

Infection Control Insights for Hospital Animal-Assisted Intervention Program Implementation

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Outline for Seminar

Background

Research Goals and Hypothesis

Project 1

Project 2

Project 3

Conclusions

The Beginning of our Story



Animal-Assisted Intervention Programs



Therapy dog comforts hospital staff during coronavirus pandemic



CNN News
March 26, 2020

Knowledge Gaps



- Infection control in hospitals challenging
- Therapy animals can possibly serve as mechanical vectors of hospital associated pathogens
 - methicillin-resistant *Staphylococcus aureus* (MRSA)

New York Times Magazine May 19, 2013

Why did they approach our lab?



Dissertation Goals

- Research Objectives
 - Understand balance of negatives (microbial transmission) and positives (human-animal bond) in hospital AAI
- Hypothesis
 - Use of the One Health framework can identify potential targets for improved program implementation
- Goals
 - Protect and promote AAI program usage

Dissertation Parts

Project 1

- Apply One Health to hospital infection control
- Identify knowledge gaps
- Provide rationale for our research

Project 2

- Aim 1 – Stakeholder perspectives on benefits & concerns
- Aim 2 – Implementation recommendations

Project 3

- Aim 3 – Sharing of all microbiota + pathogens
- Aim 4 – Unintended consequences of controls

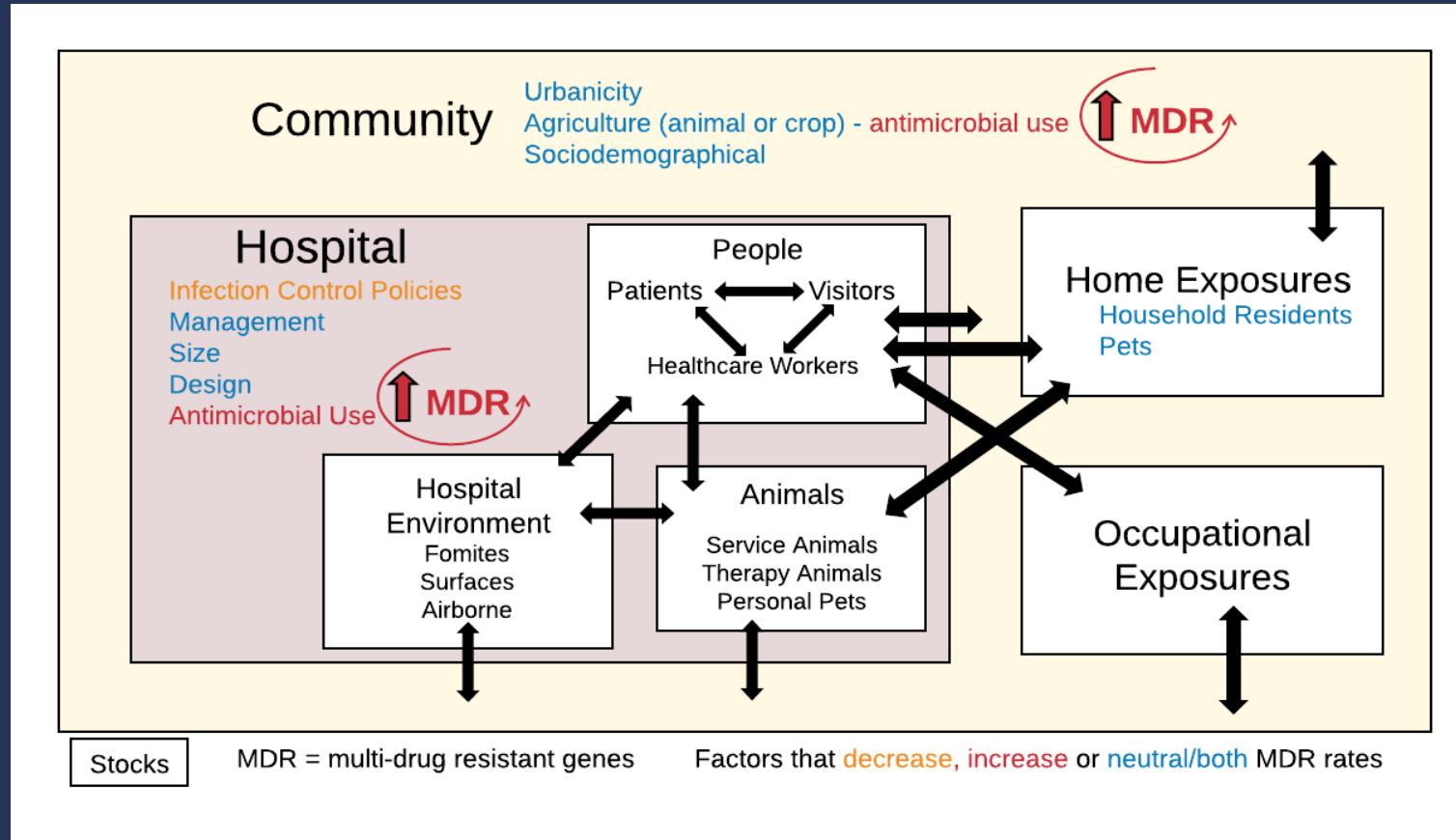
Project 1

What is known from the research?

Literature Review

One Health in Hospitals

- One Health framework identified key gaps in hospital infection control
- Can help direct future research and implementation efforts by non-traditional conduits



Literature Review

Hazards in AAI

29 total articles:

- 13 commentaries, reviews, or guidelines
- 16 original research (epidemiological studies or case reports)

Gaps:

- No evidence backing control measures
- No information on microbial carriage or transmission to patients, other individuals, or environment
- Lack clear communication

Literature Review

Main Takeaways



Need for standardized guidelines backed by comprehensive epidemiological studies



Guidelines should be designed using a One Health approach

Project 2

What are the perceived risks in the field?

Qualitative Project

Background

- Stakeholder perspectives on hospital policies, including infection control, critical to uptake and adherence
- Design protocols that are effective and feasible
- Understand new uses for AAI programs:
Healthcare Workers
 - Stress & burnout major occupational issue
 - Many hospitals using AAI to target this



Qualitative Project

Project Goals

Collect perspectives from key stakeholders to characterize:

- 1) Opinions of AAI as a stress reduction intervention in healthcare workers, plus barriers and facilitators to their use
- 2) Concerns of infectious risk, and attitudes on infection control practices

Qualitative Project

Methods

- Study Population:
 - Healthcare workers (HCW)
 - AAI Workers
 - Snowball sampling
- Data Collection:
 - Interviews conducted via Zoom
- Data Analysis:
 - Thematic coding using Programmatic Framework Analysis



Qualitative Project

Results – Study Population

Study Population	Total
Healthcare Workers	19 (51%)
Physicians	4
Nurses	6
Child Life Specialists	3
Rehabilitation Therapists (PT/OT)	2
Clinical Social Workers and Psychologists	4
AAI Workers	18 (49%)
Volunteer Handlers	13
AAI Program Directors	5
Total	37

Qualitative Project

Results – Major Themes

Topic Area 1: Program Use for Healthcare Workers

- Benefits
- Barriers
- Facilitators

Topic Area 2: Perceived Infectious Disease Risks

- Concerns
- Controls
- Responsibility

Qualitative Project

Results – Major Themes

Topic Area 1: Program Use for Healthcare Workers

- Benefits
- Barriers
- Facilitators

Gateway to Other Therapy

HCW: "I have never gone to [a *counseling session*] because it's something that I tend to deal with more internally. But if they're like, come play with some big, fluffy golden retrievers for an hour, I'd be like great, I'm there. And I might be more willing to open up about stuff if I'm already in the room."

Qualitative Project

Results – Major Themes

Topic Area 1: Program Use for Healthcare Workers

- Benefits
- Barriers
- **Facilitators**

Importance of Leadership & Collaboration

AAI Worker: “[We] got our leadership team behind it ... and just making sure that all the appropriate parties are involved and making sure they feel like they have some input into the program and what it would look like.”

Qualitative Project

Results – Major Themes

Source of Infectious Disease Concerns

HCW: "I'm concerned about multiple people are touching the same animal. Whatever the person before me passed on, is it staying on the dog. Is it just like another surface that I can just pick it up."

Topic Area 2: Perceived Infectious Disease Risks

- **Concerns**
- Controls
- Responsibility

Qualitative Project

Results – Major Themes

Rationale for Control Measures

AAI Worker: "I think the [volunteer handlers] who do it are totally into it. They're proud of their dogs and they just want to do the right thing. You just want these kids to be happy ... the rules are there for a reason to protect us as well as the patients."

Topic Area 2: Perceived Infectious Disease Risks

- Concerns
- Controls
- Responsibility

Qualitative Project

Results – Major Themes

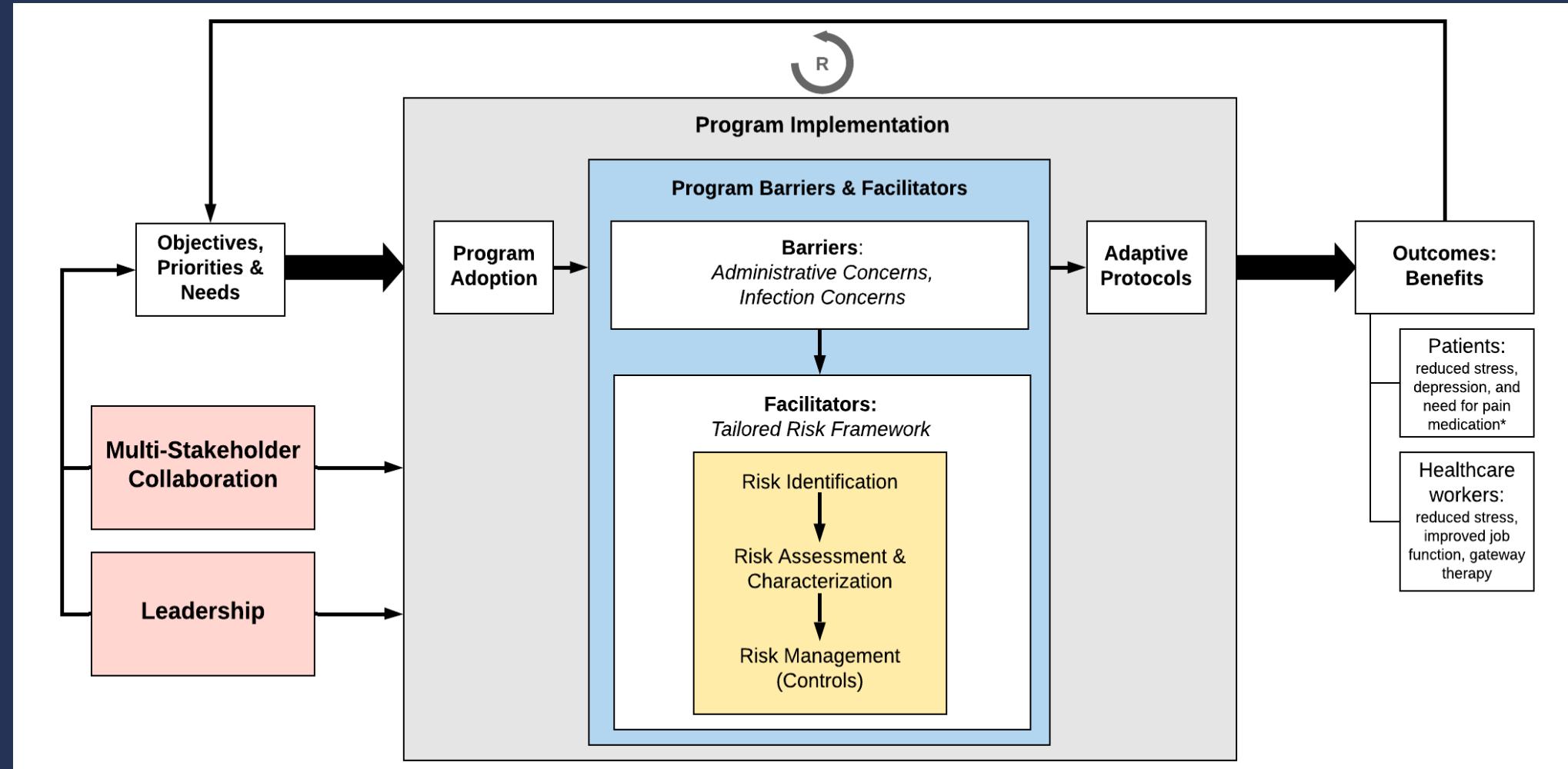
Training and Support

AAI Worker: “Handlers should try to educate themselves about so that they can be advocates for themselves and for their [animal] partners to have a safer experience.”

Topic Area 2: Perceived Infectious Disease Risks

- Concerns
- Controls
- Responsibility

Qualitative Project Results – Implementation Framework



Qualitative Project

Main Takeaways



Healthcare workers can benefit from AAI



Leadership & collaboration to overcome program barriers



Adaptive program implementation based on individual needs assessment

Qualitative Project

Future Directions

Wider Target Populations

- Other professional roles
- Other departments and hospitals

Improved Generalizability

Mixed Methods

- To increase audience



Project 3

Can we quantify the risks in the field?

Microbial Project

Hospital Infection Control

- 5-10% of patients develop an infection in the hospital
- 30-40% of hospital-associated infections spread by employees
- Workers at higher risk of acquiring pathogens and infections
- Animals as fomites ?

Microbial Project

Hygiene Hypothesis

- Broad microbial exposures → increased microbiome diversity
- Train immune system to tolerate a variety of environmental allergens
 - Reduced auto-immune conditions
 - Improved capability to fill vital functions
 - Possible protection against pathogen colonization



Microbial Project

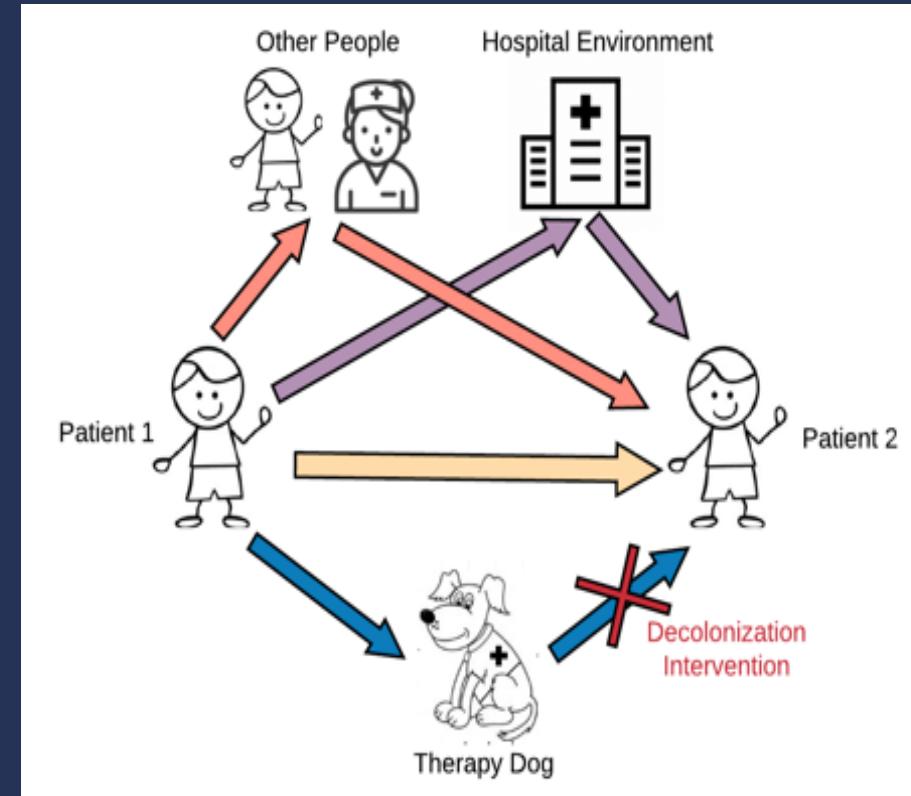
Project Goals

- 1) Quantify the degree of microbial sharing between therapy dogs and patients in a pilot study on hospital AAI programs
- 2) Determine if patient-dog contact level modifies microbial sharing
- 3) Examine the effect of a dog decolonization on microbial diversity and microbial sharing

Microbial Project

Methods

- Sampling
 - Pediatric patients, therapy dogs & hospital
 - Before & after every visit
 - Nares from kids & dogs, plus other dog sites
- Contact level
- Intervention: dog decolonization
- Laboratory
 - Culture *S. aureus* → PCR confirmed + qPCR
 - 16S rRNA sequencing microbiome



Microbial Project

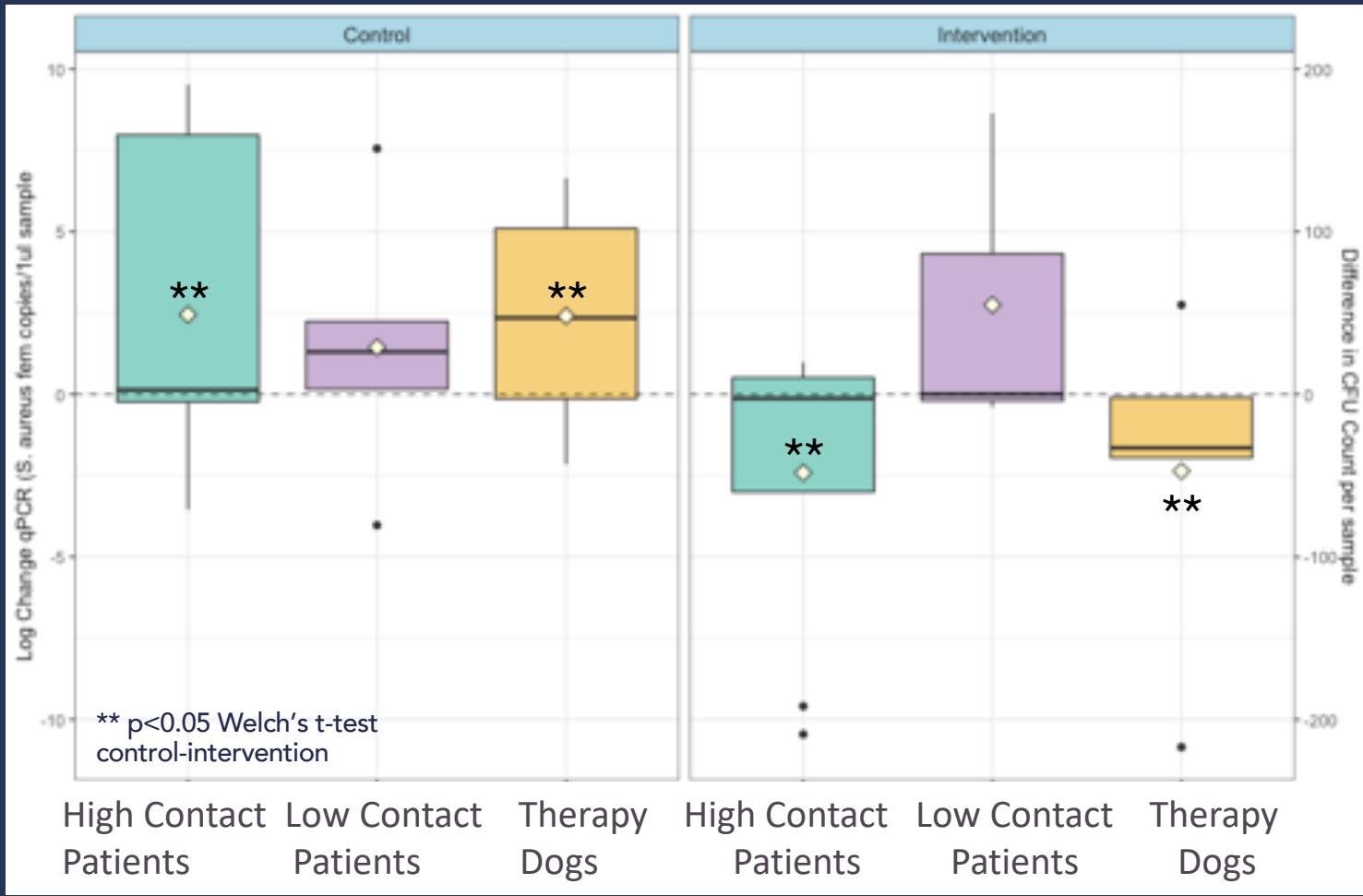
Results – Study Population & Samples

Study Population	All Visits	Control Visits	Intervention Visits
Patients		n (% total)	n (% total)
Total sampled	49 *45	26 (53%) *23	23 (47%) *22
High Contact (%)	25 (51%)	12 (46%)	13 (56%)
Visits			
Total	13	8 (62%)	5 (38%)
Patients per visit, mean (range)	3.77 (2-6)	3.25 (2-5)	4.6 (3-6)
Therapy Dogs	4		
Culture Samples - total	242	138 (57% total)	104 (43% total)
From Patients	90	46 (51%)	44 (48%)
From Dogs	126	76 (60%)	50 (40%)
From Environment	26	16 (62%)	10 (38%)
Microbiome Samples - total	203	119 (58% total)	86 (42% total)
From Patients	79	43 (54%)	36 (45%)
From Dogs	100	60 (60%)	40 (40%)
From Environment	24	16 (62%)	10 (38%)

Microbial Project

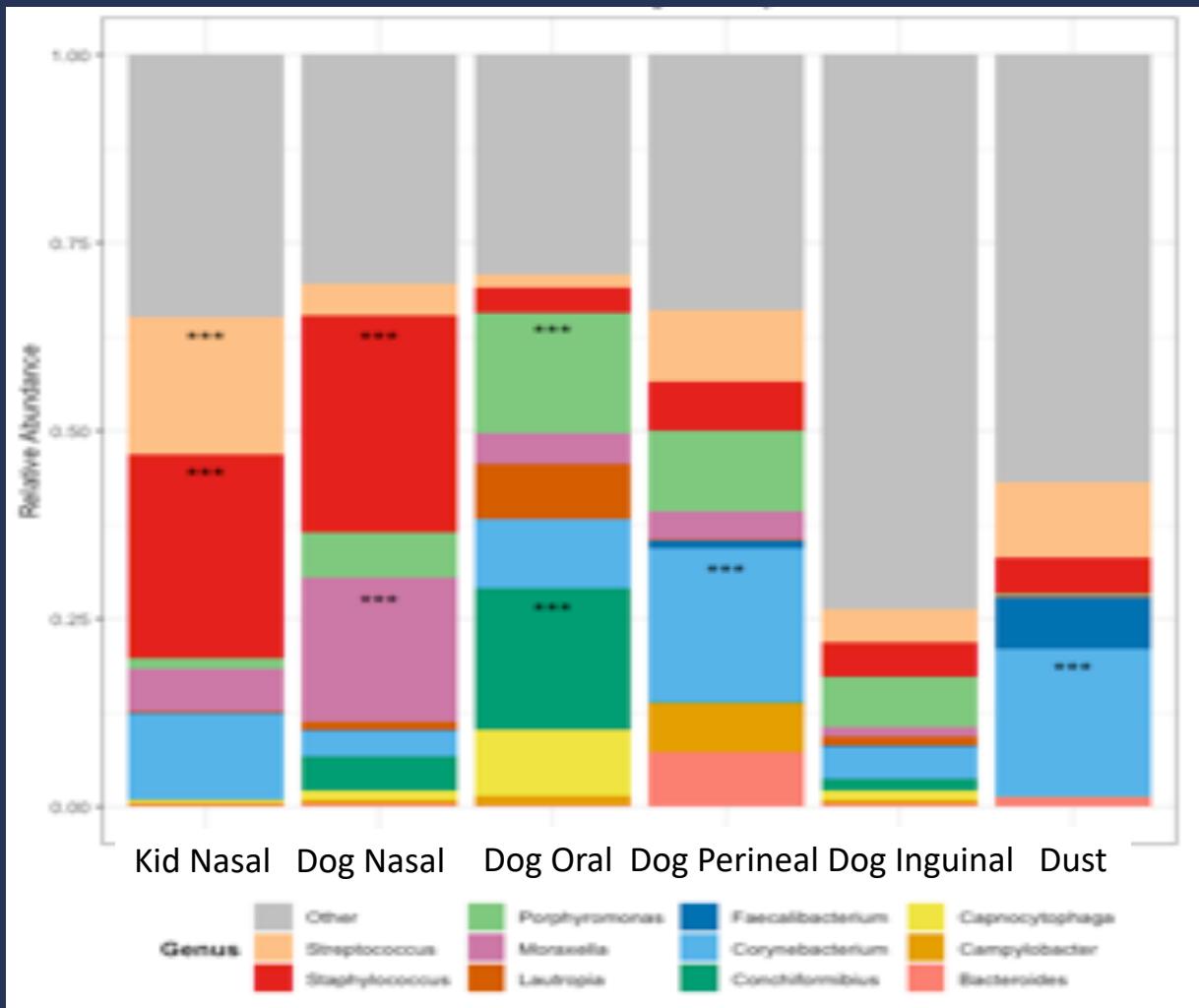
Results – Quantitative Culture-based

- Metrics
 - Kids = qPCR
 - Dogs = CFU count
- Gain in *S. aureus* in high-contact patients and therapy dogs in **control** visits
- Decrease *S. aureus* in **intervention** visits



Microbial Project

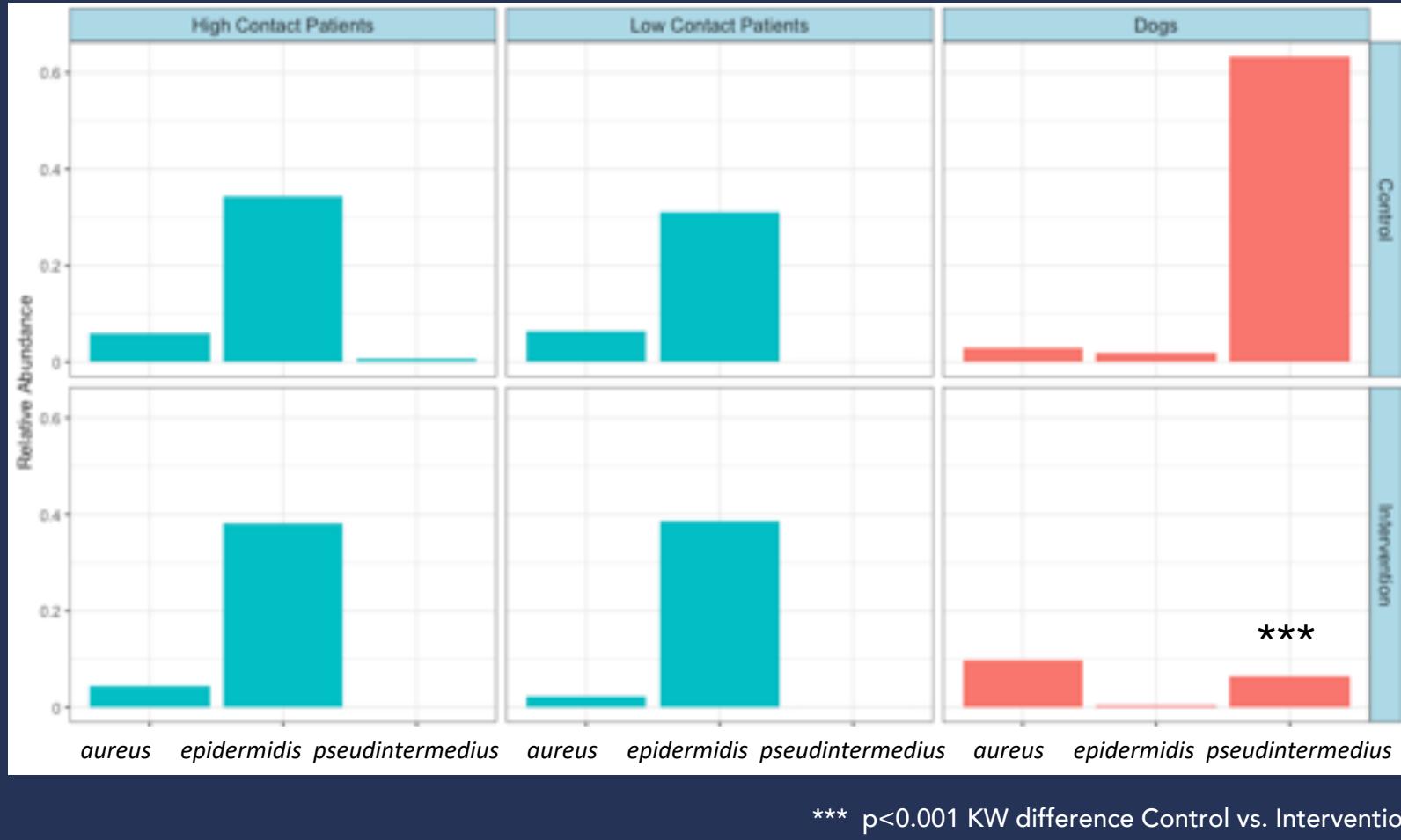
Results – Relative Abundance of Top Taxa



- Differences in microbial composition based on host and site
- Dog nasal samples more similar to kid nasal samples than other dog sites
 - *Staphylococcus* species most dominant

Microbial Project

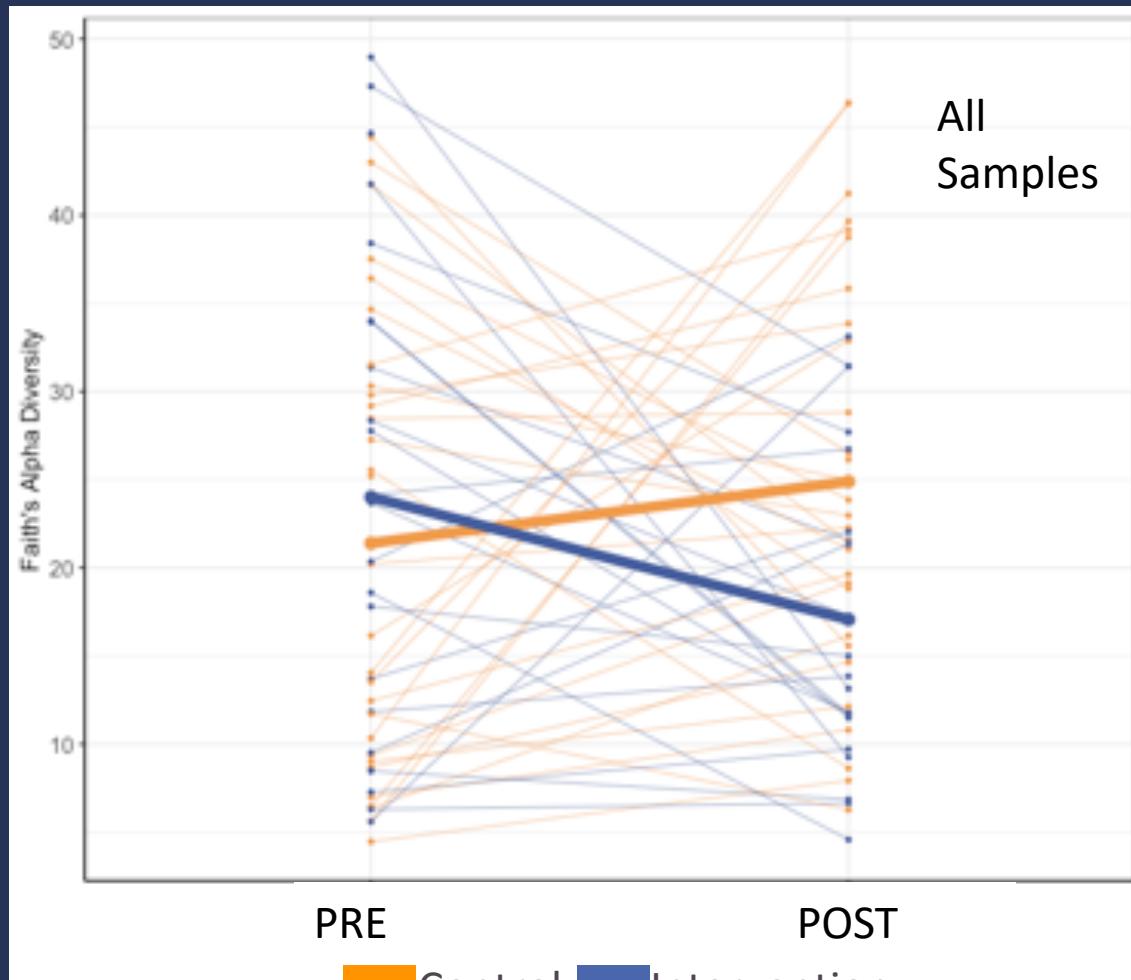
Results – Relative Abundance of Staphylococcal species



- No difference in *S. aureus* and *S. epidermidis* (kids) by contact & visit type
- Significant decrease in *S. pseudintermedius* in dogs in intervention visits

Microbial Project

Results – Alpha Diversity Levels



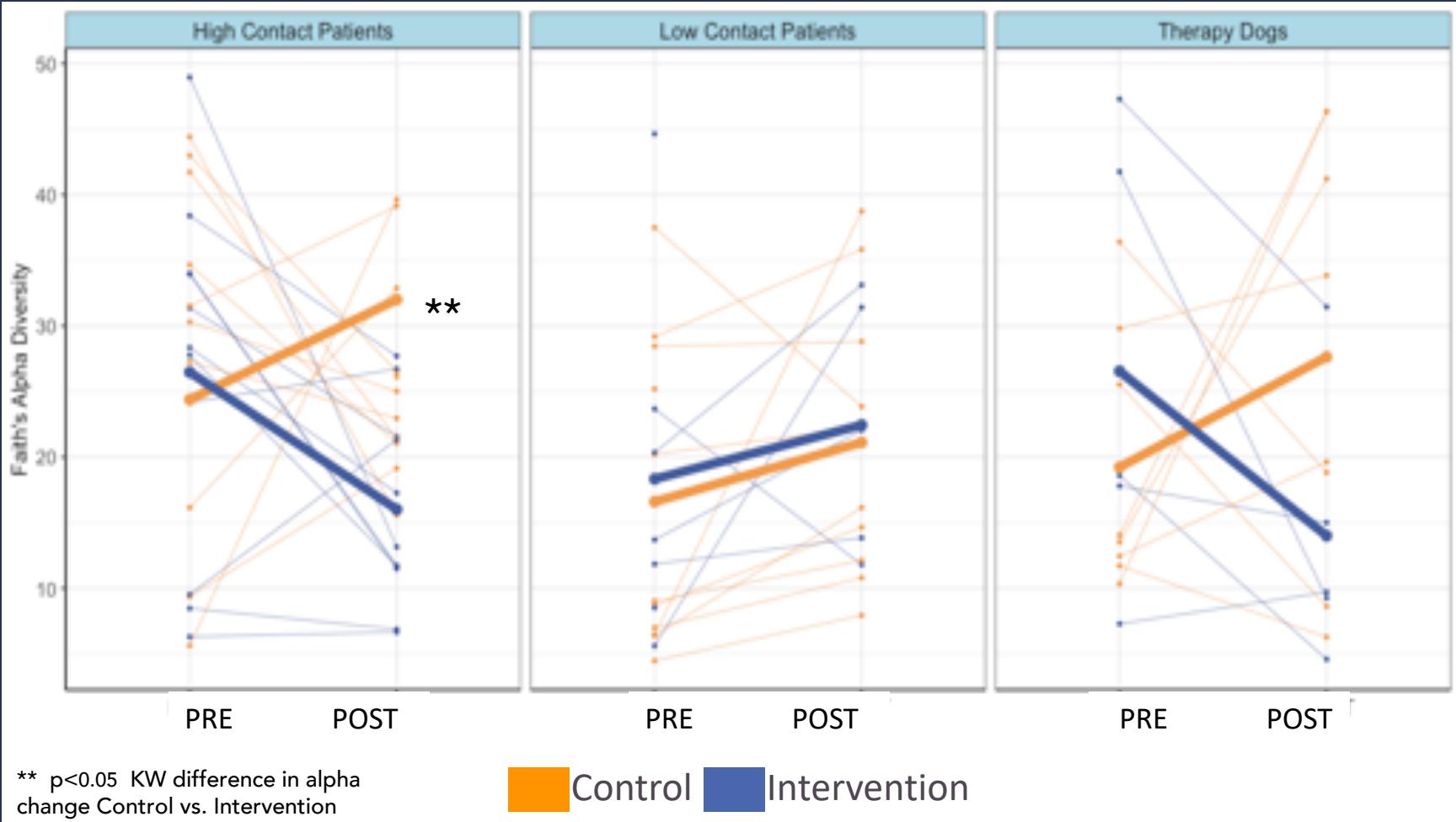
$\alpha =$



- Thin lines = individual samples
- Thick lines = group means

Microbial Project

Results – Alpha Diversity Levels



$$\alpha =$$



Increase in control visits in within-sample diversity in high-contact patients and therapy dogs

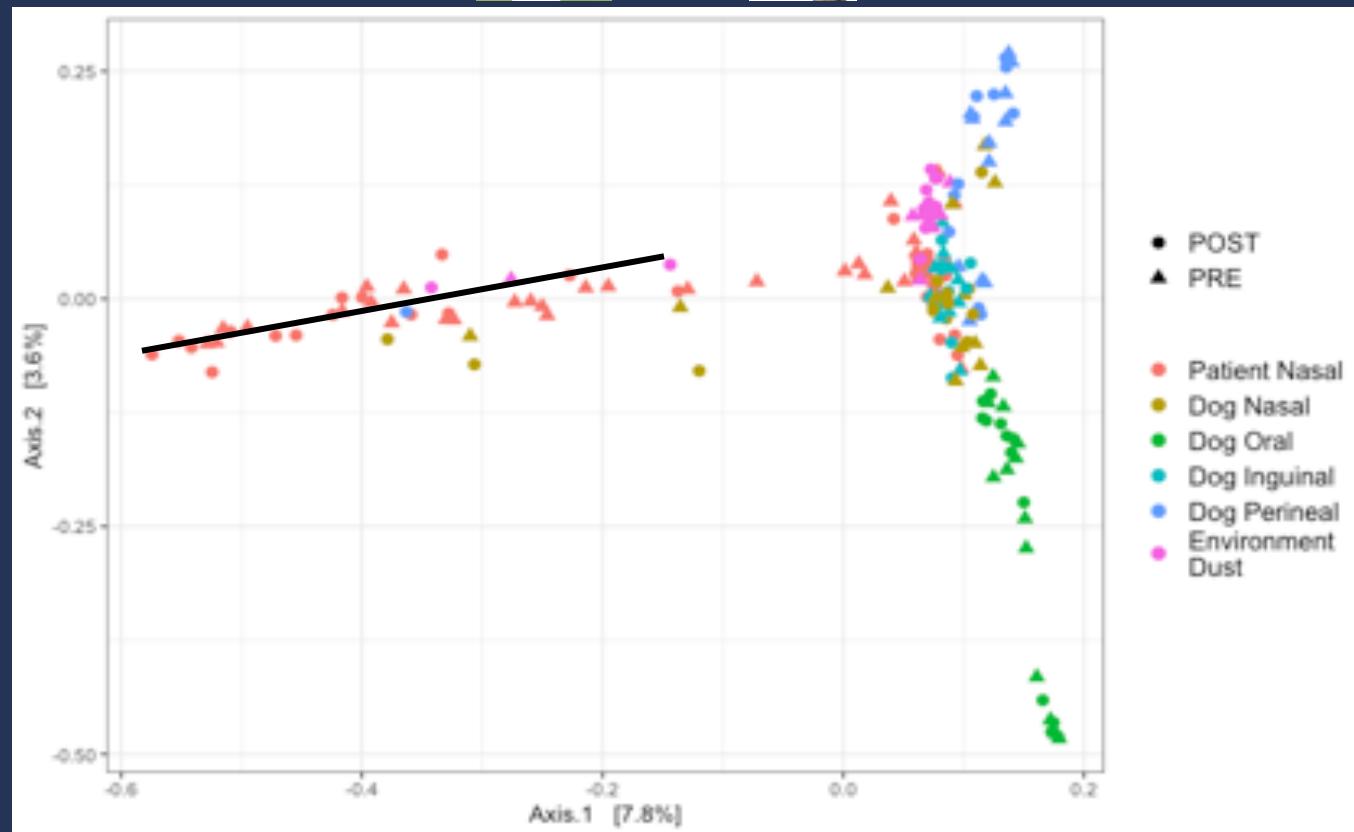
Decrease in intervention visits

Microbial Project

Results – Beta Diversity Levels

- Principle Coordinate Analysis Plot (PCoA)
 - multi-dimensional data into 2D
- Host and site samples closer together = more similar
- Used to get distance metric for microbial similarity

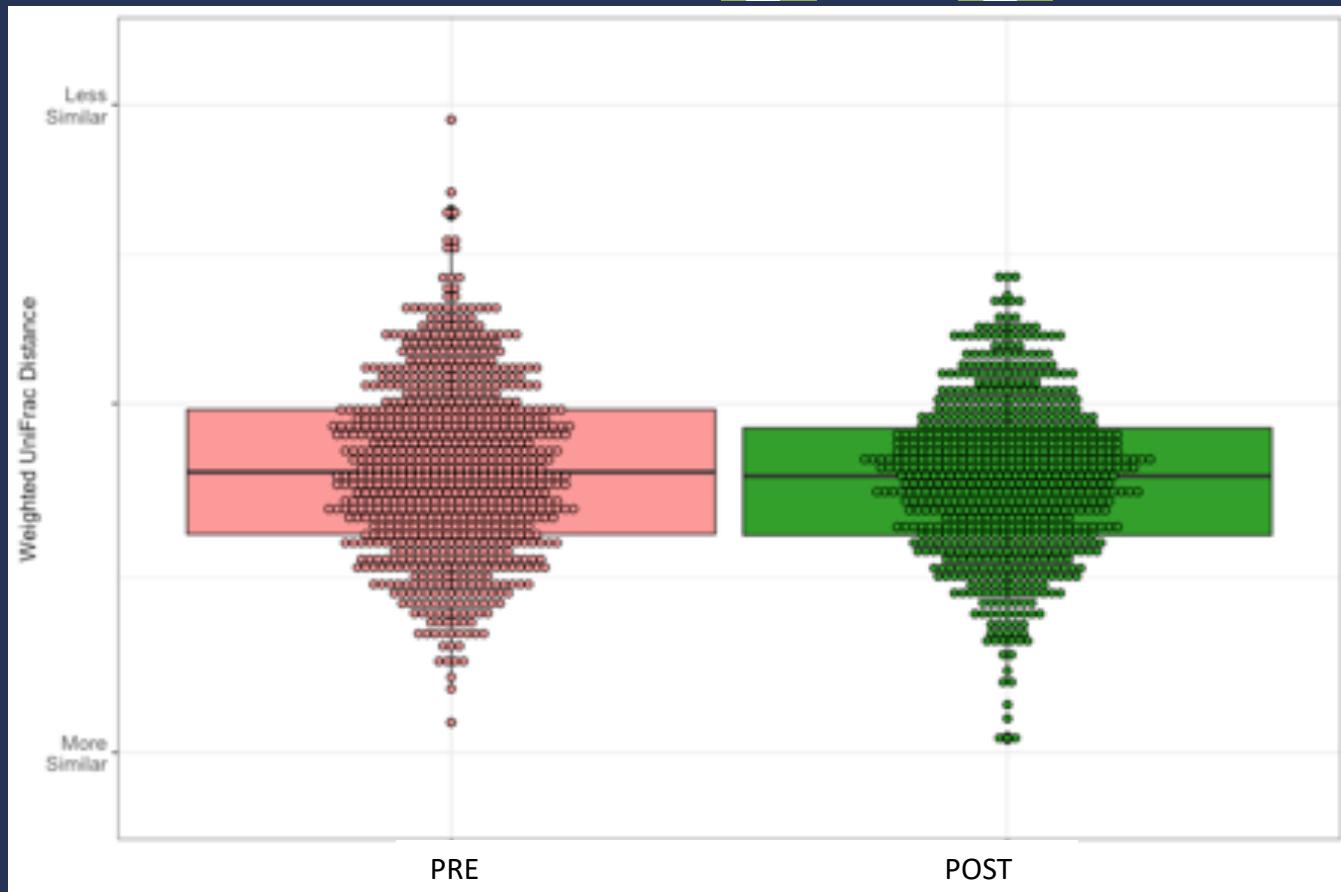
β =



Microbial Project

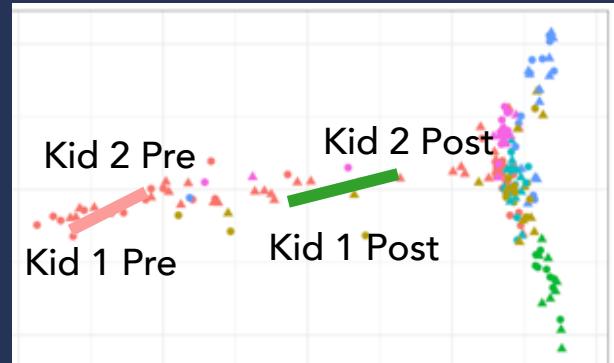
Results – Beta Diversity Distance

Kid – Kid Distance



Each dot is the distance between two patients

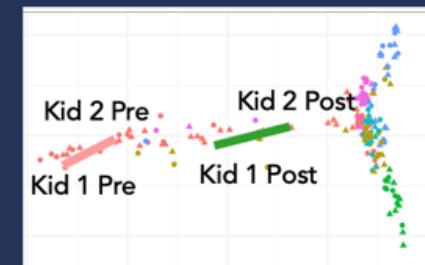
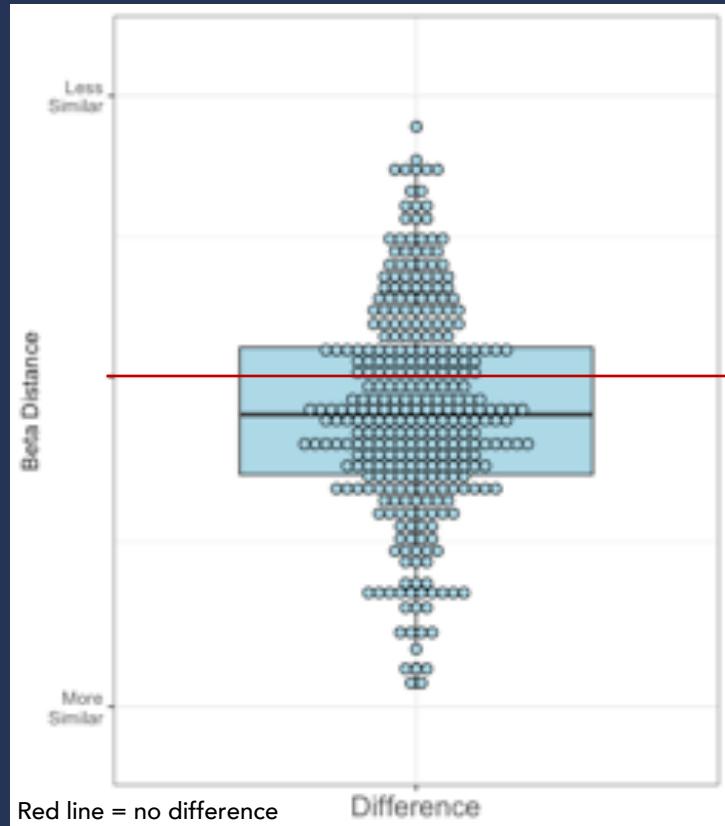
- More similar = lower value



Microbial Project

Results – Beta Diversity Distance

Kid – Kid Difference



Difference =

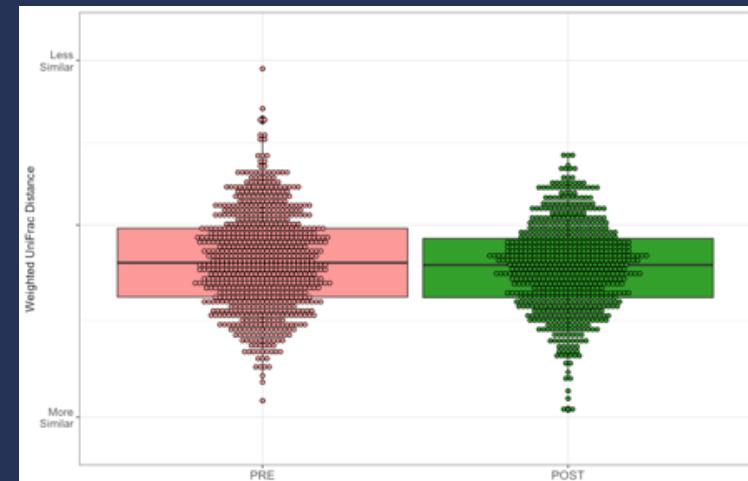
(Distance between Kid 1
and Kid 2 Post)

—

(Distance between Kid 1
and Kid 2 Pre)

Kids are more similar in
microbial compositions to other
kids after AAI visits

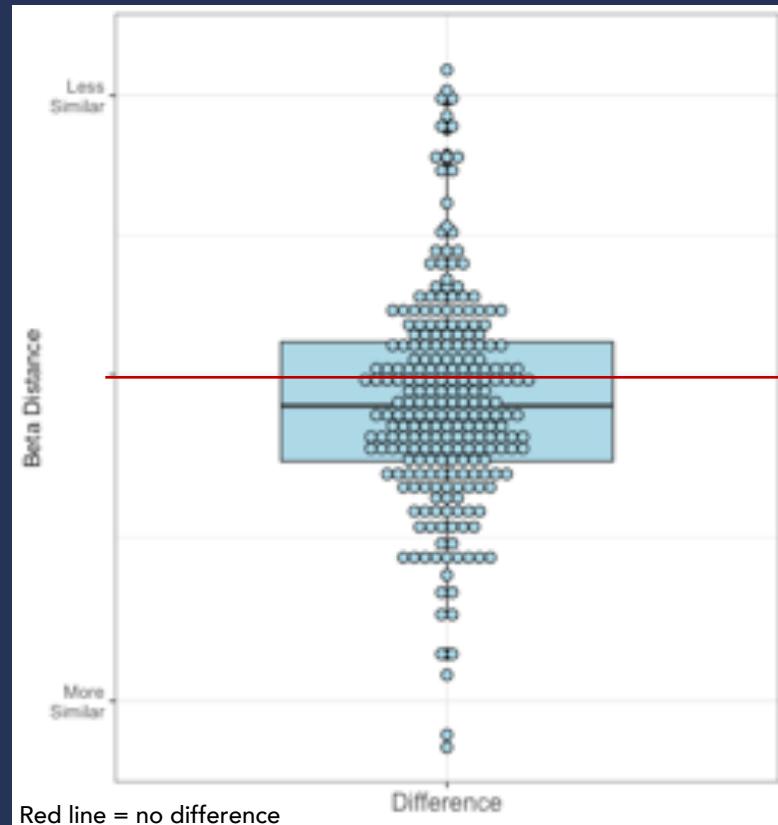
- Due to sharing of
microbes



Microbial Project

Results – Beta Diversity Distance

Kid – Dog Difference


 β


Difference =

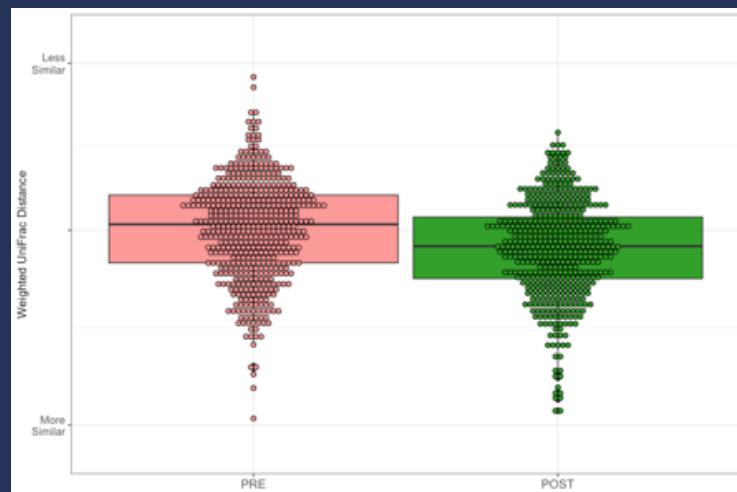
(Distance between Kid 1
and Dog 1 Post)

—

(Distance between Kid 1
and Dog 1 Pre)

Kids are more similar in
microbial compositions to
therapy dogs after AAI visits

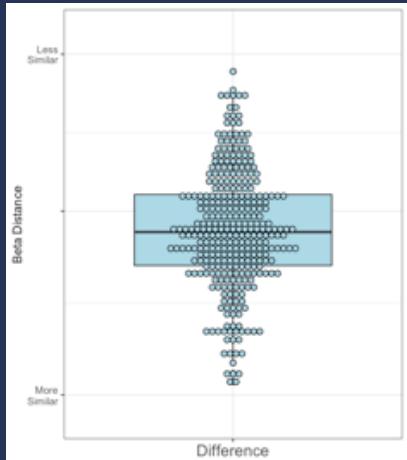
- Microbial Sharing



Microbial Project

Results – Beta Diversity Distance

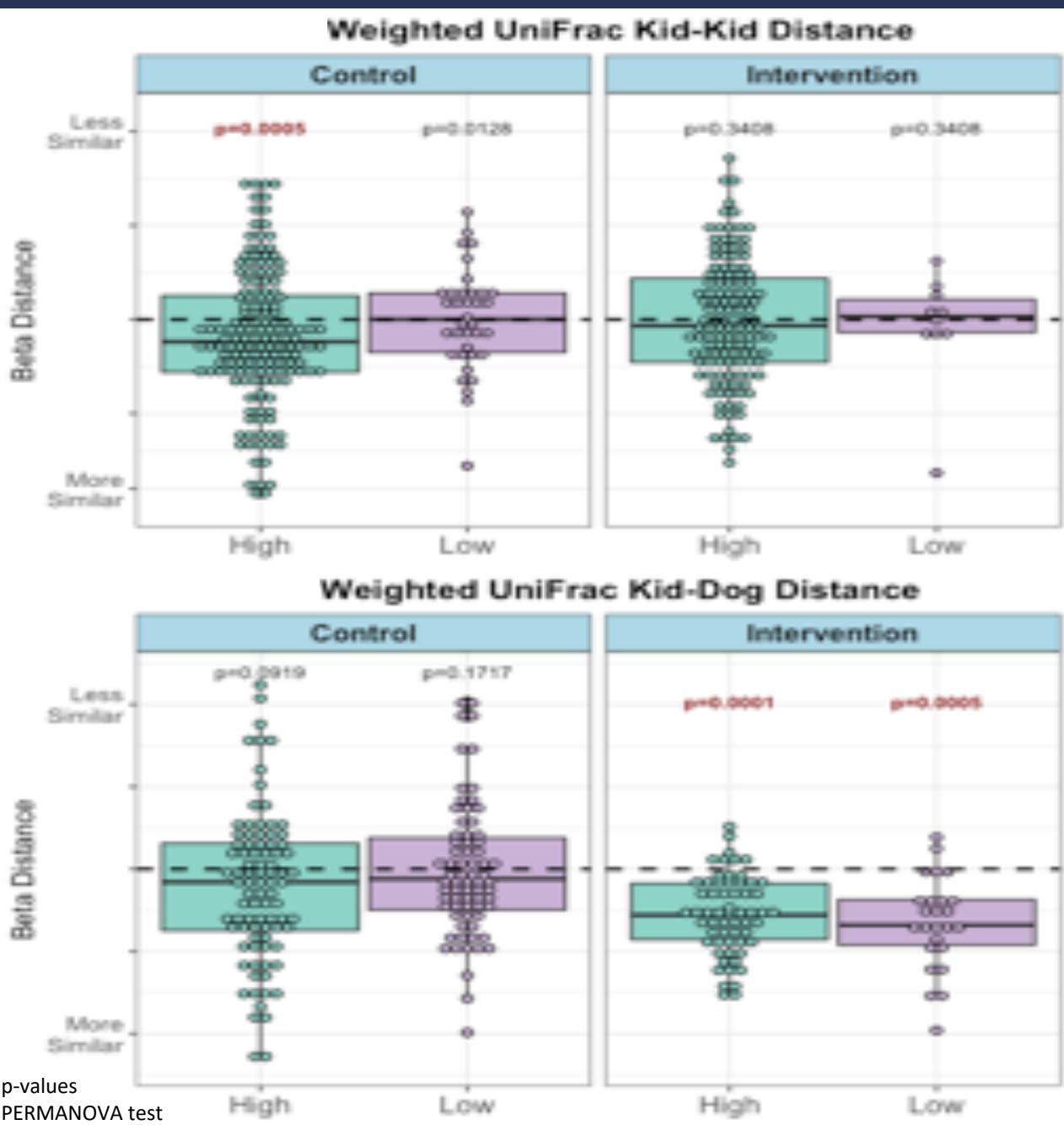
Separate differences by Contact level and Visit Type



β



β



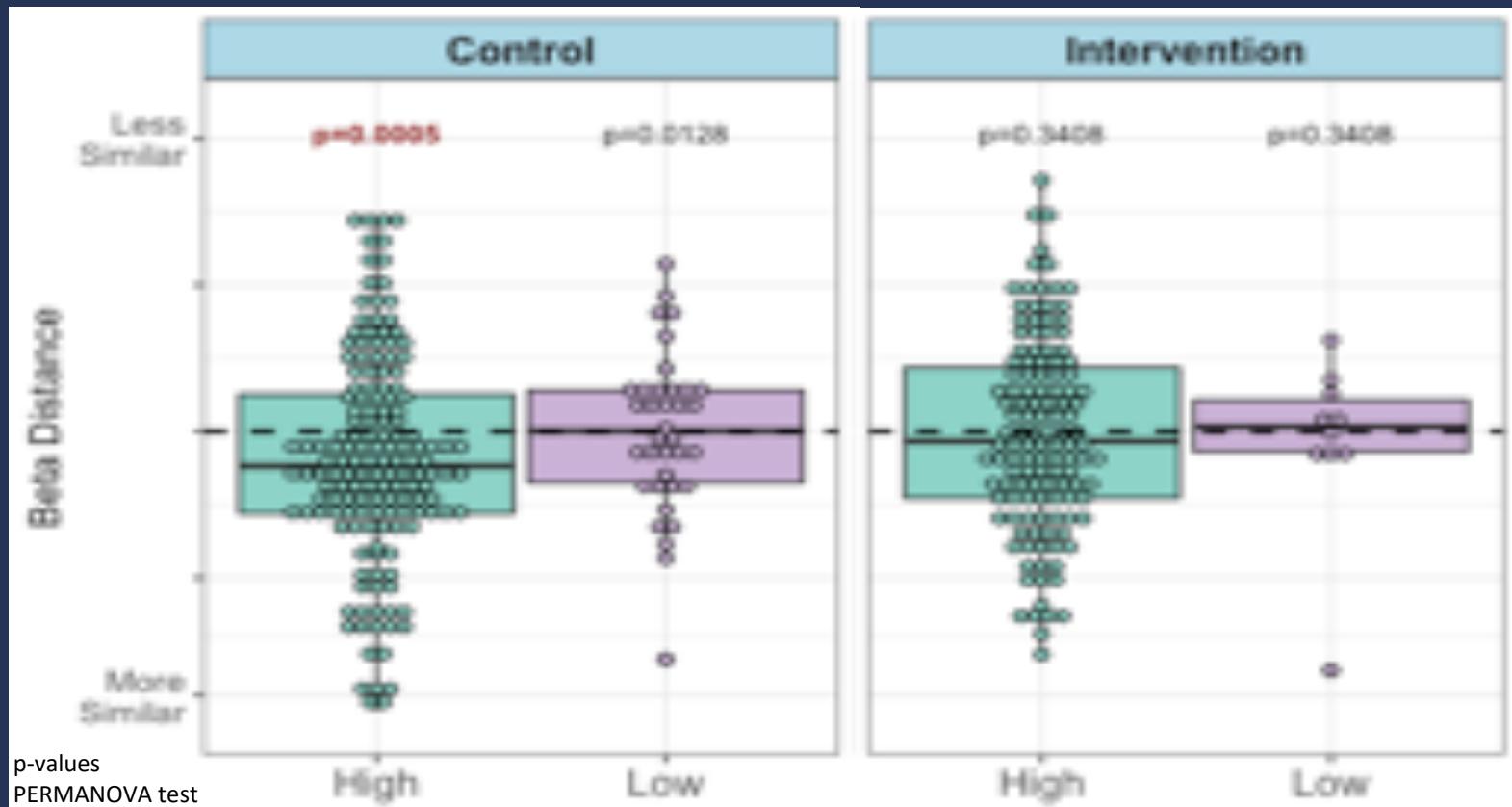
Microbial Project

Kids – Kids



Results – Beta Diversity Distance

- High contact = more similar other kids
 - not low contact
- Intervention = blocks sharing
- **Dog as intermediary vector**



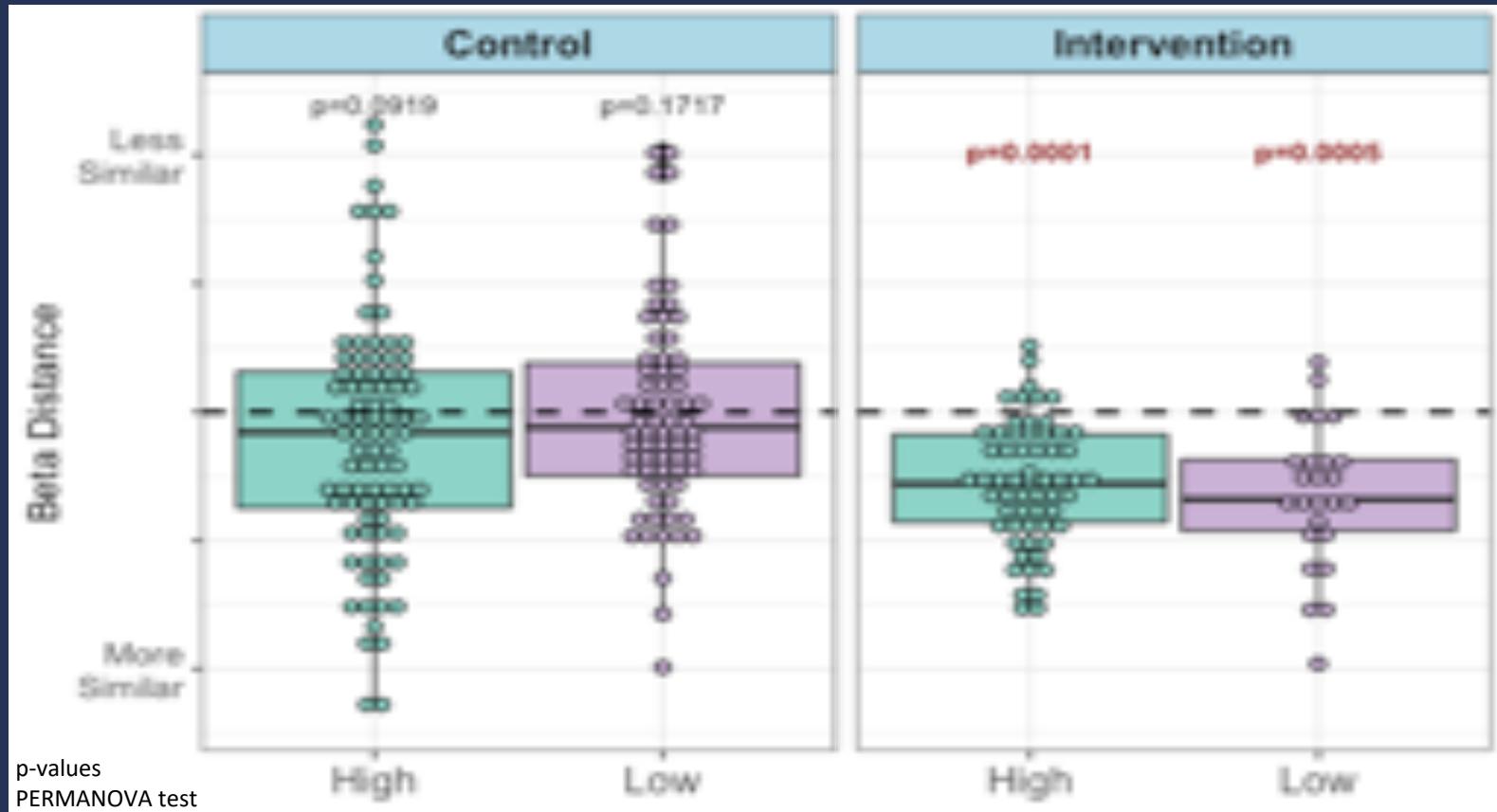
Microbial Project

Kids – Dogs


 β

- Minimal sharing dog bacteria
- Intervention removes dog bacteria
- **Other pathways important in microbial sharing**

Results – Beta Diversity Distance



Microbial Project



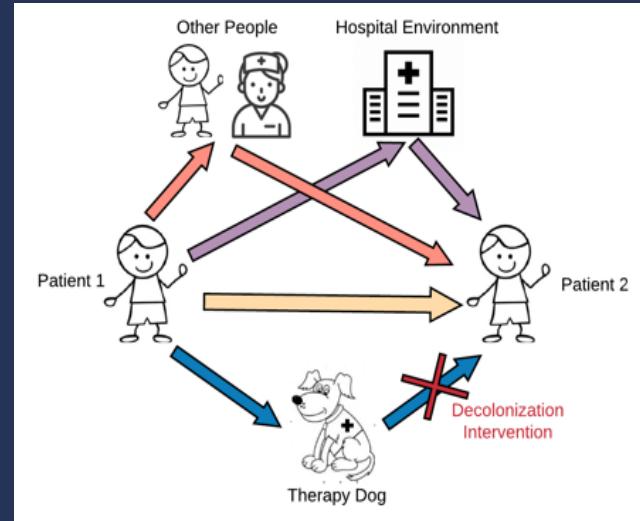
Microbial sharing occurs between patients and therapy dogs during AAI



Increased contact
↓
increased sharing



Dog decolonization blocked role as intermediary vector



Other pathways of microbial transmission important to consider

Microbial Project

Future Directions

- Temporal stability → clinical significance
- Sample other pathways
- Broaden other situations
 - Hospitals
 - Patient populations / wards
 - Group vs. one-on-one sessions



Overall Findings from Research

Summary of Findings

Qualitative Project

- AAI could be extended to HCW to address occupational stress
- Barriers addressed through collaboration and leadership to develop functional programs

Microbial Project

- Microbial sharing between patients and therapy dogs, with the dogs as intermediary vectors
- Sharing was modified by contact level and dog decolonization intervention

Summary of Findings

Lack of information leads to program hesitancy

Collaboration & leadership to understand and address barriers

Contribute to holistic design of control strategies and protocols

Improve safety and minimize unintended consequences

Implications for Public Health and Policy

1. Contribute potential novel health benefits of AAI
2. Address concerns from clinicians
3. Inform development of targeted interventions to improve safety

One Health framework to understand positive and negatives of AAI applied to future research studies and policies

Next Steps

Both projects will be extended to create more robust results:

- Qualitative – best practices in program implementation across a wide array of hospitals
- Quantitative – multi-center RCT to test the safety and effectiveness of our intervention for hospital pathogens and microbiome



Used to create evidence-based universal guidelines for AAI implementation

Conclusion

- Tangible and robust example of the power of the human-animal bond
- Ultimate goal is the justification, protection, and promotion of these indispensable programs

The Story continues