Photo credit: Dr. Gilda Jones, CDC

The Microbiome Quality Control Project:
Implications for Reproducibility in Microbiome Science

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Reproducibility: A Refresher

- What it is
  - The ability of researchers working independently to repeat each other's experiments and reach similar conclusions
- Why you should care about it
  - Objective truth
  - Time and money
  - Avoiding frustration and embarrassment

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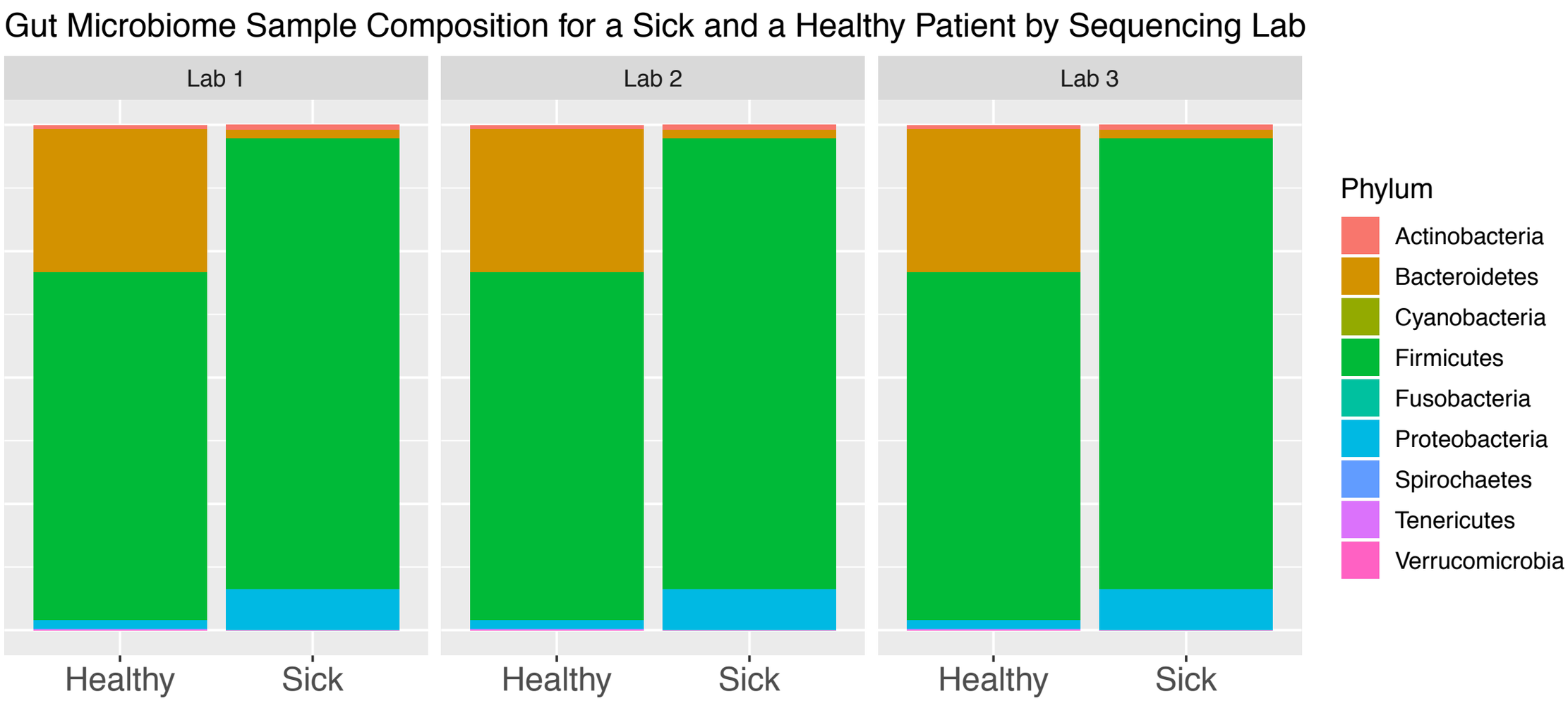
What Does Reproducible Data Look Like?



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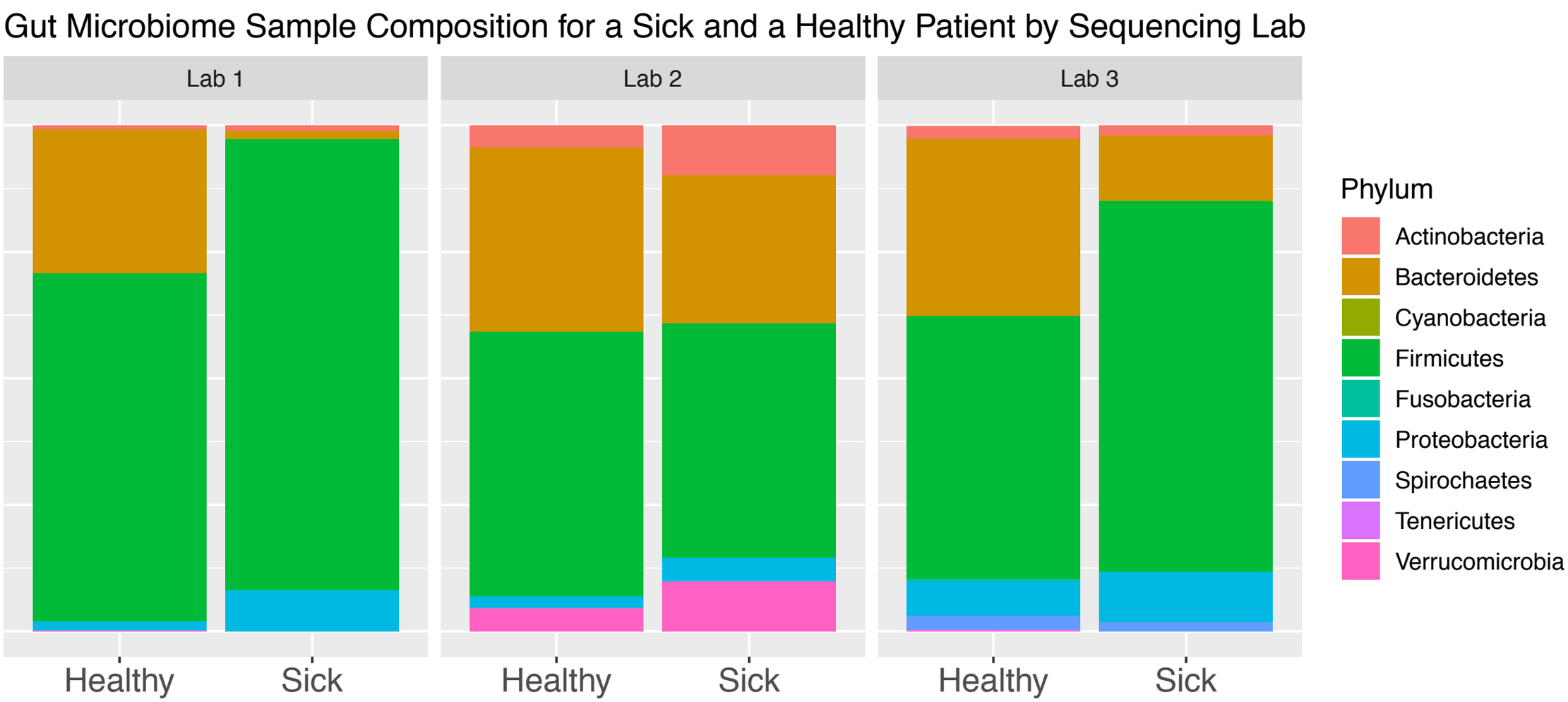
Here’s What Data Actually Looks Like



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Does Measurement Error Affect Results?

- Assuming no measurement error is a model assumption
- Significant results may be due to incorrect modeling assumptions

MBQC: An Opportunity to Quantify How Measurement Error Affects Results

- The Microbiome Quality Control Project (MBQC)
  - Identical samples sent to different sequencing labs
  - OTU count data available online (www.mbqc.org)
  - Only 16S
    - But similar patterns may hold for other technologies

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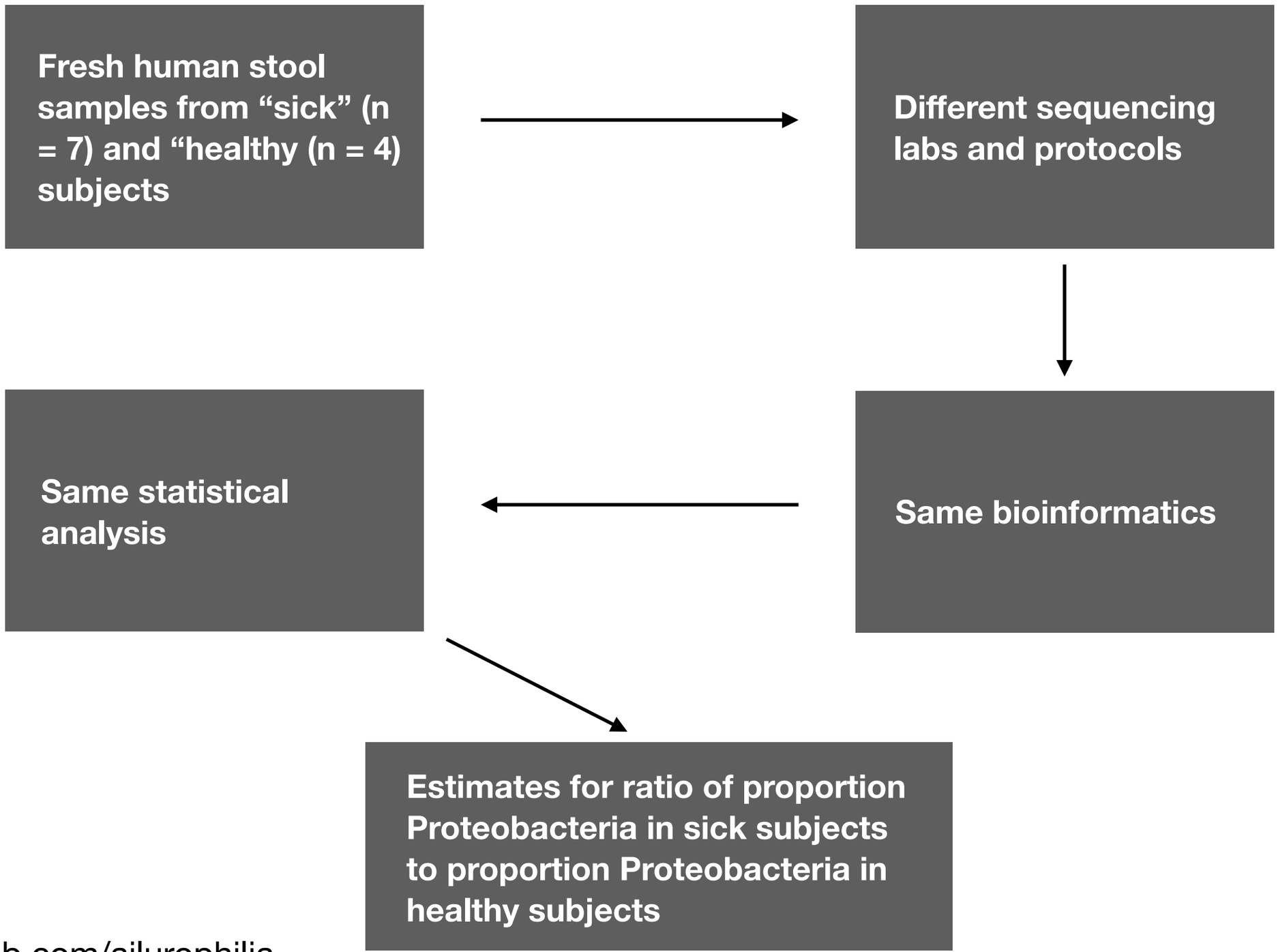
MBQC Data: Does Measurement Error Affect Inference at the Phylum Level?



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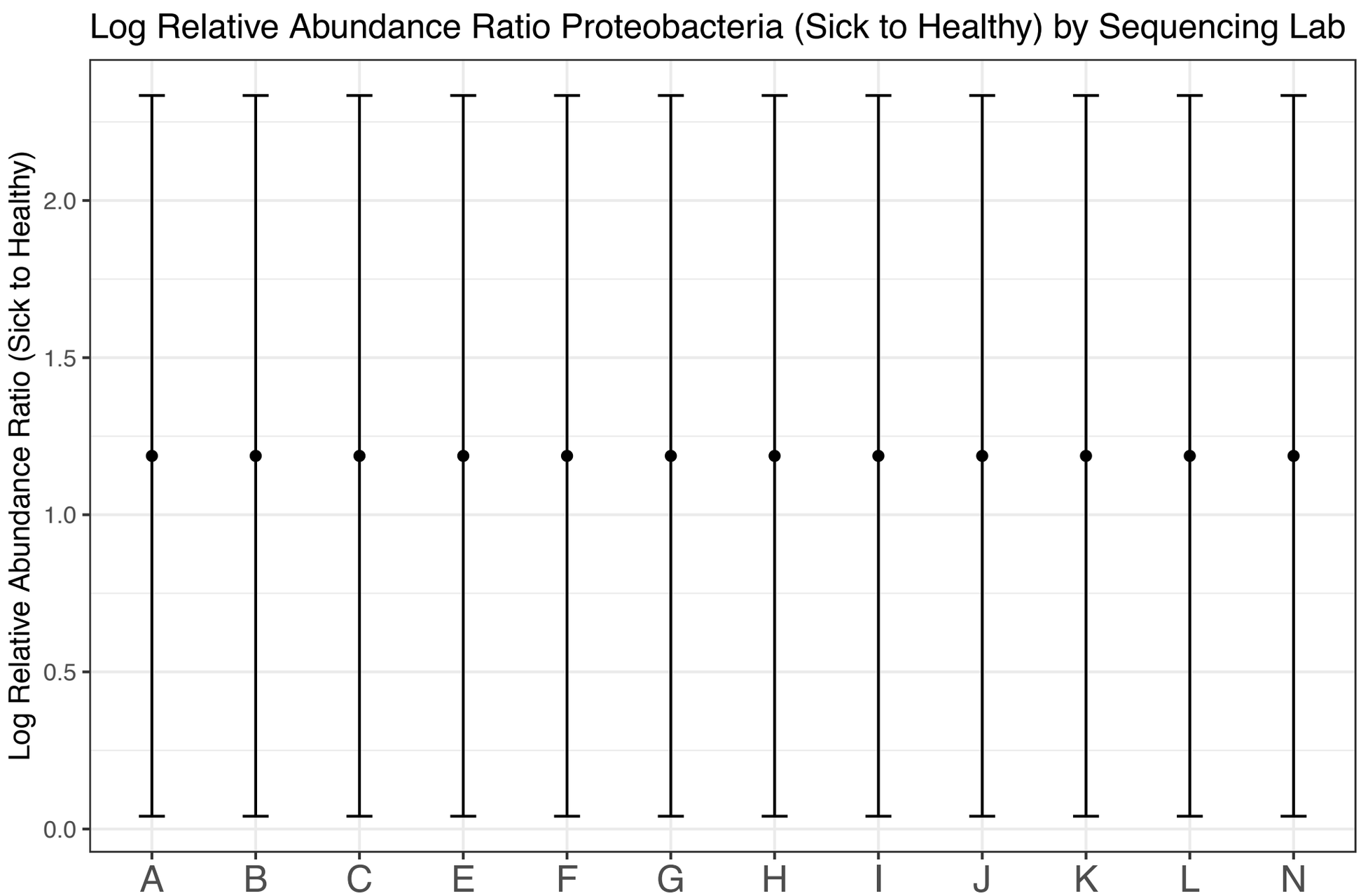
Results: What Would No Lab-Induced Variability Look Like?



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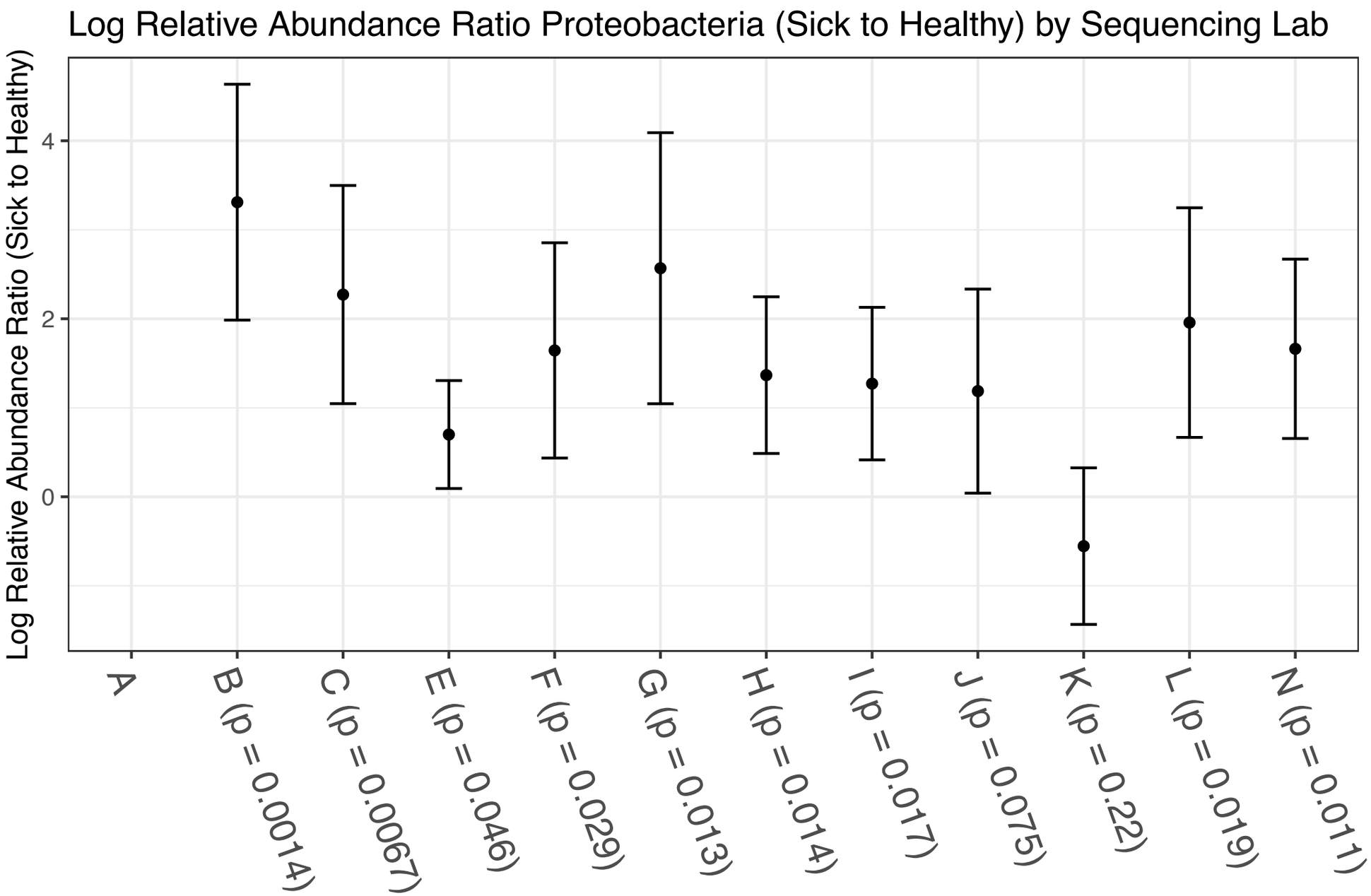
Results: What Does Real Data Look Like?



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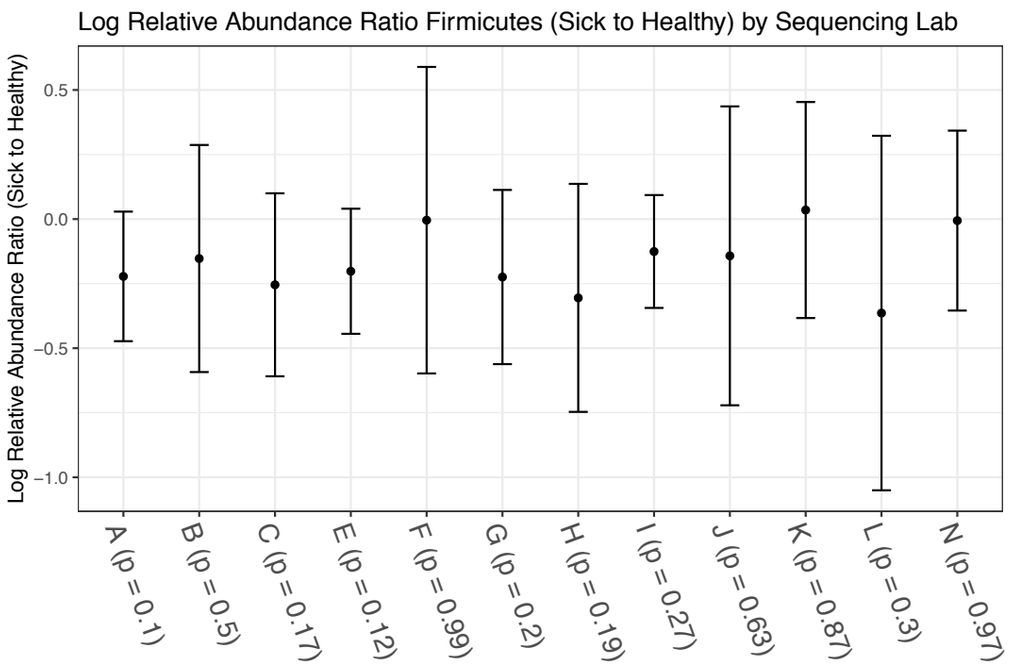
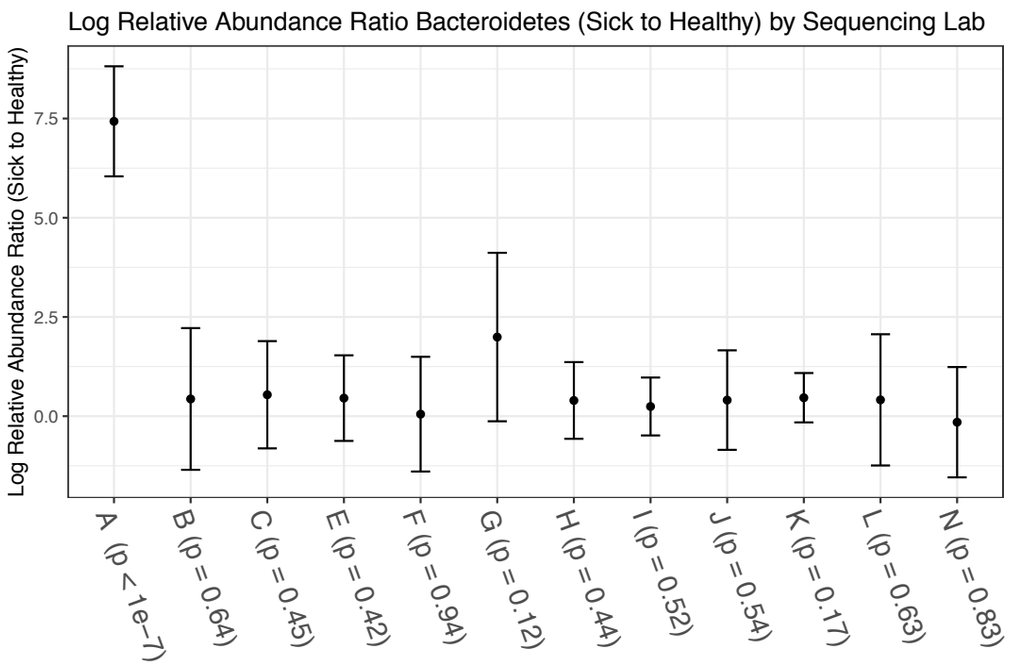
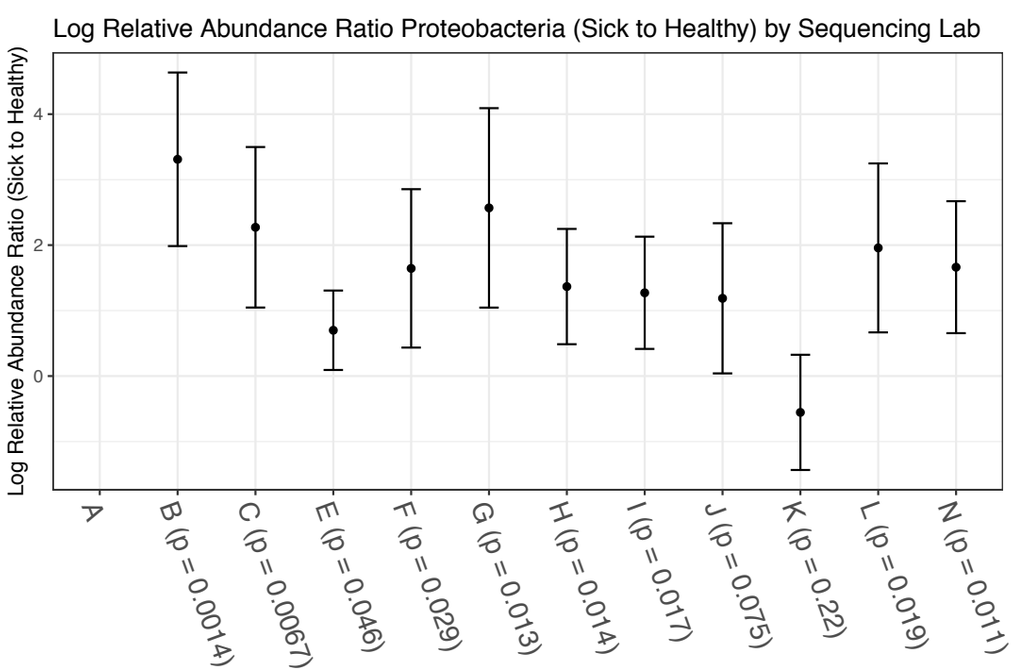
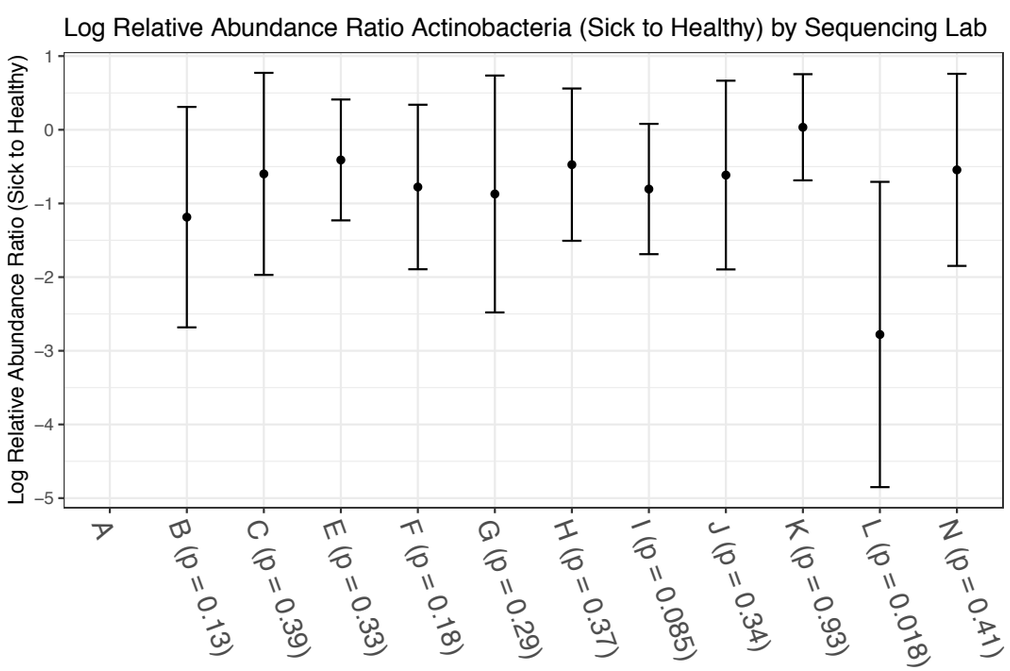
What About Other Phyla?









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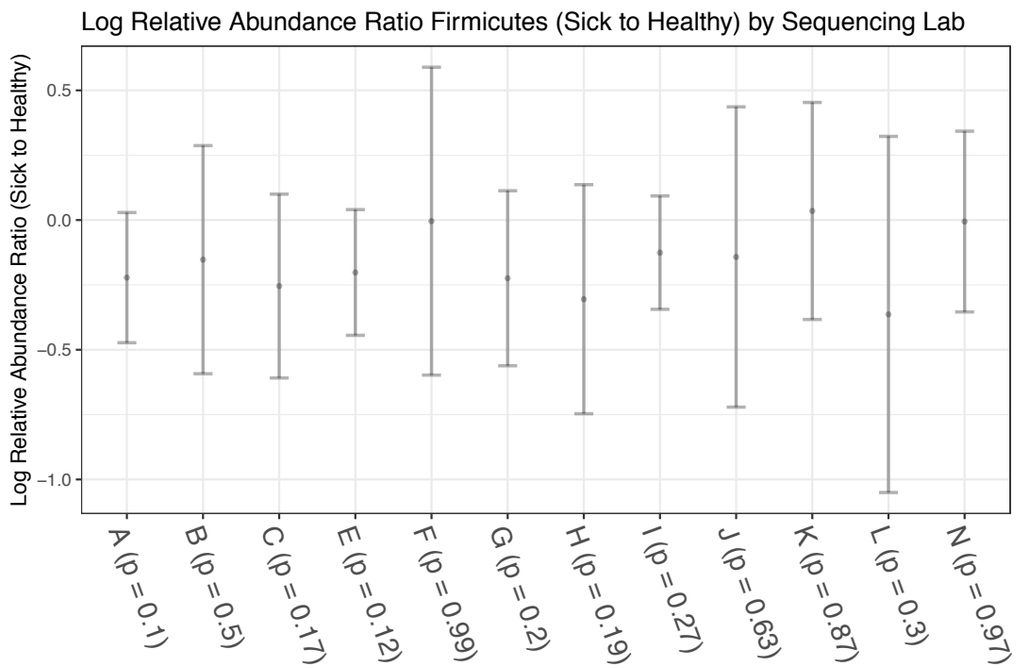
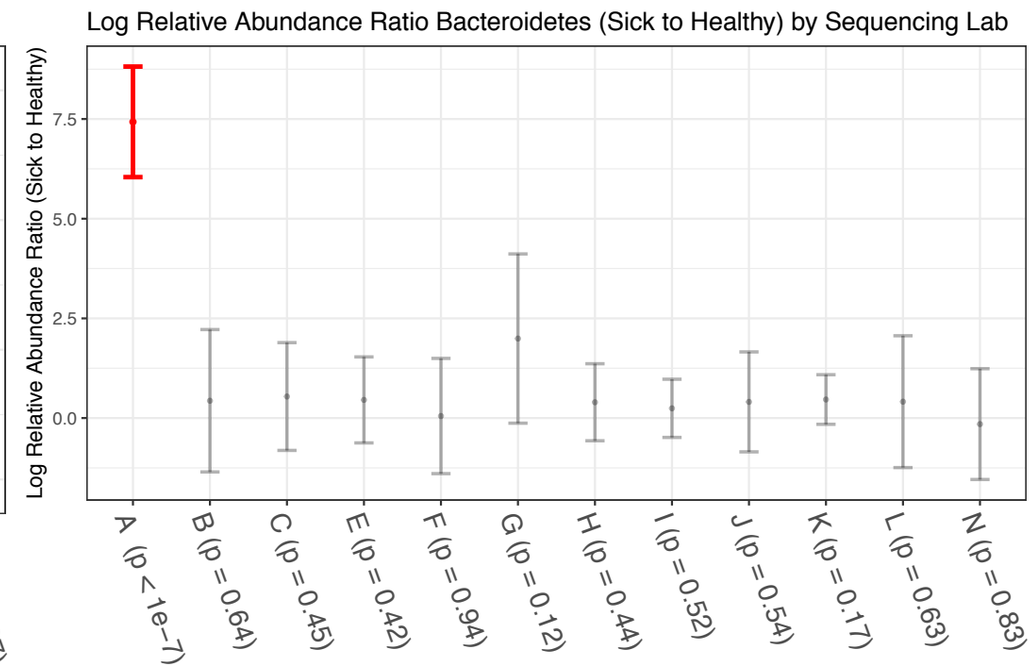
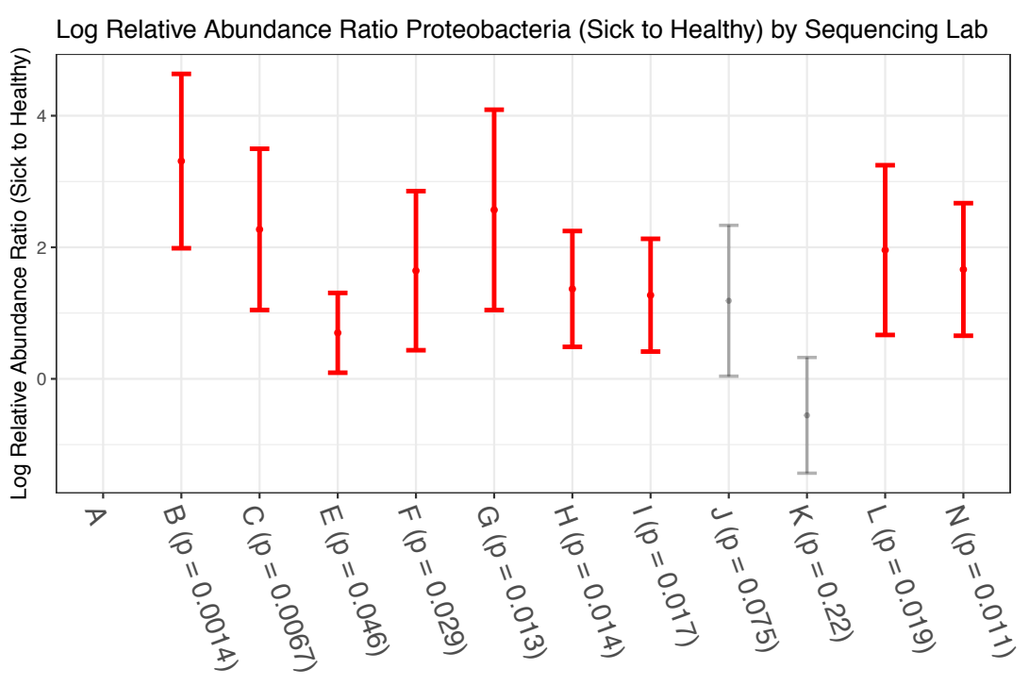
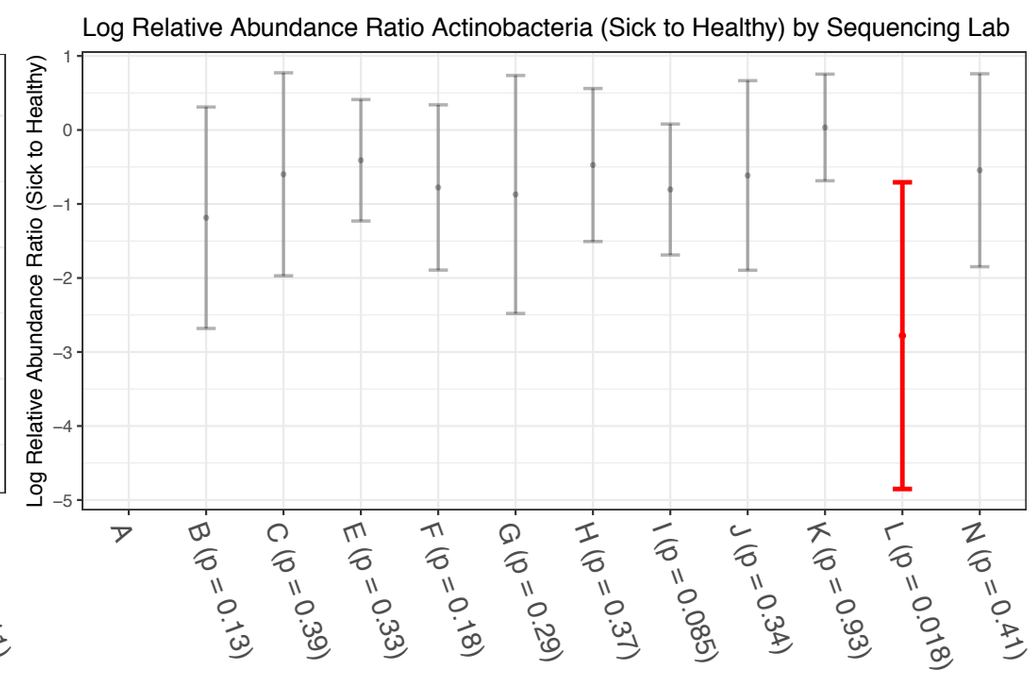
Who’s Getting Published?









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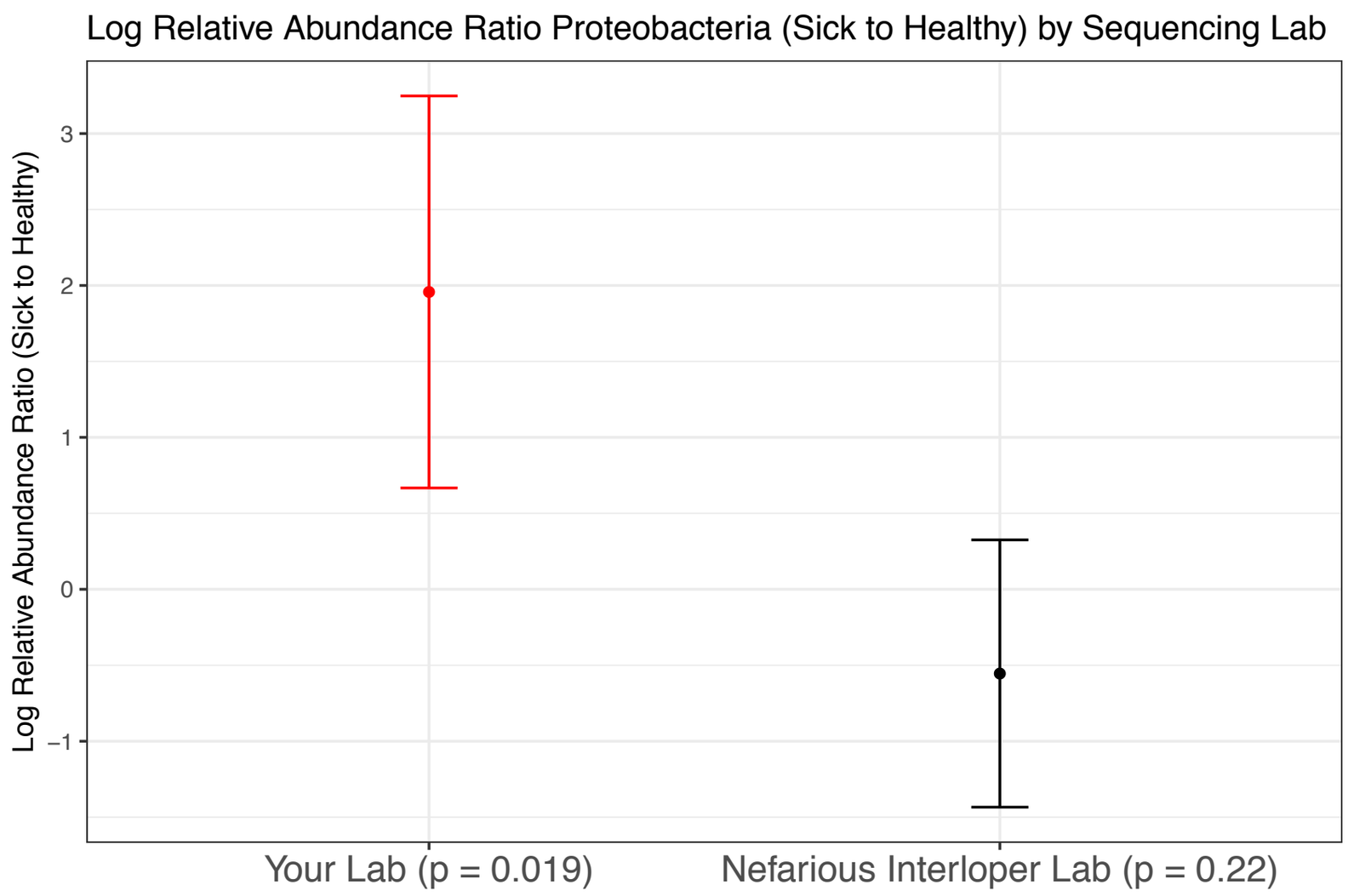
“Okay, But My Lab Has Good Protocols!”

- That’s great!
  - … until another lab tries to reproduce your results



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What You Can Do

- Be aware of these problems at every step of research
  - writing and reviewing grants
  - reviewing articles
  - planning, conducting, and reporting your own research
    - take replicates
    - use controls
- Engage in sustained collaboration with statisticians

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Further Research

- Addressing between-lab variability not explained by protocol variables
- Developing statistical tools to make replicates and controls more useful

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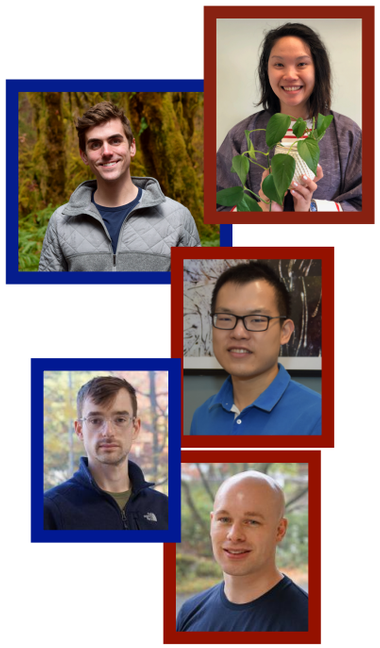
Thank You

Further Resources

- UW Statistics & Biostatistics Consulting
  - https://www.stat.washington.edu/consulting/
- Statistical Diversity Lab
  - adwillis@uw.edu
  - dsc24@uw.edu

statistical diversity lab

Prof. Amy Willis, PhD fearless leader



Pauline Trinh — bioinformatics, human-animal-microbe interactions

Bryan Martin — relative abundance, compositional data

Kendrick Li — networks, taxonomy

David Clausen — replication and data quality in microbiome science

Alex Paynter — diversity and regularised ML

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