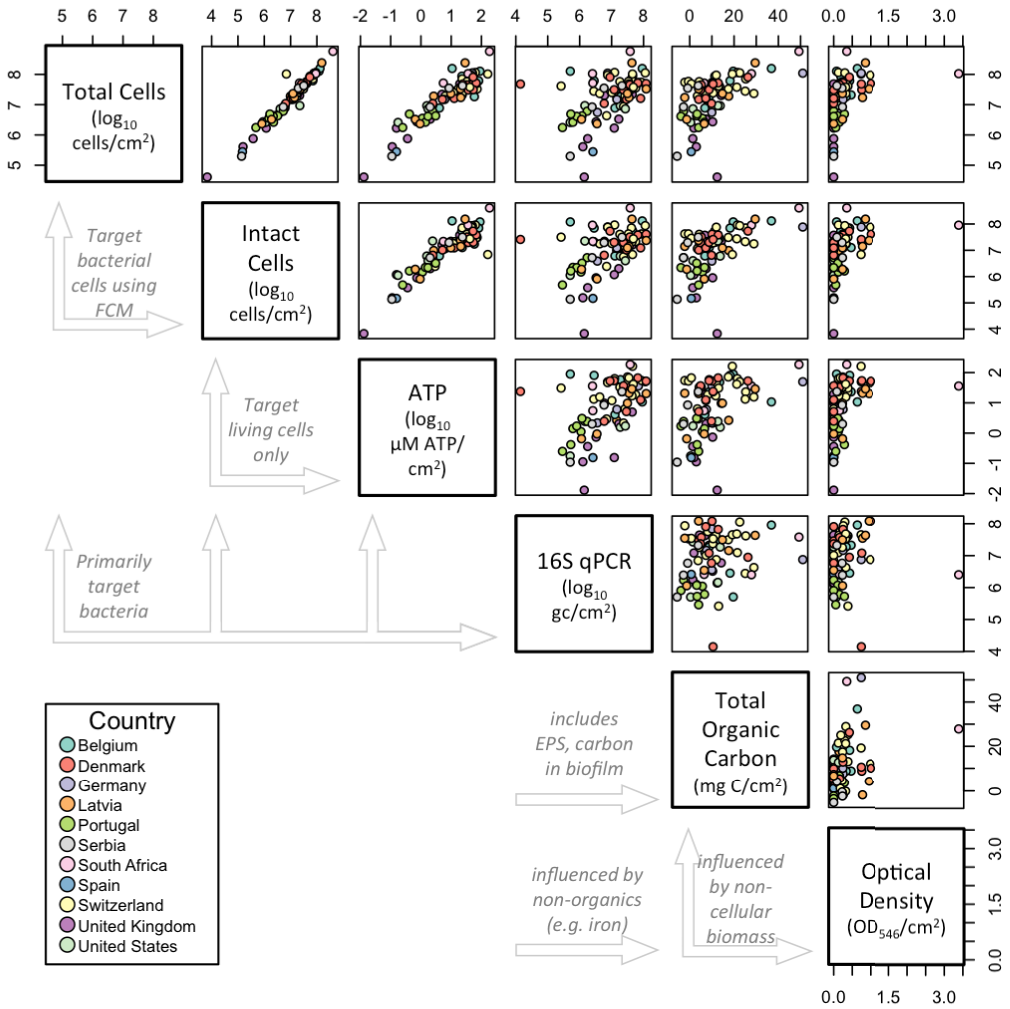

Figure S3: Correlation between various measures of biofilm concentration. All scatter-plot points represent values for individual shower hose samples, colored by country of sample origin. Some factors (Total cells, intact cells, ATP, and 16S qPCR gc) are transformed as indicated due to the wide spread of values.

Further discussion about biofilm concentration measures:

- TCC, ICC, and ATP had strong correlations with one another. These all target primarily bacteria. ICC and ATP both target living biomass.
- qPCR did not correlate well with TCC in this study. This could be because the efficiency of extra processing steps (e.g., DNA extraction) was affected unequally by inorganic deposits that varied unequally across biofilms (e.g., iron).
- TOC was likely influenced by both cells and extracellular polymeric substance (EPS) production. It may have captured some aspects of 'sliminess', which is otherwise difficult to quantify.
- OD did not correlate well with TCC. While cells likely contributed to OD, other factors contributed to the color, and thus the OD of the suspended biofilms. For example,

red color can be caused by inorganic (iron deposition) and organic (*Meiothermus* bacteria). Hardness deposition (calcium, magnesium) likely contributed with opaque white particles. OD did correlate with several metals (Spearman's ρ for lead:0.68, iron:0.67, copper:0.86, calcium:0.40, and manganese:0.51).

Methods (related to Figure S3)

Intact cells (ICC) analysis for biofilm suspensions

Measurement of ICC was the same as for TCC, except for the stain used. Propidium iodide (PI; 30 mM) was mixed with the SYBR® Green I working solution to a final PI concentration of 0.3 mM. 200 µL was stained with SGPI at 10 µL/mL. Samples were preheated to 35 °C (3 min), then incubated with stain in the dark for 10 min at 35 °C before measurement. Flow cytometric measurements were performed, as described previously, using a BD Accuri C6® flow cytometer (BD Accuri cytometers, Belgium). Data analysis was performed using the BD Accuri CFlow® software, following the procedure described previously (Prest *et al.*, 2013) to calculate ICC.

Adenosine tri-phosphate (ATP) analysis for biofilm suspensions

Total ATP was determined using the BacTiter-Glo™ reagent (Promega Corporation, Madison, WI, USA) and a luminometer (Glomax, Turner Biosystems, Sunnyvale, CA, USA) as described elsewhere (Hammes *et al.*, 2010). A biofilm suspension sample (100 µL) and the ATP reagent (100 µL) were warmed to 38 °C simultaneously in separate sterile Eppendorf tubes. The sample and the reagent were combined and then the luminescence was measured after 20 second reaction time at 38 °C. The data were collected as relative light units (RLU) and converted to ATP (nM) by means of a calibration curve made with a known ATP standard (Promega). ATP was measured in triplicate, and the relative standard deviation among technical replicates was below 4%.

16S qPCR

Quantification of the 16S gene were completed as previously described (Proctor *et al.*, 2016). Briefly, the primers Bact349F/Bact806R and probe Bac516F (Takai and Horikoshi, 2000) and were performed using LightCycler 480 Probes Master hot start reaction mix (Roche). Either 100-fold or 1000-fold sample dilutions were used. qPCR reactions were performed on a LightCycler 480-II (Roche) and analyzed using the LightCycler 480 ver. 1.5.1 software (Roche).

Total organic carbon (TOC)

TOC concentration was determined by thermal oxidation to CO_2 and infrared detection with the non-purgeable organic carbon method according to EN 1484 (TOC-V_{CPH}, Shimadzu, Kyoto, Japan). All samples were diluted tenfold with a purified water with TOC < 5 µg/mL organic carbon.

Optical Density

Optical density of biofilm suspensions was measured on an Uvikon 930 spectrophotometer (Kontron Instruments, Germany).

Table S7: Water quality and use patterns for 15 samples in the controlled study

Sample	Household use patterns			Water Quality						
				Incoming (Cold) water						Hot ♭
	Number of People	Uses per week	Notes	Nitrogen	Phosphorous	Magnesium	Calcium	Total Cells	% Intact cells	% Intact Cells
				mg/L	µg/L	mg/L	mg/L	cells/mL	%	%
1	3	14		4.7	7.8	2.5	5.00	2.44E+06	46	62
2	1	4		0.9	7.3	7.5	49.2	2.55E+05	40	63
3	locker room	8	*same room as 6 often stagnant on weekend	2.56	6.7	11.5	71.0	7.72E+05	42	64
4	locker room	20	*same room as 5 often stagnant on weekend	3.14	4.9	12.4	76.1	1.77E+06	45	55
5	locker room	30	*same room as 4 often stagnant on weekend	3.14	4.9	12.4	76.1	1.77E+06	34	55
6	locker room	9	*same room as 3 often stagnant on weekend	2.56	6.7	11.5	71.0	7.72E+05	38	58
7	2	2	**same household as 14	1.0	6.8	9.6	56.5	1.85E+05	55	52
8	3	15		3.68	3.0	1.3	7.19	2.70E+04	70	73
9	5	16		1.0	3.0	8.0	50.7	1.59E+05	63	73
10	4	21		0.92	3.9	7.9	51.0	6.07E+04	61	76
11	2	14		6.0	3.0	9.6	32.4	2.53E+05	57	75
12	2	17.5	often stagnant on weekend	1.11	6.9	8.5	53.7	7.27E+04	63	77
13	2	9.5	Typically only used for high temperature cleaning	2.30	7.2	13.1	113.9	8.10E+04	72	77
14	2	14	**same household as 7	1.0	6.8	9.6	56.5	1.85E+05	47	62
15	2	11		0.84	9.4	6.6	47.6	1.69E+05	54	51

* Hoses 3 – 6 were from two locker rooms (men's, women's) in the same building.
** Hoses 7 and 14 were from two bathrooms in the same apartment.
♭ Hot water samples as described in methods.

Water Quality Methods (related to Table S7)

Water quality parameters were quantified by the AuA laboratory of Eawag, Switzerland. Briefly, nitrogen was measured via chemiluminescence utilizing Shimadzu TOC-L CSH. Phosphorus (Total-P) was measured after chemical digestion with potassium peroxide in the autoclave (Truttnauer/Systec 2540 EL) at 121°C followed by the spectrophotometric determination of ortho-phosphate after the reaction to phosphorus-molybdenum-blue-complex. Total-P was measured on a Spektrophotometer Varian Cary 50 Bio. Magnesium and calcium were measured using Ion chromatography (Column: Metrohm C6 – 250/4.0) with a Metrohm 930 Compact Flex. Intact cells were measured as described with Figure S3. The percentage is determined by dividing the intact cell concentration by the total cell concentration.

Table S8: Correlation values between use patterns and calculated weekly doses and biofilm concentration. Calculated weekly loads were derived by multiplying the number of uses per week by water quality concentrations (nitrogen, phosphorous, magnesium, calcium or total cells in the cold flowing water, (Table S7)) and the volume inside a shower hose. For all, N=15 for the 15 biofilm samples. Uses per week alone (e.g., without multiplying by a water quality parameter) had the strongest correlation with biofilm TCC, while other water quality measurements had only moderate correlations. That is to say, no single nutrient or load was controlling the system with stronger predictive power than frequency of alone. It could be either a combination of nutrients/cells or some other aspect of frequency of use that controls the biofilm TCC.

Correlation with biofilm total cell concentration [log_{10} (cells/cm2)]			(Pearson's test)	
			R	p
	Uses	use/week	0.70	0.004
Calculated weekly load	**Total nitrogen**	mg/week	0.61	0.02
	Total phosphorous	µg/week	0.52	0.04
	Magnesium	mg/week	0.58	0.02
	Calcium	mg/week	0.62	0.01
	Total cells	log_{10}(cells)/week	0.52	0.04

Figure S4: Photo from outside of a shower hose, with metal partially removed (left), and the inside of a shower hose with a particularly red/orange biofilm (right). On the left, biofilm formed yellow spots, resembling bacterial colonies on agar. On the right, the biofilm had a rough texture and deep red/brown/orange color.

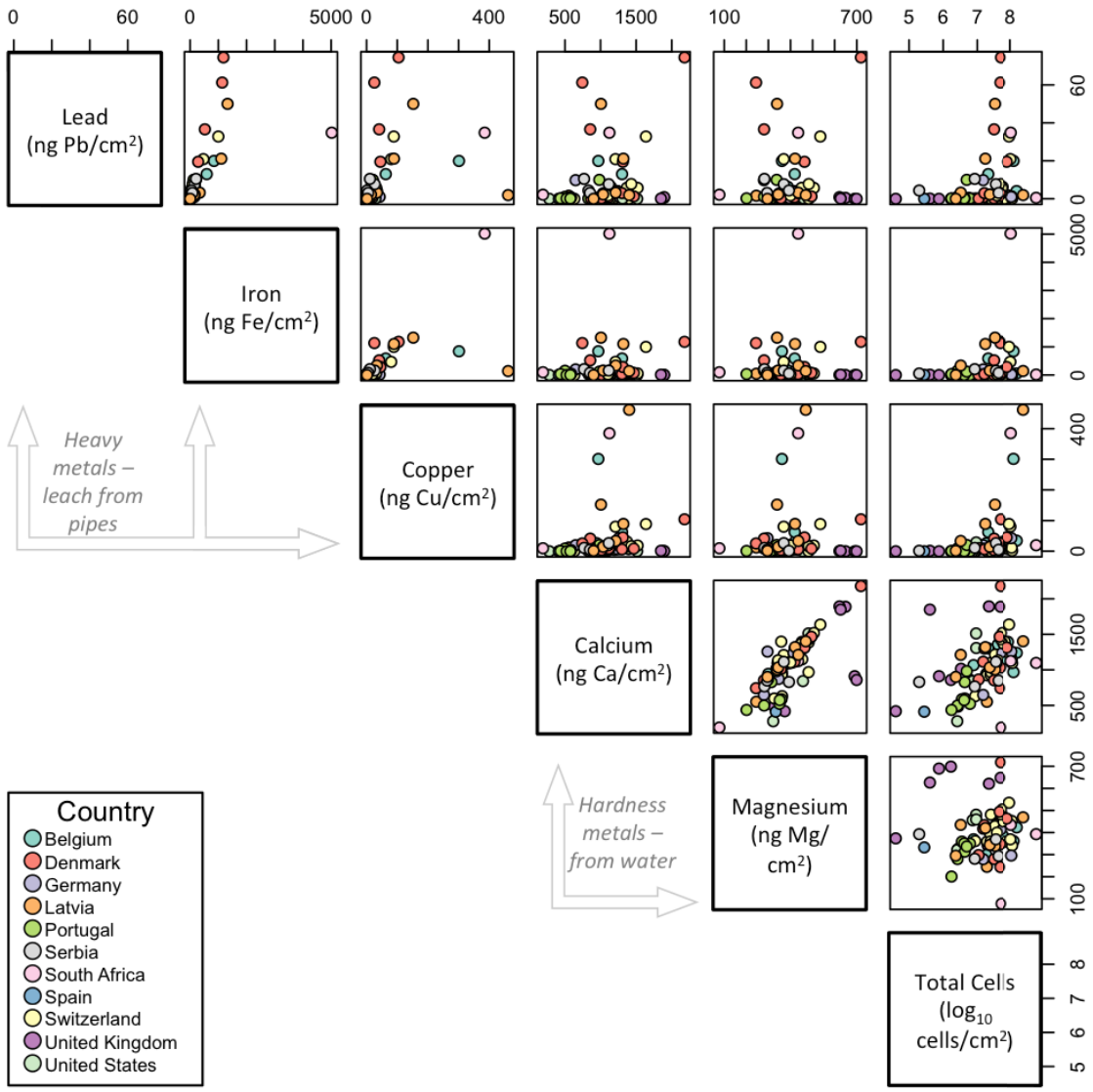

Figure S5: Concentrations of metals (lead, iron, copper, calcium, and magnesium) and biofilm total cell concentration (biofilm TCC), with their correlations. Points represent individual hoses, colored by country. None of the metals correlated well with biofilm TCC. There were many non-detects for lead, iron and copper, but when present, there tended to be positive relationships between these metals – i.e., these metals precipitated together in biofilms. Calcium and magnesium were present in all biofilms, and had a positive relationship with each other. While the first three metals likely originate from up-stream pipes in the distribution system, calcium and magnesium likely originate from hardness in the water.

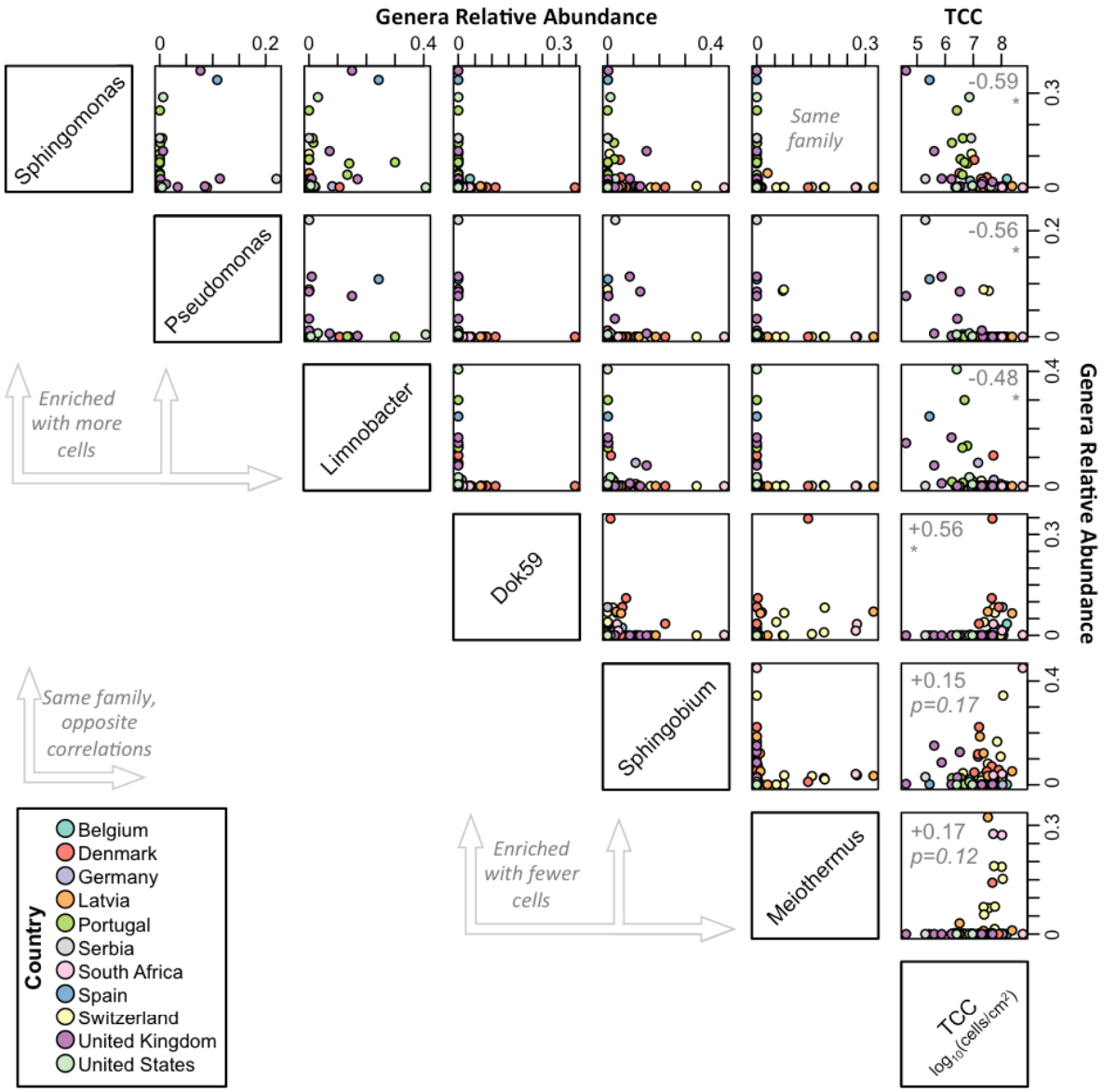

Figure S6: Correlational analyses between relative abundance of genera (sum of all OTUs identified within that genera) and biofilm total cell concentration (TCC) (log10 transformed). Points represent individual hoses, colored by country. Spearman rank correlations noted for correlations with biofilm TCC, with (*) indicating $p<0.001$. These are the three most significant positive and negative correlations from the top 10 most abundant genera, but these do not necessarily represent the strongest correlations. For example, a significant positive correlation was found between *Legionella* and biofilm TCC (Spearman's $\rho=0.36$, $p<0.001$). This analysis focused on the top 10 most abundant genera because more frequent non-detects with less abundant OTUs likely affected results strongly. Notably, two genera from within the same family (*Sphingomonas* and *Sphingobium*) were both amongst the top 10 most abundant genera, but had opposite correlations.

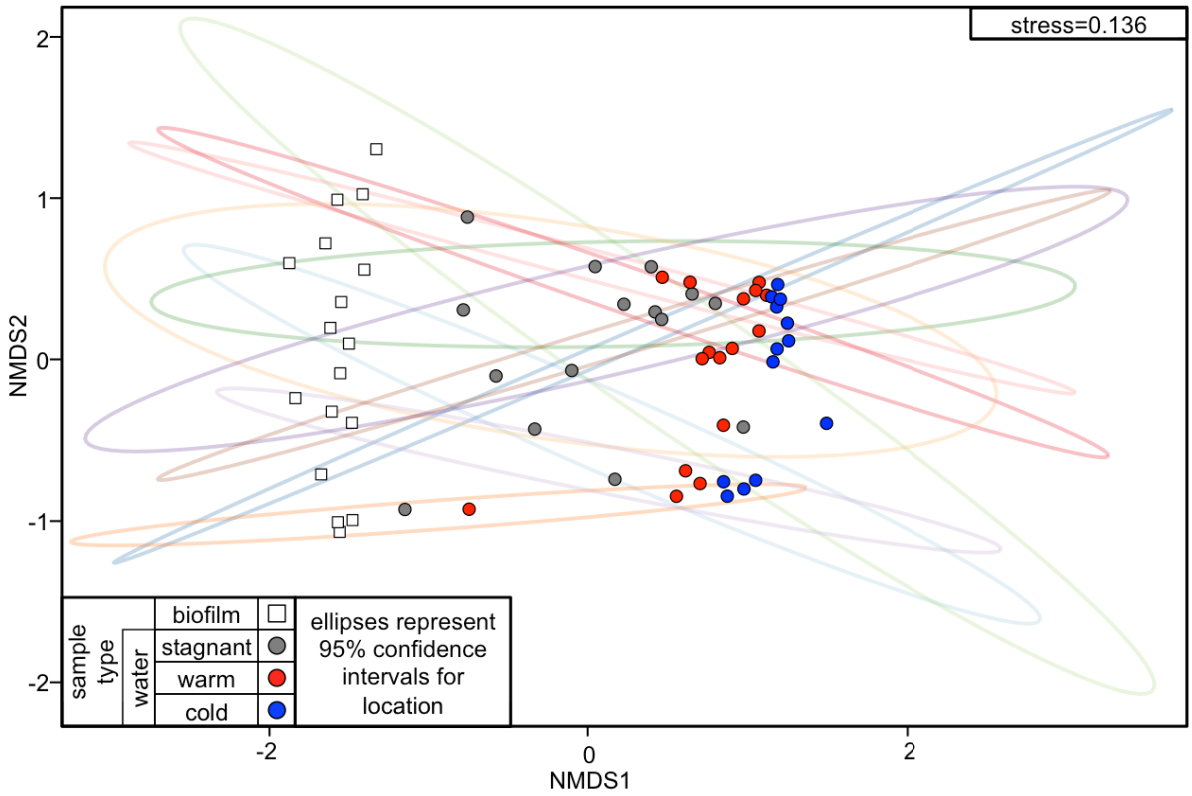

Figure S7: NMDS representing Bray-Curtis dissimilarities between samples in the controlled study. Samples consist of 15 biofilms, and matching stagnant water, warm running water, and cold running water. Ellipses represent 95% confidence intervals for each household. These ellipses are generally narrow across an NMDS2 range, but extend widely through NMDS1 to capture all sample types. Household explained 41% of microbiome variation (Adonis). Thus, while there are similarities between sample types (symbol type and color), there are some strong similarities in a household. This could, for example, be due to drift into the household (cold flowing water) selecting downstream microbiomes.

Table S9: Products available for addressing biofilms in shower hoses, including quarterly replacement systems and single-use shower hoses.

	Product name	Description	Link	Screenshot Page (After Table S9)
Quarterly Replacement	TSafe® Replacement Hand and Wall Showers	Shower hoses and heads made with antibacterial coatings. With four different colors, they can be replaced quarterly, or taken off for cleaning.	https://www.grahamassetmanagement.co.uk/DatabaseDocs/nav_6024781__replacement_shower_brochure_oct_2016.pdf	7 of 16
	Dupal L8 Shower ®	The company replaces antimicrobial shower heads and hoses quarterly, and collects them for recycling. The system uses four different colors to keep track of replacement.	https://www.antibacterialshower.co.uk/	9 of 16
	Challis Ag+® Antimicrobial shower hoses	Made with anti-microbial plastics, and four different colors to keep track of replacement. The company delivers new hoses and collects old ones for recycling.	http://www.alchallis.com/enviroment/environmental_policy.php	12 of 16
Single-use	Steri-Spray Steri-Cleanse Showering Attachment	Flexible single-use hose which easily connects to Steri-Spray shower systems. Designed to be used once to limit patient-to-patient contamination, it also ensures that biofilm does not grow.	http://www.steri-spray.com/shower-attachment/	15 of 16

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Prest EI, Hammes F, Kötzsch S, van Loosdrecht MCM, Vrouwenvelder JS. (2013). Monitoring microbiological changes in drinking water systems using a fast and reproducible flow cytometric method. *Water Res* **47**: 7131–42.

Proctor CR, Gächter M, Kötzsch S, Rölli F, Sigrist R, Walser J-C, *et al.* (2016). Biofilms in shower hoses – choice of pipe material influences bacterial growth and communities. *Environ Sci Water Res Technol*. e-pub ahead of print, doi: 10.1039/C6EW00016A.

Takai K, Horikoshi K. (2000). Rapid detection and quantification of members of the archaeal community by quantitative PCR using fluorogenic probes. *Appl Environ Microbiol* **66**: 5066–72.

Web screenshots (referred to in Table S1 and Table S9).

Legionella detected in water systems at two Kane centers

Updated: Mar 10, 2017 - 7:32 PM

PITTSBURGH - Low levels of Legionella bacteria have been detected in the water systems at two Kane facilities, according to Allegheny County officials.

Patients, visitors and staff in one unit at Kane McKeesport and one unit at Kane Glen Hazel will begin using bottled water immediately, a news release said. The use of ice machines is prohibited. Patients in those units are restricted from using showers. They will instead use showers in other units.

Dennis Biondo, executive director of the Kane Regional Centers said all four Kane centers were equipped with copper-silver ionization water treatment systems, following positive Legionella tests last year. Several centers also had their water systems flushed and filters installed in ice machines

http://www.wpxi.com/news/top-stories/legionella-detected-in-water-systems-at-two-kane-centers/501536863

Web-Screenshots 1 of 16

Ocoee gym being examined after 3 sickened by Legionnaire's disease, officials say

by: Samantha Manning Updated: Apr 19, 2017 - 11:35 PM

OCOEE, Fla. - Officials were investigating an Ocoee gym Wednesday after three people who used the facility recently came down with Legionnaires' disease.

The Florida Department of Health contacted management at L.A. Fitness on Silver Star Road after the infections were detected.

While the outbreak of the dangerous bacterial infection has not been conclusively linked to the gym, management said they wanted customers to know they may have been exposed.

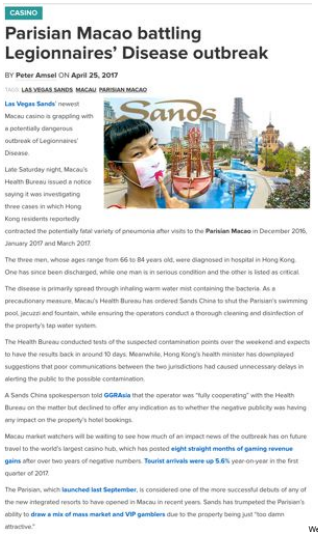
According to the Centers for Disease Control and Prevention, Legionnaires' disease is a serious type of pneumonia caused by the Legionella bacteria.

The bacteria can grow in contaminated water and infections happen when an individual inhales water droplets in the air, the CDC said.

The most common sources of water containing the Legionnaires' disease bacteria are showers, cooling towers, decorative fountains and hot tubs, the CDC said.

http://www.wftv.com/news/local/ocoee-gym-being-examined-after-3-sickened-by-legionnaires-disease-officials-say/514286196

Web-Screenshots 2 of 16



CASINO

Parisian Macao battling Legionnaires' Disease outbreak

BY **Peter Amsel** ON **April 25, 2017**

TAGS: **LAS VEGAS SANDS MACAU PARISIAN MACAO**

Las Vegas Sands' newest Macau casino is grappling with a potentially dangerous outbreak of Legionnaires' Disease.

Late Saturday night, Macau's Health Bureau issued a notice saying it was investigating three cases in which Hong Kong residents reportedly contracted the potentially fatal variety of pneumonia after visits to the **Parisian Macao** in December 2016, January 2017 and March 2017.

The three men, whose ages range from 66 to 84 years old, were diagnosed in hospital in Hong Kong. One has since been discharged, while one man is in serious condition and the other is listed as critical.

The disease is primarily spread through inhaling warm water mist containing the bacteria. As a precautionary measure, Macau's Health Bureau has ordered Sands China to shut the Parisian's swimming pool, jacuzzi and fountain, while ensuring the operators conduct a thorough cleaning and disinfection of the property's tap water system.

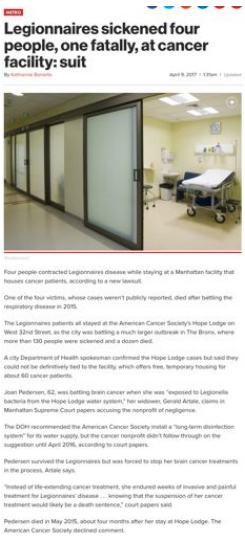
The Health Bureau conducted tests of the suspected contamination points over the weekend and expects to have the results back in around 10 days. Meanwhile, Hong Kong's health minister has downplayed suggestions that poor communications between the two jurisdictions had caused unnecessary delays in alerting the public to the possible contamination.

A Sands China spokesperson told **GGRAsia** that the operator was "fully cooperating" with the Health Bureau on the matter but declined to offer any indication as to whether the negative publicity was having any impact on the property's hotel bookings.

Macau market watchers will be waiting to see how much of an impact news of the outbreak has on future travel to the world's largest casino hub, which has posted **eight straight months of gaming revenue gains** after over two years of negative numbers. **Tourist arrivals were up 5.6%** year-on-year in the first quarter of 2017.

The Parisian, which **launched last September**, is considered one of the more successful debuts of any of the new integrated resorts to have opened in Macau in recent years. Sands has trumpeted the Parisian's ability to **draw a mix of mass market and VIP gamblers** due to the property being just "too damn attractive."

https://calvinayre.com/2017/04/25/casino/parisian-macao-legionnaires-disease-outbreak/



Legionnaires sickened four people, one fatally, at cancer facility: suit

Four people contracted Legionnaires disease while staying at a Manhattan facility that houses cancer patients, according to a new lawsuit.

One of the four victims, whose cases weren't publicly reported, died after battling the respiratory disease in 2015.

The Legionnaires patients all stayed at the American Cancer Society's Hope Lodge on West 32nd Street, as the city was battling a much larger outbreak in The Bronx, where more than 130 people were sickened and a dozen died.

A city Department of Health spokesman confirmed the Hope Lodge cases but said they could not be definitively tied to the facility, which offers free, temporary housing for about 60 cancer patients.

Joan Pedersen, 62, was battling brain cancer when she was "exposed to Legionella bacteria from the Hope Lodge water system," her widower, Gerald Artale, claims in Manhattan Supreme Court papers accusing the nonprofit of negligence.

The DOH recommended the American Cancer Society install a "long-term disinfection system" for its water supply, but the cancer nonprofit didn't follow through on the suggestion until April 2016, according to court papers.

Pedersen survived the Legionnaires but was forced to stop her brain cancer treatments in the process, Artale says.

"Instead of life-extending cancer treatment, she endured weeks of invasive and painful treatment for Legionnaires' disease . . . knowing that the suspension of her cancer treatment would likely be a death sentence," court papers said.

Pedersen died in May 2015, about four months after her stay at Hope Lodge. The American Cancer Society declined comment.

http://nypost.com/2017/04/09/legionnaires-sickened-four-people-one-fatally-at-cancer-facility-suit/

Walton pool and gym reopen almost three months after legionella bug outbreak

Walton Lifestyles pool and gym have reopened after legionella outbreak

24th February 2017

0 comments

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A LEISURE centre which was forced to close after a customer contracted the potentially deadly legionella bug has reopened today after being shut for almost three months.

Walton Lifestyles closed in December after a man was diagnosed with Legionnaires' Disease.

Tendring Council, which runs the centre, says extensive work has been carried out to ensure the gym and pool facilities are clear of the bacteria.

Water tests have now come back negative so the centre can reopen safely.

The reopening date had been put back several times.

Leisure boss Lynda McWilliams said: "The modifications have taken longer than we first anticipated but it is very difficult when you start out to estimate the exact period that the programme of works would take."

She said the council had followed expert advice "to the letter".

http://www.clactonandfrintongazette.co.uk/news/15115947.Pool_and_gym_reopen_almost_three_months_after_legionella_bug_outbreak/

Legionnaires' disease diagnosed in Fresno nursing home patient

http://www.fresnobee.com/news/local/article126494379.html

A resident at Horizon Health & Subacute Center in northeast Fresno was diagnosed with Legionnaires' disease in late December 2016. Cases of Legionnaires' disease have been increasing in the county and nationwide. **BARBARA ANDERSON** · banderson@fresnobee.com

Web-Screenshots 6 of 16

About Tandrup Water Solutions and GRAHAM Environmental Services

T-SAFE Product information

T-SAFE Exclusively distributed by GRAHAM Environmental Services

Replacement Hand and Wall Showers

GRAHAM ENVIRONMENTAL SERVICES

WATER · FIRE · AIR · ASBESTOS

SURVEY · CONSULT · MONITOR · MAINTAIN

TANDRUP

T-Safe® Replacement Hand Shower

Solution 1: ***Complete exchange of shower and hose once a quarter****

- Supply shower head with coloured locking ring and locking pawl and matching hose for full exchange on a quarterly basis. This ensures full peace of mind.

Solution 2: ***Cleaning of shower once a quarter* – exchange of faceplate and hose***

- Supply a shower head with light grey locking ring and locking pawl and hose with light grey conical.
- Supply a set of faceplates with coloured locking rings (green, blue, yellow and violet) for replacement to ensure compliance and conical for replacement ensure compliance and easily reduce cleaning time.

Solution 3: ***Cleaning of shower once a quarter* – exchange of faceplate only**

- Initial supply a shower head with light grey locking ring and locking pawl and hose with light grey conical.
- Supply a set of faceplates with four different coloured locking rings (green, blue, yellow and violet) for replacement to ensure compliance and reduce cleaning time

T-Safe® Replacement Wall Shower

Solution 1: ***Exchange of shower and faceplate*** *(not the metal fixation part)*

- Initial supply of complete shower head with grey locking ring and metal fixation set.
- Supply the shower hose with four different coloured locking rings (green, blue, yellow and violet) for full replacement to ensure compliance and vastly reduced cleaning time.

Solution 2: ***Cleaning of shower once a quarter**** *(or as required) – change of faceplate only*

- Initial supply of complete shower head with grey locking ring and metal fixation set.
- Supply a set of faceplates with four different coloured locking rings (green, blue, yellow and violet) for replacement to ensure compliance and reduced cleaning time.

**For as indicated by the rate of fouling or other risk factors, e.g. areas with high risk patients*

Web-Screenshots 7 of 16

T-SAFE Exclusively distributed by GRAHAM Environmental Services

T-Safe® Replacement Hand and Wall Showers

The innovative T-Safe® Replacement Hand Shower and T-Safe® Replacement Wall Shower offers a complete flexible hygienic full or part replacement shower solution. The showers have Biomaster Antibacterial Technology, incorporated in the material this reduces the risk of cross-contamination significantly with up to 99.9% reduction in E.coli, Staphylococcus aureus, Pseudomonas and Legionella. The internal and external smooth bore finish will also minimise the growth of biofilm within the showers.

Legislation

Under current guidelines HTM 0401, ACoP L8 and HSG274, organisations are required to dismantle, clean, de-scale and *disinfect (HTM 04-01 only)* showers including removable parts, heads, inserts and hoses where fitted quarterly or as indicated by the rate of fouling or other risk factors, e.g. areas with high-risk patients.

Existing wall and handheld wall showers and shower hoses are difficult to dismantle, clean, de-scale and disinfect. This task is time consuming and has a COSHH implication due to use of cleaning chemicals.

The T-Safe® Replacement Shower Solution

The T-Safe® replacement shower range can be utilised in a number of ways either as a fully replaceable option for each period or as a longer life part replaceable product that can be easily dismantled to enable a full internal and external clean, de-scale and disinfection. This means you can save time and money with the option of full replacement or part replacement of the products.

The aim with the design and functionality of the T-Safe® Replacement Hand Shower and T-Safe® Replacement Wall Shower is to offer a fully flexible solution that can be customised each customer's individual requirement and in a design that makes the product usable in a wide range of facilities. These showers ensure you fully comply with the guidelines of HTM 04-01, ACoP L8 and HSG274.

The quick connect shower faceplates, shower locking pawl and shower hose conicals have a discreet range of colour coding. This means you have an easily identifiable visual indicator so you quickly identify that the shower has been fully or partially replaced at an appropriate frequency as determined by your Legionella Risk Assessment.

BIOMASTER ANTIBACTERIAL TECHNOLOGY

The T-Safe® Replacement Hand Shower and T-Safe® Replacement Wall Shower are both available with Biomaster Antibacterial Additive incorporated in the product, which is effective for the lifetime of the product. When added it is dispensed throughout the entire item and becomes an integral part of the product.

Bacteria are effectively stopped from multiplying on the surfaces treated with the Biomaster protected surface, such as E.coli, Staphylococcus aureus, Pseudomonas and Legionella. The silver ions prevent them from growing, producing energy or replicating, therefore they die. This secures a hygienic surface and reduces the risk of cross-contamination significantly.

Silver is inorganic and non leaching which means that, unlike organic antimicrobial agents, it stays with the product to which it is added.

Validation:

The material used has been tested for antibacterial efficacy by an independent laboratory, Industrial Microbiological Service Ltd using ISO 22196 standard.

The active in the Antibacterial Additives is supported under the requirements of the Biocidal Products Regulation (BPR), is EPA registered and meets FDA requirements.

WRAS approved materials used in both showers and hose.

Key Features & Benefits

- Biomaster Antibacterial Technology reduces cross contamination up to 99.9%
- Durable product manufactured in ABS and POM
- Range of options including full or partial exchange of components
- Reduced maintenance and cleaning costs
- Unique removable faceplate so shower can be cleaned between exchanges
- Quick and easy to dismantle all parts
- Internal and external smooth bore finish
- Faceplates are all white and available with five different coloured locking rings
- Tool or finger release faceplate available
- No COSHH implications on full exchange service
- Anti-twist Coupling so shower hose will not twist
- Standard ½" connection on the showers
- No additional adaptors required
- Colour coding on all accessories for seamless visual inspection
- Optional flow restricter with water saving of up to 50%
- Improved compliance with HTM 04-01, ACoP L8 and HSG274
- Coloured locking pawl matches the colour on the faceplate lock ring

Web-Screenshots 8 of 16

5/16/2017 Antibacterial colour coded shower heads and hoses UK

L8Shower®

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Its time to see how much you could save on your shower compliance.

L8Shower®

Shower Scheme

Dupal UK supplies a showerhead and hose

Advantages

- It uses 40-60% less material compared

Shower design

The L8 Show

Web-Screenshots

https://www.antibacterialshower.co.uk/ 1/3

5/16/2017 Antibacterial colour coded shower heads and hoses UK

exchange scheme to hospitals, clinics, care homes, student accommodation and other public facilities. The scheme achieves total compliance with ACoP L8 guidelines, removing the use of harsh chemicals associated with quarterly deep clean and de scaling.
Our scheme includes delivery of new heads and hoses every quarter as well as collection and recycling of the used ones. We also provide full records of deliveries, collections, as well as certificates of recycling helping our clients achieve their sustainability targets.

to other scheme shower models available;

- No obstructions to water flow;
- Completely smooth inside;
- Colour coded head AND hose fittings;
- Modern up-to-date design;
- Made with antibacterial ABS plastic;
- No rubber components inside;
- No breathable mist created during showering;
- Fully compliance with British and European regulations;
- WRAS approved
- It is the most cost effective solution currently available!

developed to be both modern and practical. It uniquely features low inventory to reduce stagnant water, antibacterial for end user protection and is colour-coded for peace of mind.

The L8 Hose is also colour-coded to match with each L8 Shower. The coloured fittings ensure hoses are replaced with the showerheads every quarter without fail.

About Us

Dupal UK believe in providing a five star service to all its customers, finding solutions to help simplify essential tasks at hospitals and other public facilities, in a cost effective way. Each product and service is created with the client and end user in mind.

Contact

Enquiries

For any enquiries, questions or commendations, please call: 01342 844844 or fill out the form below

Head Office

Smallfield, Surrey
United Kingdom

Web-Screenshots

https://www.antibacterialshower.co.uk/ 2/3

5/16/2017 Antibacterial colour coded shower heads and hoses UK

sales@dupaluk.com
Tel: 01342 844 844

Name Email

Subject

Message

Send

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Web-Screenshots

https://www.antibacterialshower.co.uk/ 3/3

5/16/2017 Anti Bacterial Shower Head Recycling Scheme

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Challis Recycling Scheme

Home Environment Challis Recycling Scheme

Background

We at Challis Water Controls are experts in water and energy efficiency and the first company to introduce aerated shower heads to the UK over 15 years ago.

We have recently completed a nationwide energy/water efficiency project in partnership with the Government & OFGEM, saving over 4 million tonnes of carbon and 200 billion litres of water in households across the UK.

We have been discussing supplying our shower heads with many NHS trusts and have discovered an increasing number of them have started throwing their heads away after each quarter instead of de-scaling and cleaning them. They do this because of the time implication to their maintenance staff, it is simply more cost efficient to discard rather than clean. However this practice is not very popular with the estates staff because of its wasteful nature and is seen to be not very environmentally sound.

Direct Link to Your New Web Site

How The Challis Recycle Scheme Works

Our WRAS approved hand held shower heads are manufactured in the UK from high quality ABS anti-microbial plastic. Because the shower heads have only been used for 3 months it is actually cost effective to recycle them at the end of each quarter.

The scheme can be just the showerheads or with a white, smooth flexi hose.

Call Us On:
Telephone:
01628 529024
Fax:
0870 4580577

For a prompt and friendly response to all your water control and conservation enquiries.

Whether you are looking for advice or specific technical enquiry we will have the answer

Water Calculator

Water Energy & Carbon Saving Calculator

Free Gifts & Special Offers

Special Offer While Stocks Last
70% Off New Water Saving Multi Function Shower Riser Kit Complete

Read more

New Challis Ag+ Anti Bacterial Shower Now

Videos

The only mixer currently available that is ideally suited for use with combination boilers

Shower Maintenance

Please enter your e-mail address to get our monthly newsletter packed with water energy saving tips, articles, free gifts and special offers

Web-Screenshots

http://www.alchallis.com/environment/environmental_policy.php 1/3

· We supply the appropriate number of showerheads/hoses to the hospital.
· Maintenance staff install new showerheads/hoses.
· Before the start of the second quarter new showerheads delivered.
· Showerheads/hoses swapped for the second time and heads/hoses from the first installation bagged ready for collection.
· Third set of showerheads/hoses delivered first set collected for recycling.
· This continues quarterly.

To watch our new video describing the recycling scheme

CLICK HERE

Benefits To The Hospital Trust

· Significantly less time spent maintaining showerhead cleanliness.
· Each quarterly delivery the face and collar of the showerhead will be a different colour from the previous (colours tbc) this will allow easy monitoring of which units have been changed.
· Fast ROI showerheads can save up to 50% on water, sewage and gas.
· Less need to store and handle cleaning chemicals.
· Showerheads are WRAS approved.
· Our technology is OFGEM accredited to help reduce CRC.
· Environmentally friendly — heads recycled instead of incinerated or thrown away.

Infection Control Benefits

Challis showerheads can significantly reduce bacteria growth for the following reasons:

· Manufactured in the UK from ABS anti-microbial plastic which is already used within the NHS and proven to reduce bacteria growth.
· Helps prevent patient to patient transfer of bacteria - the anti-microbial properties are on the external and the internal surfaces of the showerhead.
· Bacteria thrive on the warm wet surfaces of showerheads particularly multi function spray heads and the ones which have rubber protruding through the holes which aid in scale removal, they live and breed in the mechanism and channels or between the rubber and the showerhead itself. Challis showerheads have a fixed spray, no moving parts and no rubber face plate
· When the shower is turned off water drains completly from the showerhead leaving it dry helping prevent bio film growth and scale formation.
· We do not claim to disinfect the water passing through our showerhead, nor do we advise making any changes to your current cleaning regime. But with the anti-microbial properties within our heads and hoses any bacteria including legionella that comes in contact with surfaces will be killed within 24 hours.
· Because there are no moving parts, flow channels etc there are no "nooks and crannies" for the bacteria to hide in and any that do settle on the plastic will be quickly eliminated.
· Because the head drains after it's turned off less scale forms and does not provide a home for the legionella bacteria to grow.

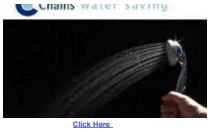
To view our new video about the Ag+ Anti Bacterial Shower Head CLICK HERE

Water, Energy & Carbon Reduction

We are the only showerhead manufacturer to have OFGEM accreditation, it means we can guarantee an organisation a minimum of 1 tonne of carbon saving off their CRC.

Fitting our showerheads is one of the easiest and cheapest ways to reduce your carbon footprint.

Below is a link to a short video that demonstrates how our showerheads work.



Click Here

Our showerhead technology is used by many organisations including David Lloyds Health Clubs, Bannatynes Fitness, Accor Hotels, Crowne Plaza, Jurys Inns, MacDonald Hotels, Alton Towers Hotels, NHS Trusts, Ministry of Defence and many housing associations.

We believe by fitting our anti-microbial showerheads and shower hoses you are significantly improving the protection you give your patients against potentially harmful bacteria whilst showering. You will also reduce your carbon footprint and make substantial savings on water, sewage and gas .

BUY NOW OR CALL 01462 491005

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1 2 3 4 5 6

Why Choose STERI-SPRAY?

How Steri-Spray WORKS

Product Links :

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Steri-Spray Products
Surface Shower
Concealed Showers
Panel Showers
Steri-Cleanse
Steri-Tap
Spare Parts & Sensor

Steri-Cleanse Showering Attachment

A single use, shower hose and rose attachment that connects directly onto any model of Steri-Spray shower with a simple twist on/off motion.

10 unit order code: SCA/10
100 unit order code: SCA/100
Order Here

The Steri-Cleanse is a disposable flexible shower hose designed to reduce the risk of patient cross infection and solve the bacterial problems associated with standard flexible showering handsets.

Flexibility whilst protecting patients & staff from MRSA & legionella
Simple twist on/off connection to all Steri-Spray showers
Fixed head showering, whilst maintaining flexibility for cleaning with a hose

Preventing MRSA

Steri-Spray has recognised the need to protect patients, carers, nurses and residents from nosocomial infections such as MRSA. Standard flexible shower hoses are handled and used by multiple patients in very close proximity to their vulnerable open and surgical wound areas. Sharing standard shower handsets in this way poses a real threat in the fight against patient to patient bacterial cross contamination.

Steri-Cleanse is a response to this threat. It is a single use, shower attachment that connects directly onto any model of Steri-Spray shower with a simple twist on/off motion. It was designed for use by patients during stays in hospital and for carers of those who need assistance showering.

Convenient and Safe Cleaning

Steri-Spray showers also enable hotels and other facilities to have a fixed shower head (preventing water spillage outside of the bath or shower tray area), whilst maintaining the flexibility to clean these areas with the aid of a Steri-Cleanse flexible hose attachment. With Steri-Cleanse, you can be sure that only treated water is dispensed from the shower rose, protecting clients and domestic staff against Legionella and allowing for convenient cleaning.

Download or Request BROCHURE click here

Surface Mounted SHOWERS click here

Panel SHOWERS click here

Concealed Mounted SHOWERS click here

Steri-Cleanse Showering ATTACHMENT click here

Steri-Tap NON TOUCH TAP click here