



The Microbiome of an Outpatient Sports Medicine Physical Therapy Clinic: Factors Contributing to Surface Contamination



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INTRODUCTION

Healthcare facilities such as sports medicine outpatient clinics, are a potential reservoir of pathogens which may contribute to Healthcare Associated Infections (HAIs). While HAIs are well studied within hospitals & inpatient facilities, little is known about HAIs and the microbiome (the collective microbes that inhabit an environment) of outpatient sports medicine PT clinics.

Purpose

To examine the microbiome of an outpatient sports medicine PT clinic and determine how contact by staff and patients, surface type (porous versus nonporous) and cleaning frequency contributed to contamination of surfaces.

Hypothesis

The microbiome of an outpatient PT clinic harbors potentially pathological microbes, including SARS CoV-2 and the degree of patient contact is the best predictor of surface contamination.

METHODS

- In order to measure degree of contact, patients and staff at the clinic used hand sanitizer altered by the addition of a fluorescent dye, GloGerm™ on separate days. At the end of each experiment day, surfaces were swiped and residual GloGerm was used as an indicator of contamination.
- Surfaces were also swiped for bacterial and viral material on separate days and DNA and RNA were isolated.
- Total bacterial DNA was determined using the Femto DNA Quantification™ kit (Zymo Research, Inc.) and sequenced using the MiSeq Illumina system (Argonne National Laboratory).
- RNA samples were assayed for SARS-CoV-2 using the 2019-nCoV RUO Kit™ (IDT).
- Bioinformatic analysis included Linear Discriminant Analysis Effect Size (LEFSE) to identify taxa most closely associated with environments.
- Statistical analysis included Pearson and Spearman correlations.

Figure 1: Map of the Sports Medicine Clinic Showing Sampled Sites



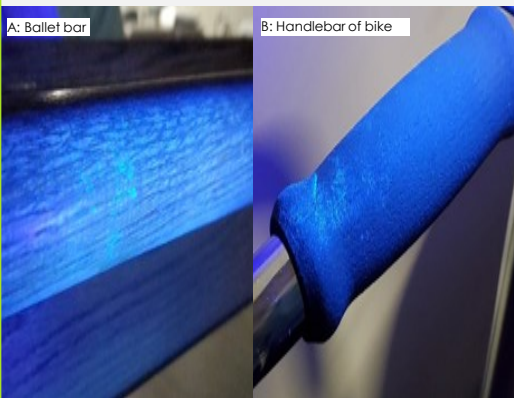
Map showing all 49 sites sampled around the clinic. Surfaces pre-identified as frequently contacted are shown in orange.

Table 1: Description of Sites Sampled

Site #	Description	Contact Fluorescence Pos	Contact Fluorescence Neg	Priority Category	Frequency of Cleaning	Bacterial Load
1	Outside door handle	2306.2	0	non-porous	daily	0.00000000
2	Handbar handle	2769	697.9	non-porous	daily	0.00004125
3	Resistance cord	1905.1	1006.4	non-porous	daily	0.00000000
4	18 x 28 rectangle of corner of front desk	384.3	603.3	non-porous	daily	0.00000000
5	Top handle of chair to left of desk	4716	622.9	porous	daily	0.00000000
6	Orange safety ball	1452.1	0	non-porous	daily	0.00000000
7	Track Gym™ track desk	2266.9	2306.4	porous	daily	0.00000000
8	Track Gym™ ball handles	6554.5	3197.1	porous	daily	0.00000000
9	Track Gym™ ball handles with HR monitor	1702.9	1388	non-porous	daily	0.00000000
10	Track Gym™ control panel	6127.5	1066.8	non-porous	daily	0.00000000
11	NuStep™ side handles	6219.5	10391.1	porous	daily	0.00000000
12	NuStep™ arm rest and seat adjustment bar	22216.8	6221	porous	daily	0.00000000
13	Stationary bike handle bars, just the metal part, side desk part	17423.1	2426.9	porous	daily	0.00000000
14	Stationary bike control panel	2567.5	1143.3	non-porous	daily	0.00000000
15	Star stepper side handles	6225.1	1076.9	porous	daily	0.00000000
16	Star stepper control panel	2472.9	1473.8	porous	daily	0.00000000
17	Pro-Fit hand board	21786.2	10592.3	non-porous	daily	0.00000000
18	WFF resistance board	8695	8341.4	non-porous	daily	0.00000000
19	Resistance board used by therapists	2472.9	2371.9	non-porous	more than once per week	0.00000000
20	Handheld floor treated by pulley handles	2236.9	396.4	non-porous	more than once per week	0.00000000
21	Pulley handles back of desk	3062.1	961	non-porous	daily	0.00000000
22	Desk handle in back of desk	2405.3	1066.9	non-porous	more than once per week	0.00000000
23	Handheld straps	2269	209	non-porous	daily	0.00000000
24	TRX™ resistance chord handles	4775.3	4643.9	porous	daily	0.00000000
25	TRX™ resistance chord	3796.3	3671.6	porous	daily	0.00000000
26	FRANK™ resistance board	10171.5	5247.4	non-porous	daily	0.00000000
27	Balance bar	11346.3	0	non-porous	daily	0.00000000
28	Blackboard™ bar handle	8919.4	696.4	porous	daily	0.00000000
29	Blue ball	15997.2	0	porous	daily	0.00000000
30	Purple resistance cord on floor	18919.1	10927.1	porous	daily	0.00000000
31	Green resistance cord	10327.8	2924.9	porous	daily	0.00000000
32	Trampoline handles	11016.5	2349.3	porous	daily	0.00000000
33	1 lb. dumbbell	30726.9	3776.9	non-porous	daily	0.00000000
34	5 lb. dumbbell	20116.4	20116.4	non-porous	daily	0.00000000
35	10 lb. dumbbell	10897.7	2095.7	non-porous	daily	0.00000000
36	edges of 40-ohm treatment plinth	3600.4	2633.3	porous	daily	0.00000000
37	1140-ohm treatment plinth	4124.9	4124.9	porous	daily	0.00000000
38	Handle for step stool	13494	9412.4	porous	unreported	0.00000000
39	Handbar	8714.9	5329	porous	daily	0.00000000
40	edges of 40-ohm treatment plinth	24022.1	5233.2	porous	daily	8.127792E-09
41	edges of 20-ohm treatment plinth	12010.1	12010.1	porous	daily	0.00000000
42	edges of 20-ohm treatment plinth	6376.9	4447.9	porous	daily	5.129201E-10
43	edges of 10-ohm treatment plinth	10097.2	1204	porous	daily	0.00000000
44	edges of 10-ohm treatment plinth	3712.5	2814.2	porous	daily	0.00000000
45	Unlabeled gear bag	1385.9	1086	non-porous	daily	0.00000000
46	Resistance board	2728.9	2029	non-porous	daily	0.00000000
47	Massage gun handpiece/massage head	7126.9	3087.4	porous	daily	0.00000000
48	Massage gun control panel and adjustment handle	2412.9	2027.9	porous	more than once per week	0.00000000
49	Massage gun control panel and adjustment handle	2062.7	2062.7	porous	more than once per week	0.00000000

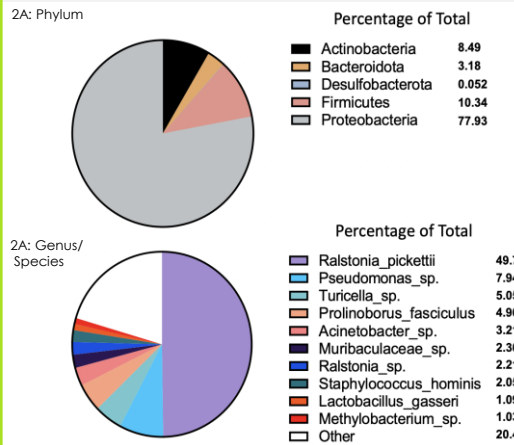
Description of the 49 sites sampled in the map above along with the fluorescence reading based on patient and staff contact, porosity category, frequency of cleaning and total bacterial load (in ng)

Figure 2: Examples of GloGerm on Clinic Surfaces



This image shows residual GloGerm after measuring patient contact on two sites (ballet bar and bike handlebar) using a UV (black) light. Clinic staff identified these two sites as potentially "high touch" surfaces.

Figure 3: Breakdown of Major Phyla and Genus/Species



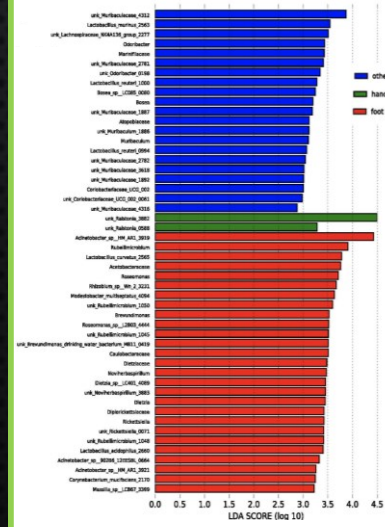
Breakdown of the major Phylum and Genus/Species based on percentage. Data calculated from sequencing analysis. Other category included all genus and species < 1% of total.

Table 2: Correlations Between Contamination and Clinic Factors

Clinic Factors	R value	95% confidence interval	P value	Significance
Degree of contact by patients	0.3549	0.08191 - 0.5784	0.0123	*
Degree of contact by staff	0.00664	-0.2751 - 0.2873	0.9639	
Surface porosity	0.1677	-0.1275 - 0.4356	0.249	
Frequency of cleaning	-0.00866	-0.3000 - 0.2841		

Degree of surface contact correlations determined by Pearson correlation. Surface porosity and frequency of cleaning correlations determined by Spearman correlation.

Figure 4: Associations Based on How Surfaces were Contacted using LEFSE



Linear Discriminant Effect Size (LEFSE) was used to draw associations between how surfaces were contacted and microbial taxa. Both Ralstonia g and R. pickettii were strongly associated with hand contact. The linear discriminant analysis (LDA) score reflects the degree to which differences between each category (hand, foot and other) is explained by the presence of specific taxa.

RESULTS

- The three most contacted surfaces by patients were the handles of the NuStep, a resistance cord and the edges of a treatment plinth (Table 1).
- The three most contacted surfaces by staff were the balance board, gym ball and foot board (Table 1).
- The three most contaminated surfaces by bacteria were the resistance cord handles, edges of a treatment plinth and an exercise bench (Table 1)
- Patient contact significantly correlated with total bacterial contamination (Table 2).
- >50% of the total bacteria on surfaces was the genus Ralstonia and 49% was Ralstonia. pickettii, found at high levels on 14 surfaces (Figure 3)
- Abundance of Ralstonia correlated with hand contact (Figure 4, green indicates hand contact)
- No SARS Co-V 2 detected (data not shown)

Discussion and Conclusion

- Data suggests that alcohol-based hand sanitizers and nonbleach-based cleaners may be effective in eliminating SARS CoV 2, but may lead to an increase in highly resistant microbes such as R. pickettii
- Cleaning and sanitization efforts in PT clinics should focus on patient and hand contact
- Bleach-based cleaners may represent a better day-to-day cleaning agent as these are effective against both SARS CoV 2 and nearly all bacteria.
- Results suggest patient contact may play a bigger role in clinic contamination than staff contact.
- Results may help outpatient clinics develop more effective cleaning strategies to limit HAIs

Limitations:

- Bacteria was not cultured.
- Only 1 clinic was used for data collection.
- Possible changes in cleaning practices due to pandemic.
- Inability to control timing & duration of cleaning by clinic staff.

Acknowledgements
Funded in part by IPTA IL Foundation for PT Grants. 2018 and 2020 (CCE) and a MWU CHS Research Facilitation Grant 2020 (CCE). The authors thank the participating sports medicine PT clinic.