

CHANGING MICROBIOTA BY 2040: SOLUTIONS FOR THE FUTURE

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AUSTRALIAN RESEARCH COUNCIL
**Centre of Excellence for Australian
Biodiversity and Heritage**

HUMAN EVOLUTION MAY BE TIGHTLY LINKED TO OUR MICROBIAL EVOLUTION

Microbiota:

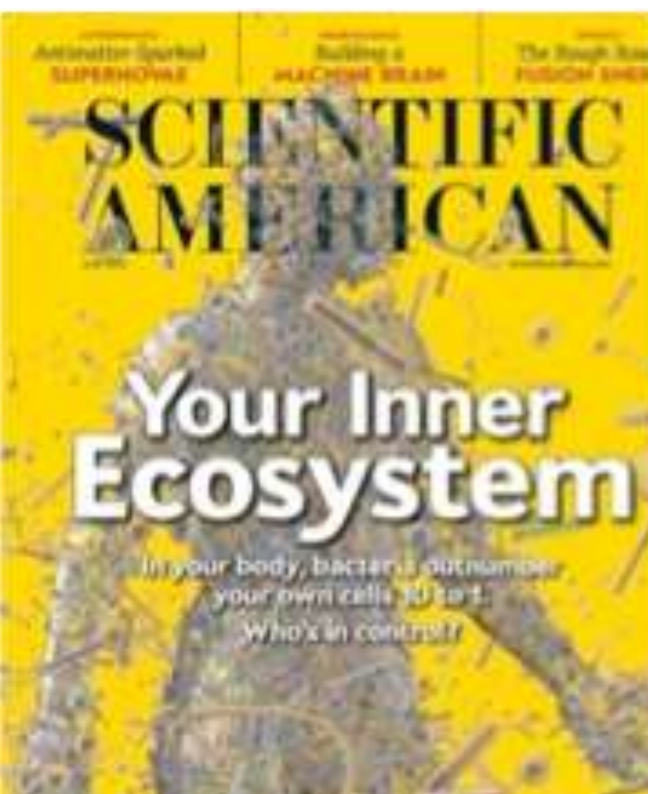
the microorganisms (bacteria, fungi, viruses) that live in your body

100 trillion bacterial cells

>50% of total cells

>1,000 species

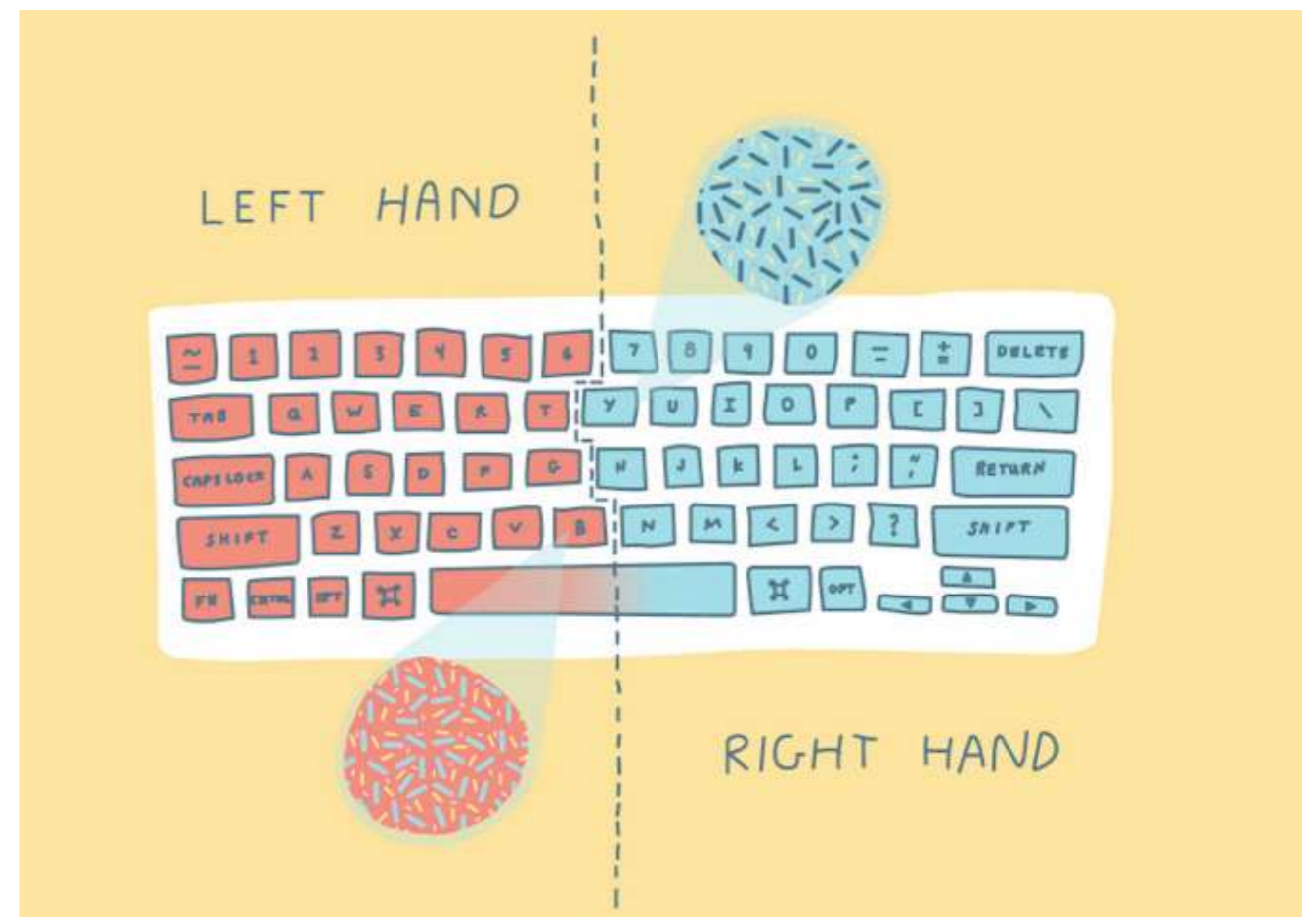
1.4 kg of body weight



MICROBIOTA ARE ACQUIRED AT BIRTH AND ARE INCREDIBLY INDIVIDUALISTIC



Dominguez-Bello, MG, et al., PNAS, 2013



Fierer, Noah, et al. *PNAS*. 107 (14): 6477–81.



MICROBIOTA FUNCTIONS ARE MORE CRITICAL THAN THE SPECIES THEMSELVES

Microbiome:

the genetic and environmental content of the microbiota present in the body

Outnumbers human cells **100 to 1!**

2-5 million genes per individual

99% of your genetic makeup!



MICROBIOTA PLAY KEY PHYSIOLOGICAL FUNCTIONS WITHIN THE HUMAN BODY

Food Digestion

Immune System
Development

Vitamin Production

Infectious Disease
Protection

Drug Metabolism

Detoxify



ALTERATIONS TO THE MICROBIOTA ARE TIGHTLY LINKED TO WESTERN DISEASES

Metabolic Diseases

Obesity

Malnutrition (kwashiorkor)

Type II Diabetes



Turnbaugh, et al. *Nature*. 2006.

Discovery Magazine



Smith et al, *Science*, 2013

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Metabolic Diseases

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Oral Diseases

Periodontal disease



ALTERATIONS TO THE MICROBIOTA ARE TIGHTLY LINKED TO WESTERN DISEASES

Metabolic Diseases

Obesity

Malnutrition (kwashiorkor)

Type II Diabetes

Oral Diseases

Periodontal disease

Mental Health

Depression

Anxiety

Addiction

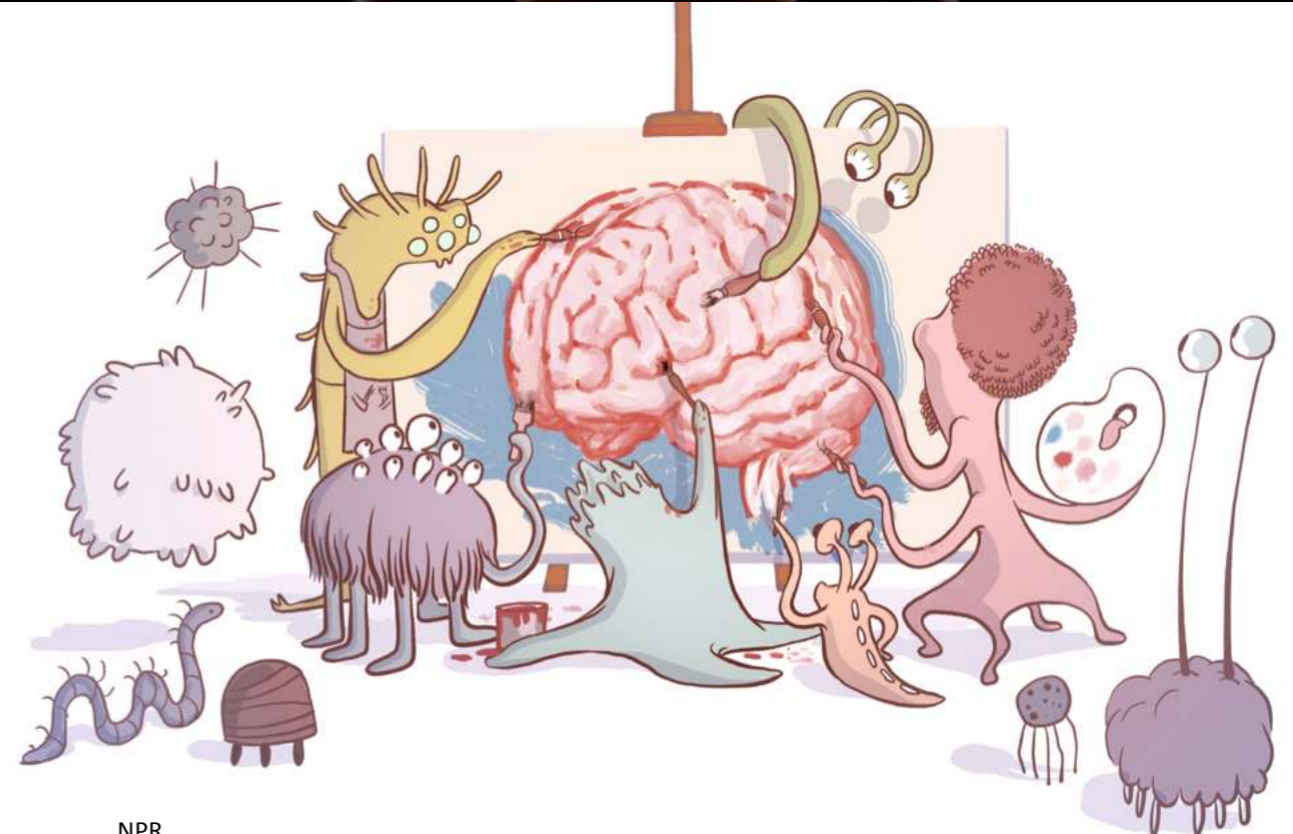
Schizophrenia

And more...

Arthritis

Cancer

Inflammatory Bowel Disease



NUMEROUS FACTORS IMPACTS THE MICROBIOME

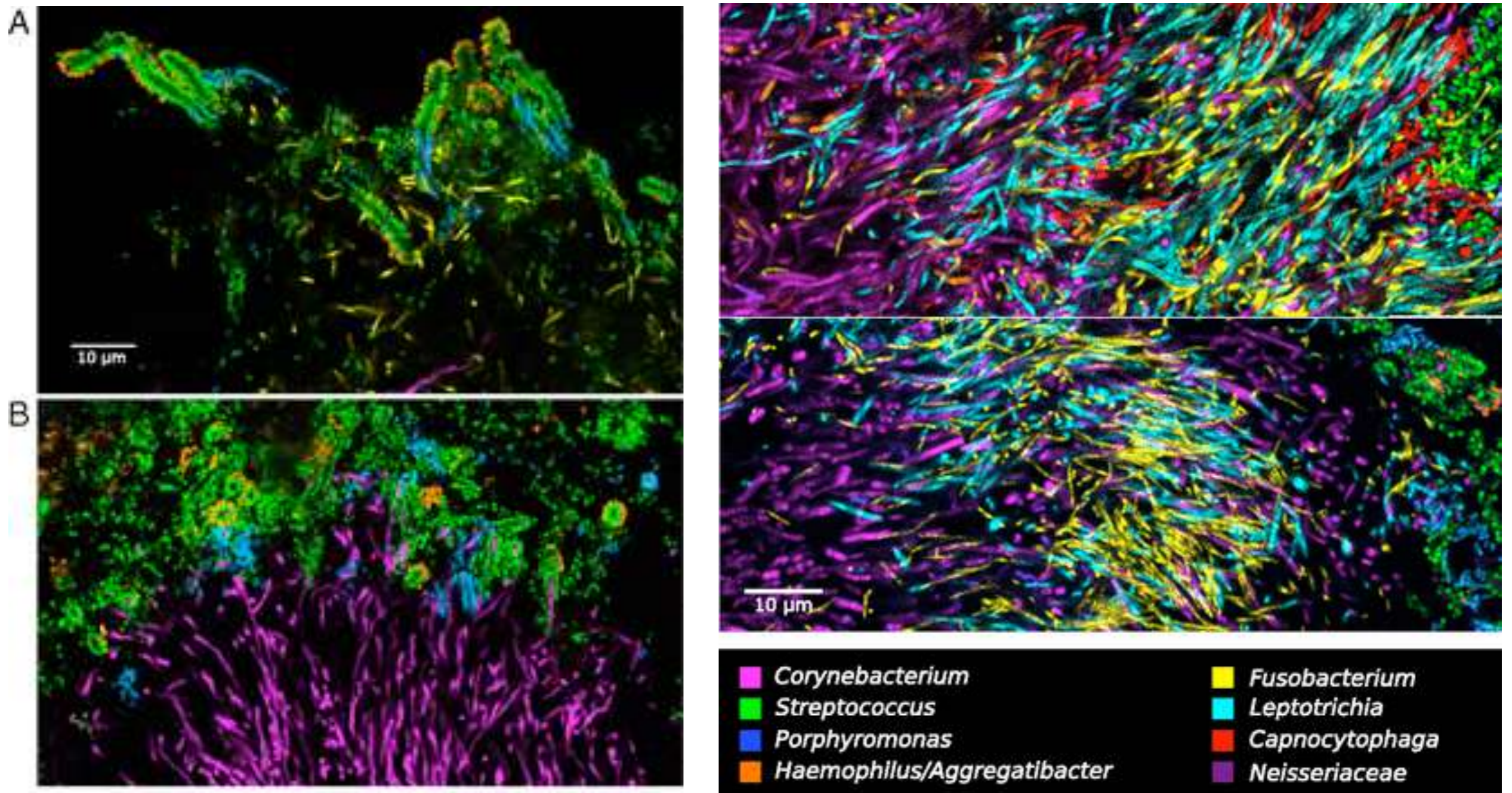
- Diet
- Living Environment
- Job
- Chemical Exposure
- Human Interactions
- Pets
- Medical Treatment
- Pollution
- Seasonality



THE CURRENT GAPS: WHAT DO MICROBIOTA LOOK LIKE?

- 1.) How to we visualise the microbiota?
- 2.) How to interpret microbiome [big] data?
- 2.) How to change the microbiota favourably?
- 3.) How to administer changes effectively?

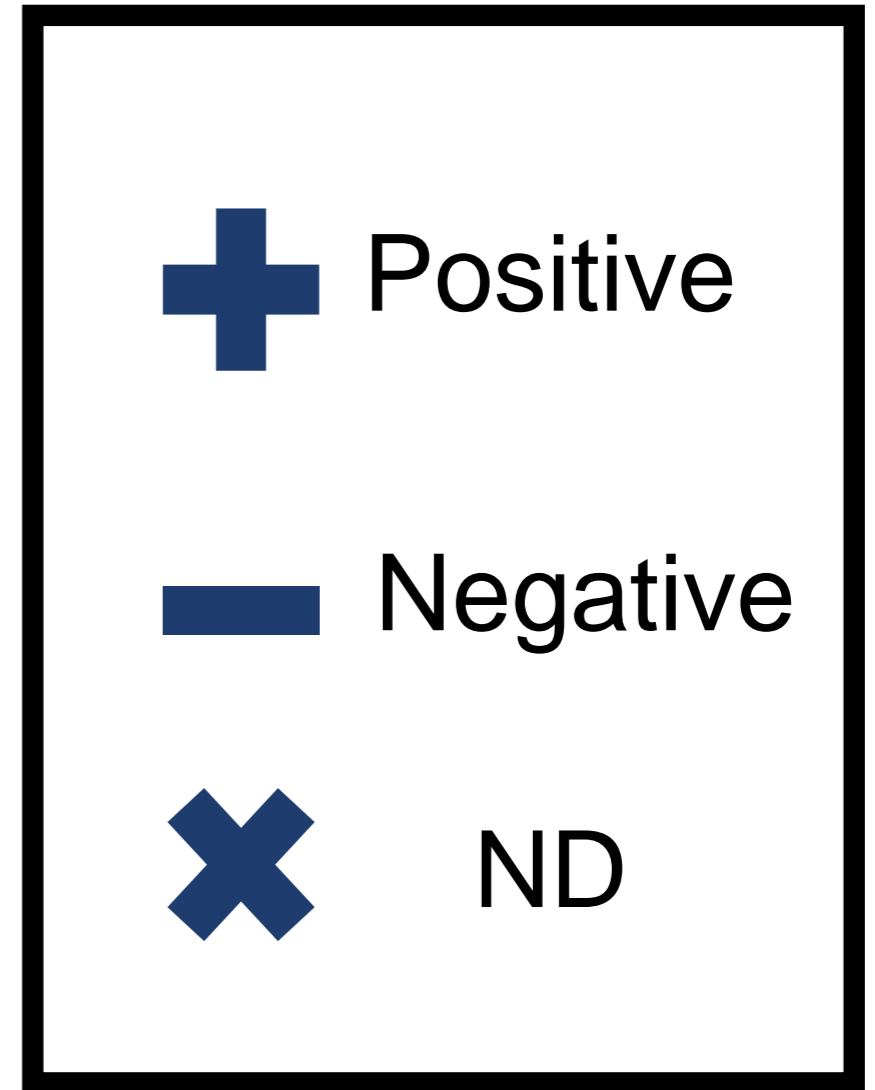
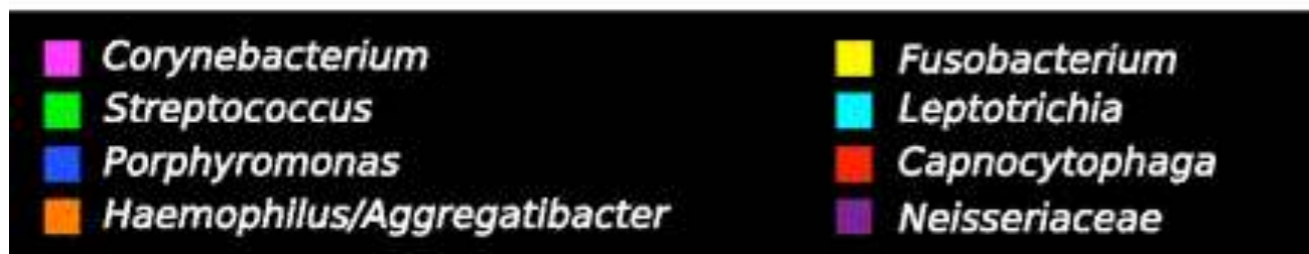
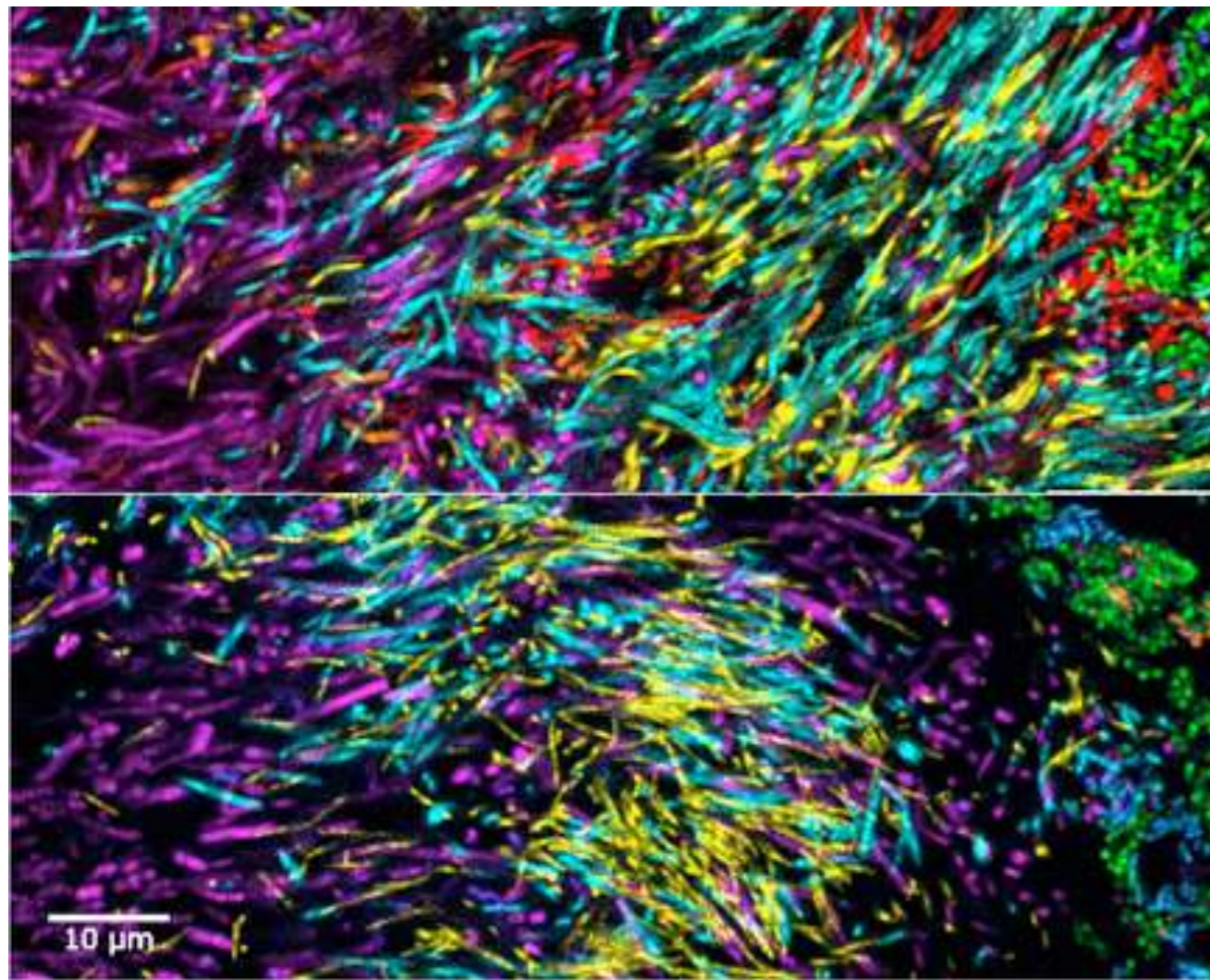
THE CURRENT GAPS IN MICROBIOTA RESEARCH: VISUALISATION



Welch, et al. *PNAS*. 2016.

2040 Solution: Develop new tools that visual in real-time

THE CURRENT GAPS IN MICROBIOTA RESEARCH: INTERPRET?

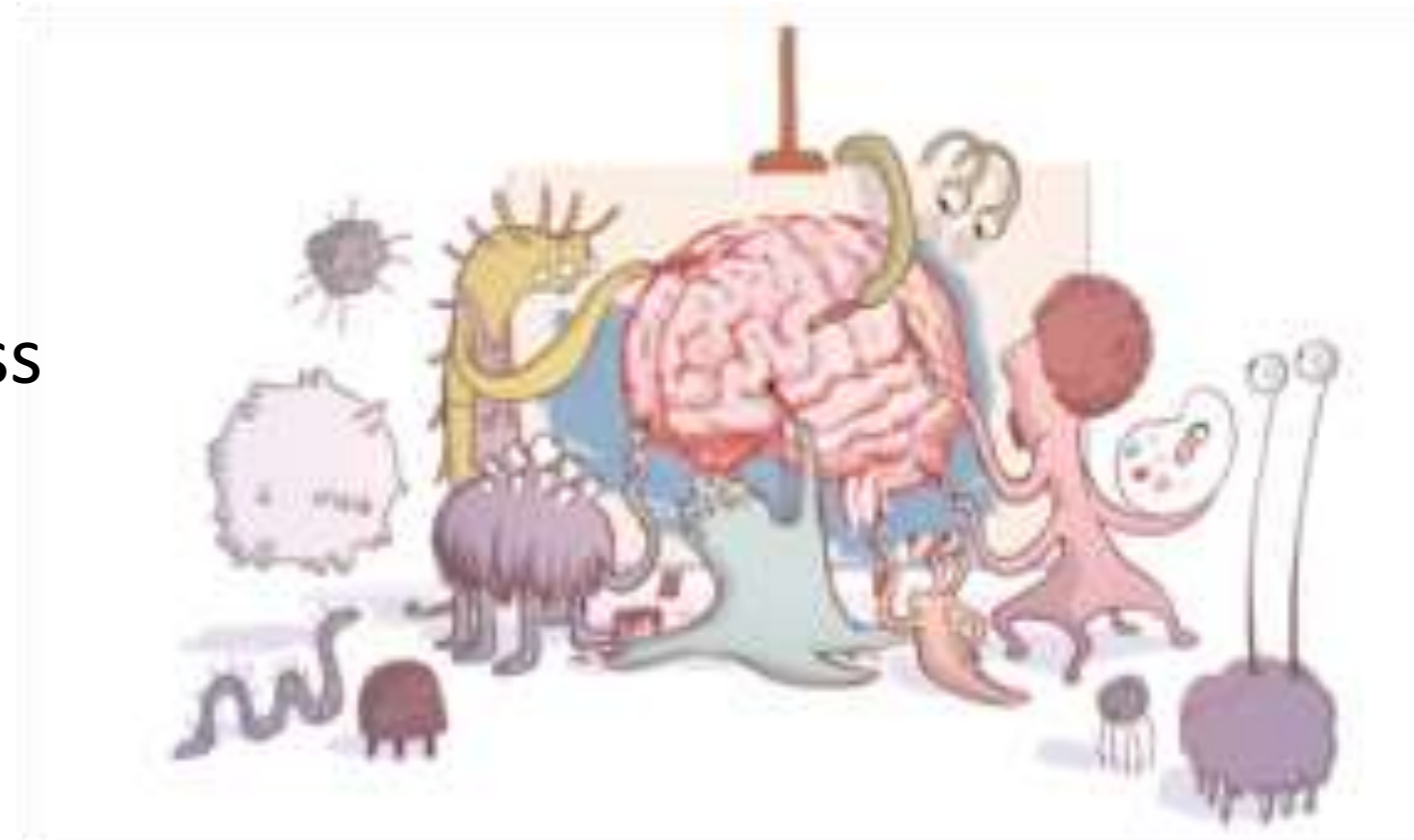


Welch, et al. *PNAS*. 2016.

2040 Solution: Develop new analysis tools that simplify big data

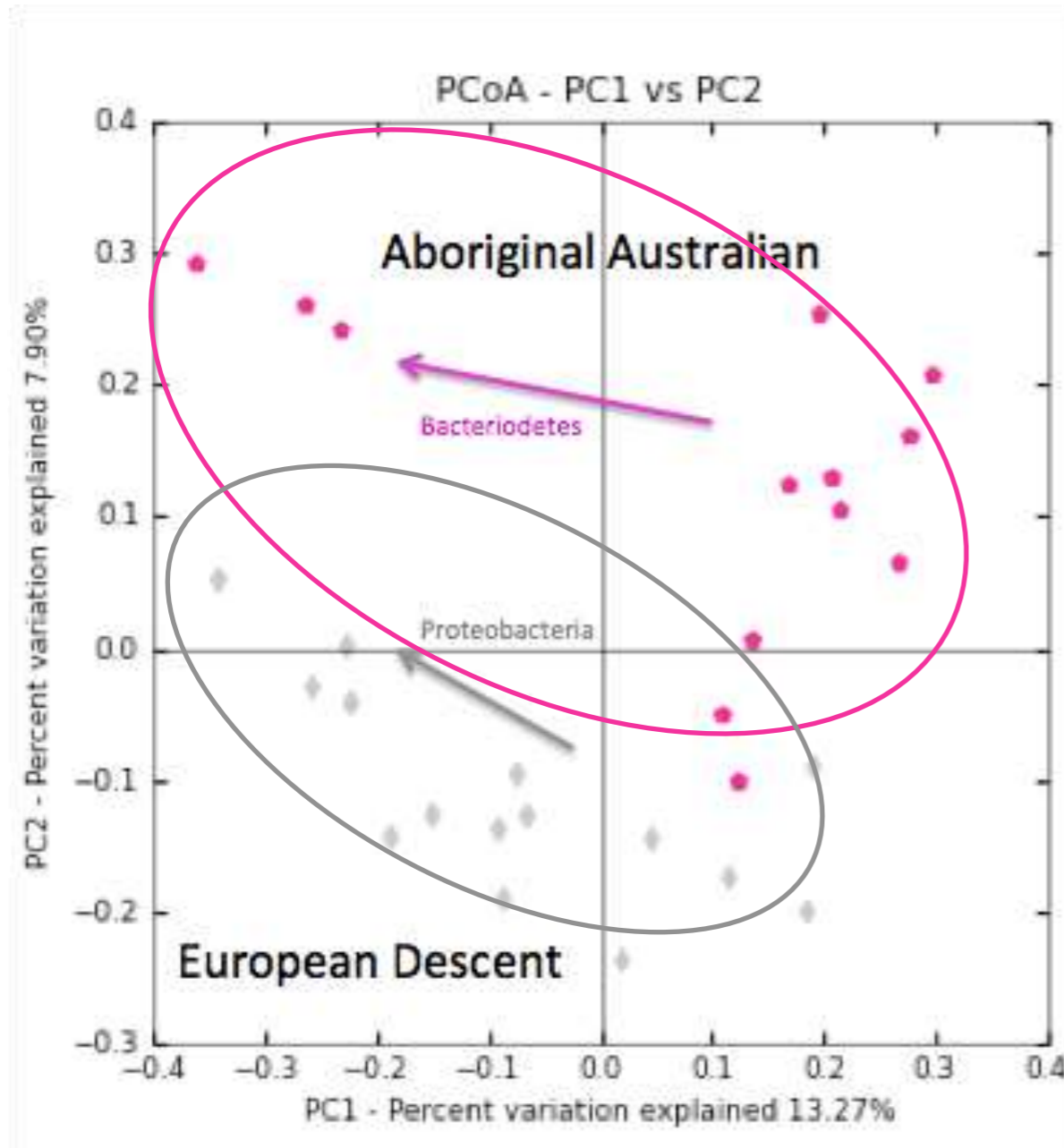
THE CURRENT GAPS IN MICROBIOTA RESEARCH: CHANGE?

- Prevent infectious disease
- Cure mental illness
- Defend against chronic illness
- Improve fertility
- Detoxify the body
- Improve medication efficiency



2040 Solution: Integrating microbiome research across fields

THE CURRENT GAPS: CHANGE?

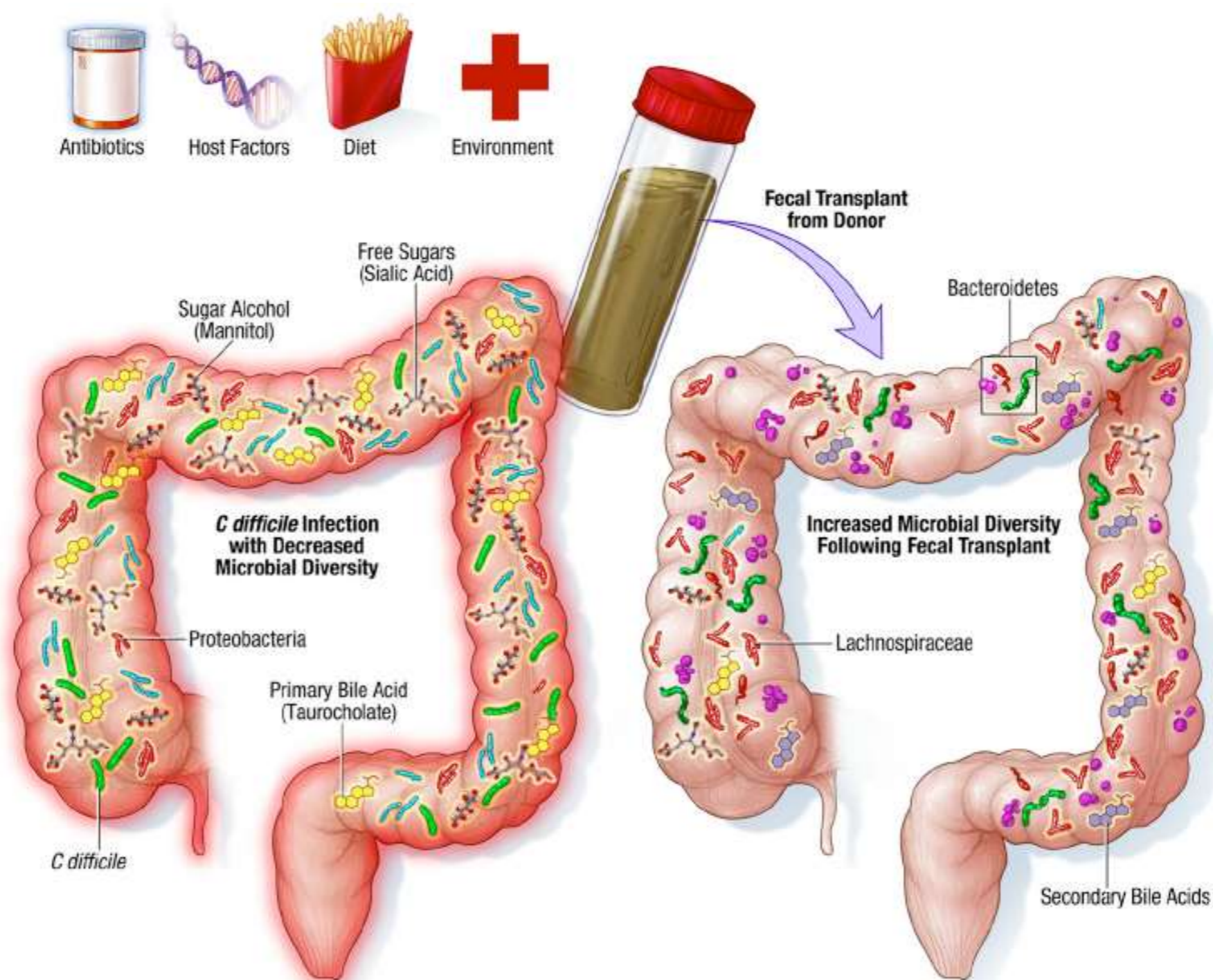


ARCPOH – Lisa Jamieson



2040 Solution: Global, collaborative projects

THE CURRENT GAPS: TREAT?



Reports Healthcare, 2018

2040 Solution: Develop new modes of administration

THE CURRENT GAPS: TREAT?

- Probiotics
- Prebiotics
- Phage therapy
- Transplants
- Vaccinate
- Lifestyle changes
- Dietary changes



Changing the microbiota by 2040

Tools will be developed to monitor microbiota and their changes in real-time.

Bacterial species [cohorts] will be identified to selectively improve health.

Nanoparticle smart vectors will effectively administer pro- and prebiotics.

Countries and consortia will work together to improve microbiota knowledge.

AUSTRALIAN CENTRE FOR ANCIENT DNA



Australian Government
Australian Research Council

**The
Wenner-Gren
Foundation**

For Anthropological Research, Inc.



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