The Human Microbiome: Medical, Philosophical, and Theological Complexity

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Disclosures

• I am a pediatric gastroenterologist.
• I am not a theologian.
• I am not a basic scientist or microbiologist.
• I am a Christian.
The Microbiome and The Human Body

- Tongue
- Colon
- Airway
- Skin
We are a mass of eukaryote cells:
1. Encapsulated nucleus
2. Organelles
3. More complex than our prokaryote friends (the bacteria)

But are we really more complex?
30 trillion human cells

Billions (trillions) of “other”: viruses, bacteria, fungi, protists (ratio 1:1 to 3:1)

We are just beginning to understand these interactions.
We are somewhat like a coral reef.
Terms:

• **Microbiome** (the microbes in our body and their genetic signature)
• **Microbiota** (the taxa identified with these microbes)
• **Probiotics**: Commensal bacteria or fungi interacting with humans (such as in the intestine). “**Good bacteria**” or “**good fungi**” (Lactobacillus, Bifidobacterium, Saccharomyces sp.). OTC supplements.
• **Prebiotics**: Non-absorbed substances which promote the growth of “good” bacteria (fiber, inulin, breast milk).
• **Synbiotics**: A combination of pro- and prebiotics.
• **ANTIBIOTICS** (a true medical miracle) → except when **overused**
The Amount of Research in this Area is Staggering!

- “Microbiome” → 31,485 articles on PubMed
- “Probiotic” → 18,543 articles
- “Prebiotic” → 5693 articles
- “Synbiotic” → 838 articles
Why Would We Want to Change the Microbiome?

1. Compete for niche space against pathogenic bacteria
2. Provide anti-bacterial effects (antibodies in breast milk)
3. Effect the immune system (increase/decrease)
Fecal transplant: From PCH
As a Pediatric Gastroenterologist, Where do I Find the Microbiome Fascinating?

**POTENTIAL THERAPEUTICS:**

1. Irritable bowel syndrome
2. Inflammatory bowel disease (Crohn disease, ulcerative colitis)
3. Celiac disease
4. Liver disease
5. Obesity
6. Starvation (especially in developing world scenarios)
7. GI cancer
8. And MANY others!

[Image from University of Pennsylvania]
Necrotizing Enterocolitis: Terrible problem among premature infants!
Necrotizing Enterocolitis (N.E.C.)

• 1% – 7% of NICU admissions (typically premature infants, <1500 grams)
• 30% - 50% mortality rate

Causes:
1. Thin bowel wall ("bacterial streaming")
2. Increased blood clotting in vessels going to intestine.
3. Dysregulated immune system due to prematurity
4. Excess growth of pathogenic bacteria and fungi in intestine (Enterobacteriaceae, Staphylococci, Candida, etc.)
Necrotizing Enterocolitis (N.E.C.)

“Bowel rest”
IV antibiotics
Surgery
Longer NICU time
Higher healthcare costs

What about probiotics?
Necrotizing Enterocolitis (N.E.C.) – Probiotics?

Could probiotics be beneficial in NEC prevention in pre-term infants?

Some studies suggest benefit:

Necrotizing Enterocolitis (N.E.C.) – Probiotics?

Problem:
• Maybe no benefit? 654 infants received Bifidobacterium vs 661 infants received placebo. **No effect** Costeloe K, *Health Technol Assess*, 2016.
  • No standardized dose
  • No specific strain(s)
  • Duration of use unknown
  • No algorithm to determine high-risk infants
Necrotizing Enterocolitis (N.E.C.) – Probiotics?

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Lots of potential. We need more research / better studies.
Cystic Fibrosis
Cystic fibrosis transmembrane conductance regulator (CFTR)
Intracellular Region

CFTR (cAMP channel)

Cl⁻

Lumen

Na⁺

Thickened secretions

H₂O transport is disrupted

Increased
Cystic fibrosis is a **Multi-Organ Disease.**
Many factors lead to intestinal inflammation in cystic fibrosis.

Cystic fibrosis: What about the Microbiome?

- The intestines of patients with CF have *different bacteria* compared to healthy controls.

Weird! Could bacteria in the gut *affect the lungs* in patients with cystic fibrosis?
What do we know so far?


What could this mean for probiotic use???
Cystic fibrosis: As intestinal bacteria **increase**, respiratory bacteria increases **follow**.

**Why?**
Clinical effect?
**What if we gave probiotics?**
What do we know so far?

• Adults with CF: Bacterial diversity appears to greatly diminish over time → possibly due to antibiotics.

• Would probiotics help? We know probiotics are being used in this population although the data is not clear.

The science of the microbiome continues to grow!

Danish population study (Danish Cause of Death Register): Hospitalization for infection (esp. increased # of infections) associated with significantly elevated risk of suicide. (JAMA Psychiatry, Lund-Sorensen et al. 2016).

Theory: Do antibiotics change microbiome to affect CNS?
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Also:

• Probiotics may decrease overall inflammation in the elderly.
• Rats given probiotics may have less anxiety.
And the science continues to grow!

Irish study compared professional rugby players vs. controls → athletes have more diverse microbiomes associated with less risk of inflammation (Clarke S et al., Gut 2014)
And the science continues to grow!

Stool from young killfish transplanted into older fish cause older fish to live longer. Microbiome of old fish then looked like young fish. *Causative?*  
(Smith et al., bioRxiv 2017  
http://biorxiv.org/content/early/2017/03/27/120980)
Let’s Get Metaphysical!

What about philosophical and Theological consideration?
• There has been minimal work in this area.
• Needs theological / philosophical expertise
• I am a physician, not a theologian or philosopher.

What initial ideas can be begin to explore?
Existentialism

Spectrum of ideas here:

• Is the individual vs. society and/or world, responsible for giving meaning to life? Where does the microbiome fit in?

• Situatedness: My freedom is present, but it is based on the foundation of my past, the Earth’s past, the universe’s past...my microbiome?
Is our freedom dependent on our microbiome?
1. For our health
2. Our environment and diet which change the microbiome
3. Communal/social interactions which change the microbiome
4. The history of the microbiome on every creature that has ever lived

Open theism vs. Omniscience?
The “Left Wall of Evolution” by S. Gould

“Progress Does Not Rule”

Or

Maybe this is not the point?
Perhaps we are all just inter-related with the microbiome being a language of life and creation.
Dualism

• Idea of **separation** of the mind and the matter that the mind studies

• If our microbiome potentially interacts with all aspects of being human, can it affect our mental and emotional health?

• For example, germ-free mice spend less time socializing and more time self grooming compared to normal mouse controls (Desbonnet L et al., *Mol Psychiatry* 2014).

What correlation exists in humans?
“Just as a body, though one, has many parts, but all its many parts form one body, so it is with Christ. For we were all baptized by one Spirit so as to form one body—whether Jews or Gentiles, slave or free—and we were all given the one Spirit to drink. Even so the body is not made up of one part but of many.” 1 Corinthians 12: 12-14 (NIV)
The Body of Christ

• We can be the foot, hand, or eye for the Body of Christ.
• But, perhaps, we can be *part of the microbiome* of the Body of Christ.

1. We may feel insignificant or negligible compared to all of humanity.
2. **BUT, in reality**, we are still important although not overtly obvious (like a bacteria in the microbiome – small but vital).
3. “Do unto others as you have them do to you” → Learning that other bodies are possibly an extension of our body (through the microbiome) is profound.
Conclusions

1. The microbiome is an important part of human health.
2. The microbiome can affect disease outcomes and likely has an effect (not yet understood) with brain function and human emotions and interactions.
3. We need a better understanding of the microbiome and its relationship with the field of philosophy and theology.
4. We can use the microbiome as a metaphor of how we can influence the world around us in our daily Christian walk.
5. Absolutely groundbreaking work is ahead of us in this field!
References


• The Human Microbiome Project (NIH), hmpdacc.org

• Christianity Today: “You are Plural”

• Pohl JF. Probiotics, prebiotics, synbiotics: on microbiomes and the meaning of life.

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