

# Diarrhoea and the Faecal Microbiome

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# About me

- Bachelors in Agriculture science with minors in Animal Science and International Ag.
- Masters of Biological Science and Agriculture Engineering: Agriculture science, sustainable and innovative agriculture systems
- PhD: School of Veterinary Medicine, University College Dublin. Teagasc Grange- Walsh Scholar





# Calf health and diarrhoea

- Diarrhoeal disease
  - Most common cause of neonatal calf death
  - Morbidity and mortality:
    - 32% mortality in neonates in Ireland
    - morbidity reaches 50% globally
  - Short- and long-term economic and animal welfare implications

*Predominant causes of death in calves in Ireland from birth to 1 yr. of age<sup>1</sup>*

	Neonatal (birth to 1mo)	Calfhood (1mo-5mo)	Weanling (6mo-1yr)
<i>GIT infection</i>	32%	15%	17%
<i>Systemic infection</i>	15%	8%	3%
<i>Respiratory infection</i>	8%	34%	41%

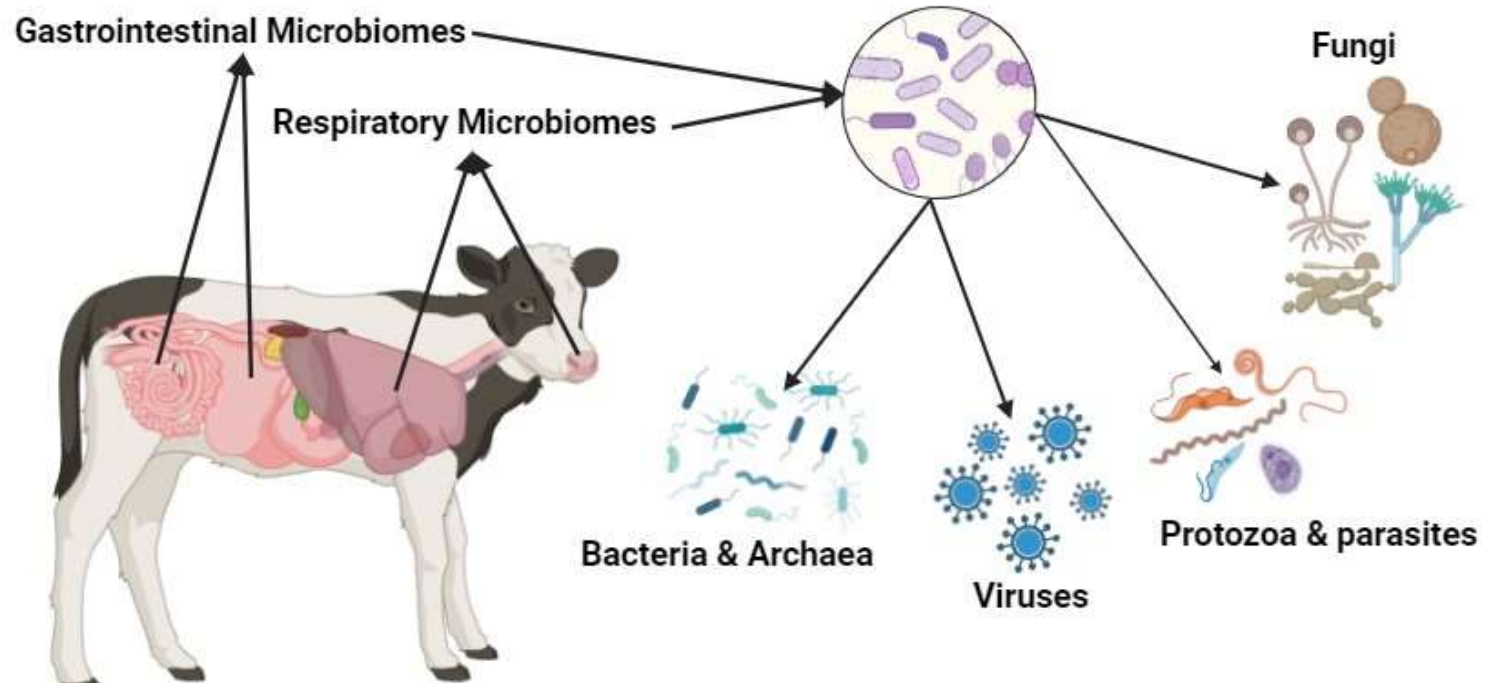
<sup>1</sup> Irish Department of Agriculture, Food and the Marine. 2023. All-Island Animal Disease Surveillance Report, 2022





# Microbiomes

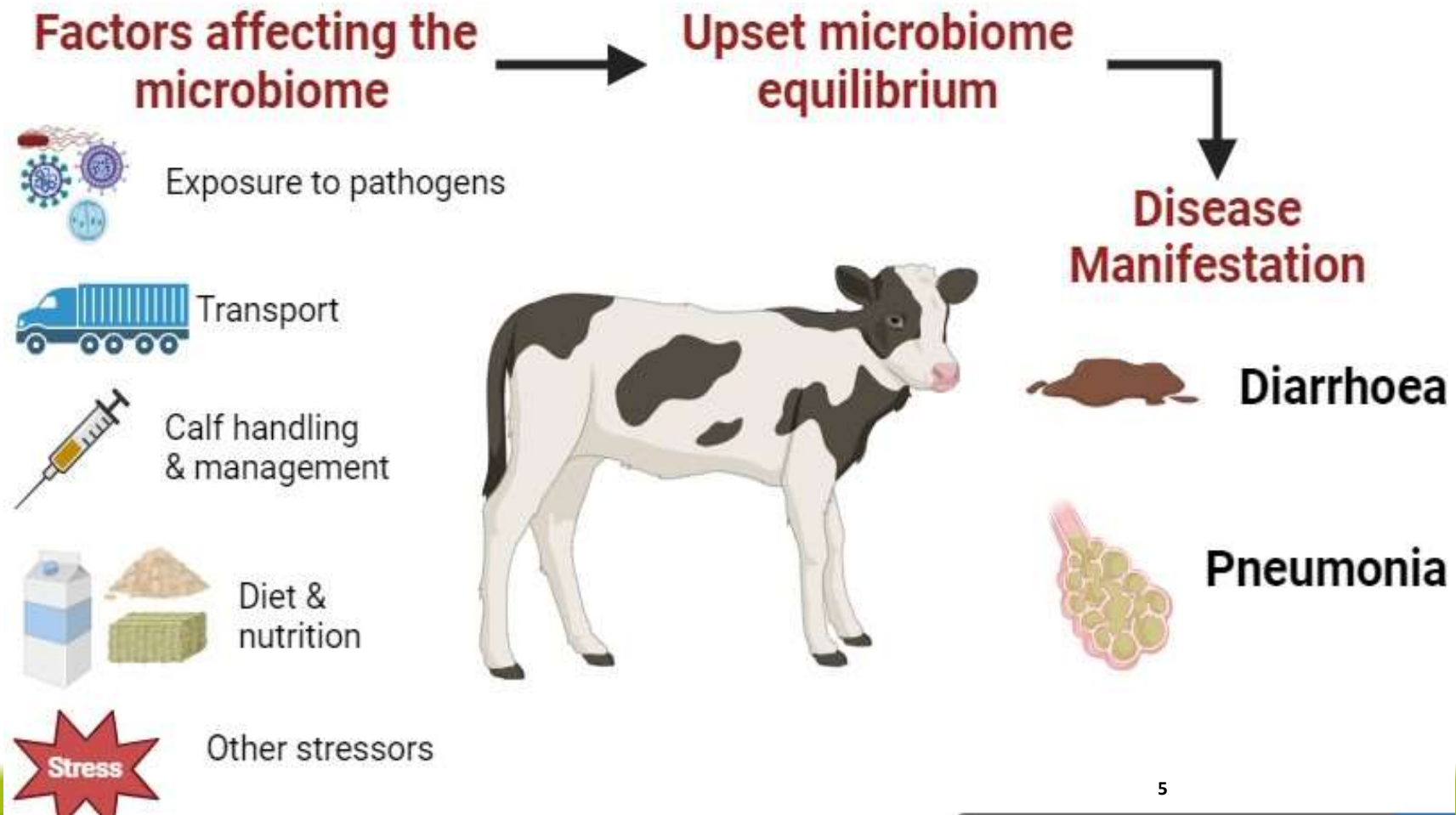
**Healthy Microbiome**  
Microbes live synergistically with each other & the host



# Dysbiosis and Disease



Dysbiosis: loss of commensal microbes accompanied by proliferation of harmful pathogens



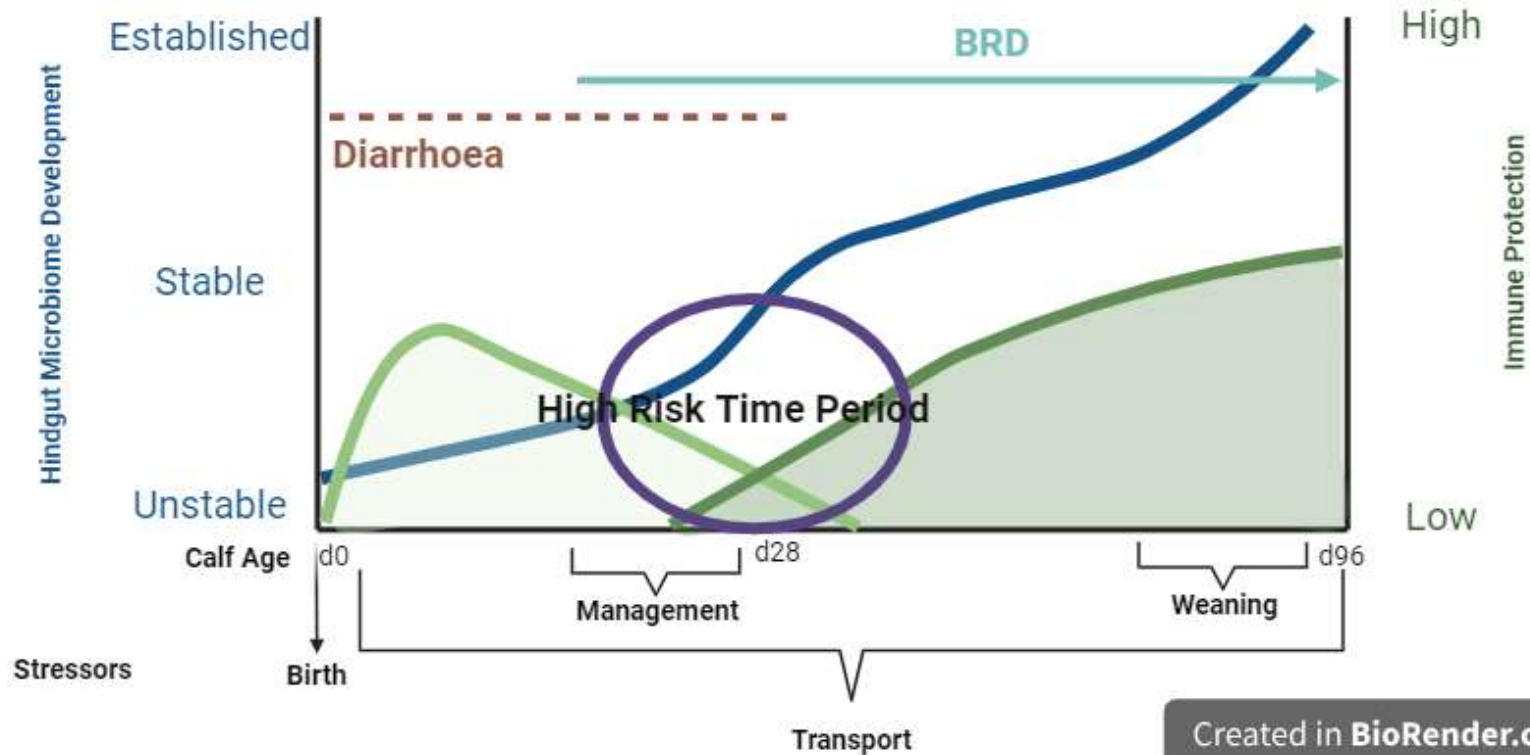
# Microbiomes and the pre-weaned calf



Unstable Microbiome + Low Immune Protection  
= Increased risk of disease

Maternally Driven  
Antibodies

Self-derived (calf)  
antibodies



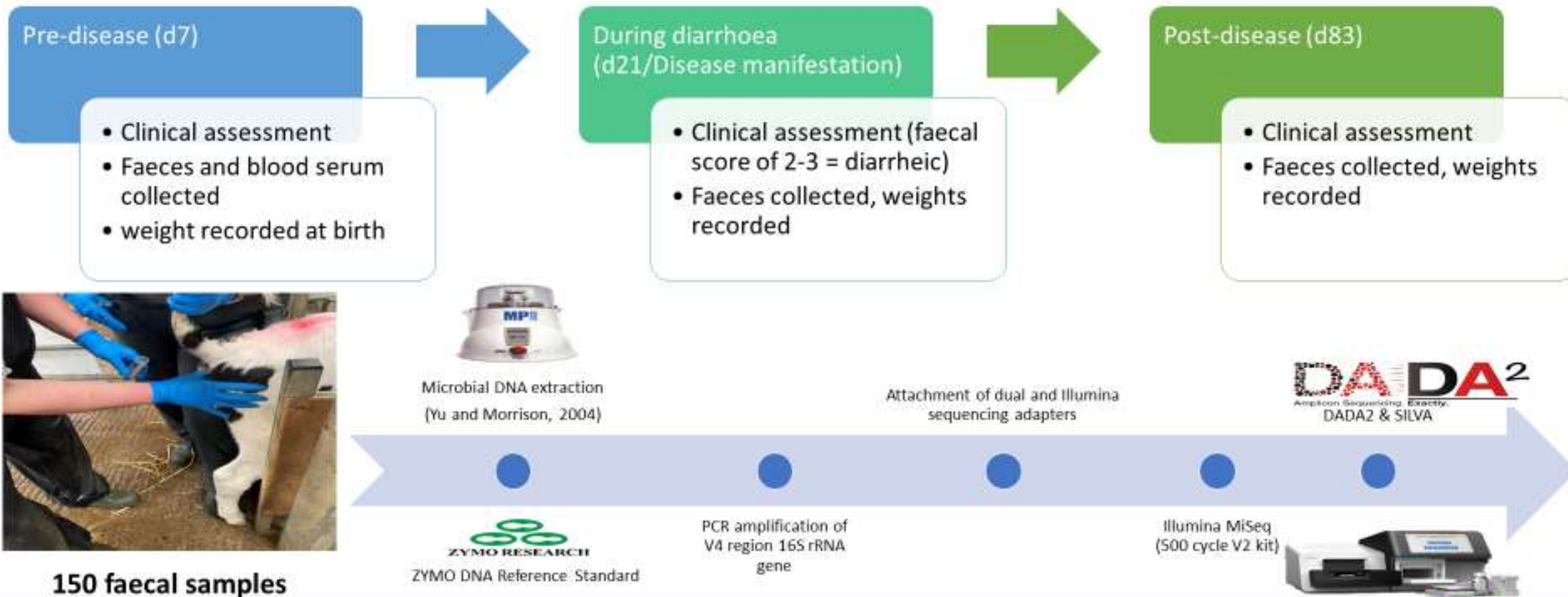
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# Animal model and data collection

51 spring-born, home-bred dairy heifer calves were observed and clinically assessed from birth to weaning and retroactively classified as **Diarrhoeic (n = 27)** or **Healthy calves (n = 24)**

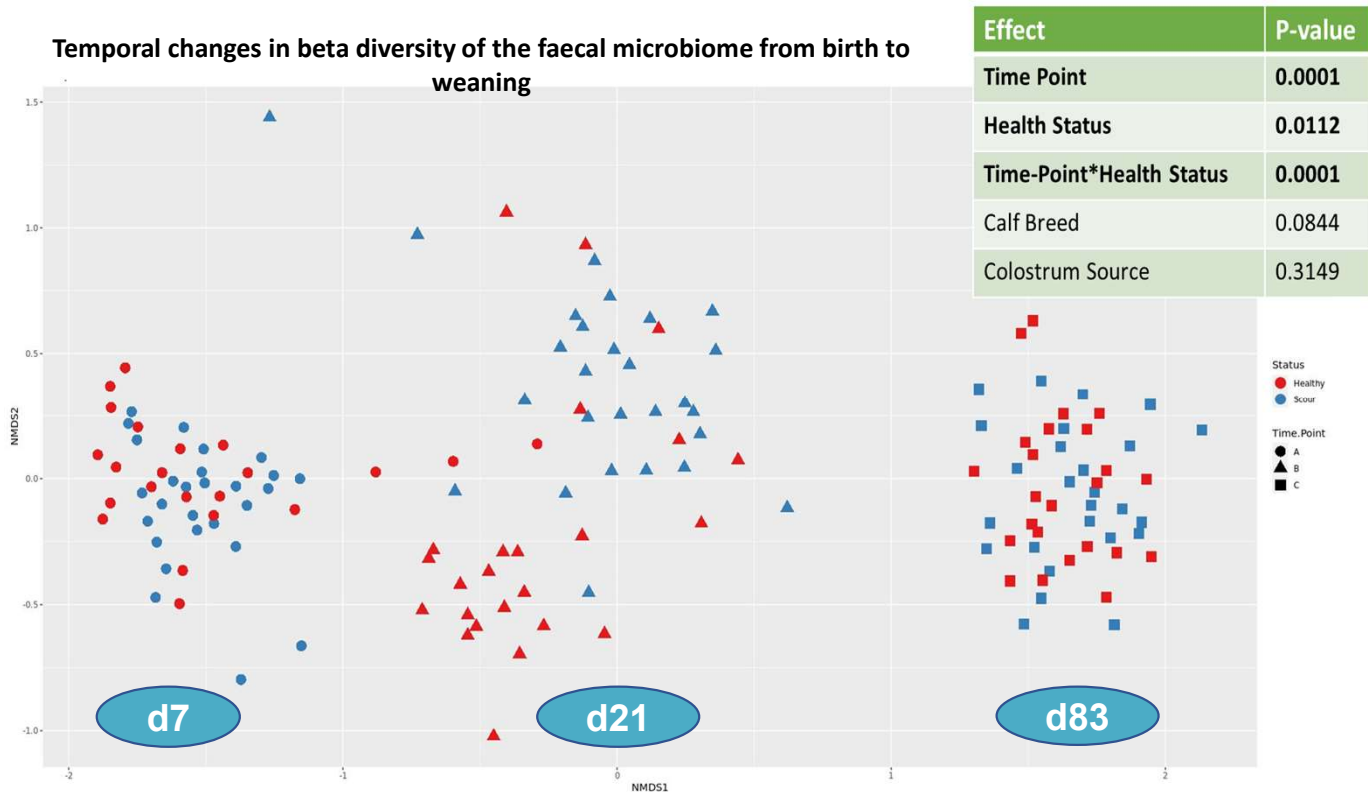




## Summary of results:

- No effect of CB, CS on health status, no effect of health status on ADG
- Little variation in sIgG concentrations between cohorts
- Diversity and composition of faecal microbiota
  - $\alpha$ -diversity increased with time
  - Interaction between **time\*health** was significant
    - No difference in composition pre- and post-disease
    - Reduced bacterial diversity at disease manifestation

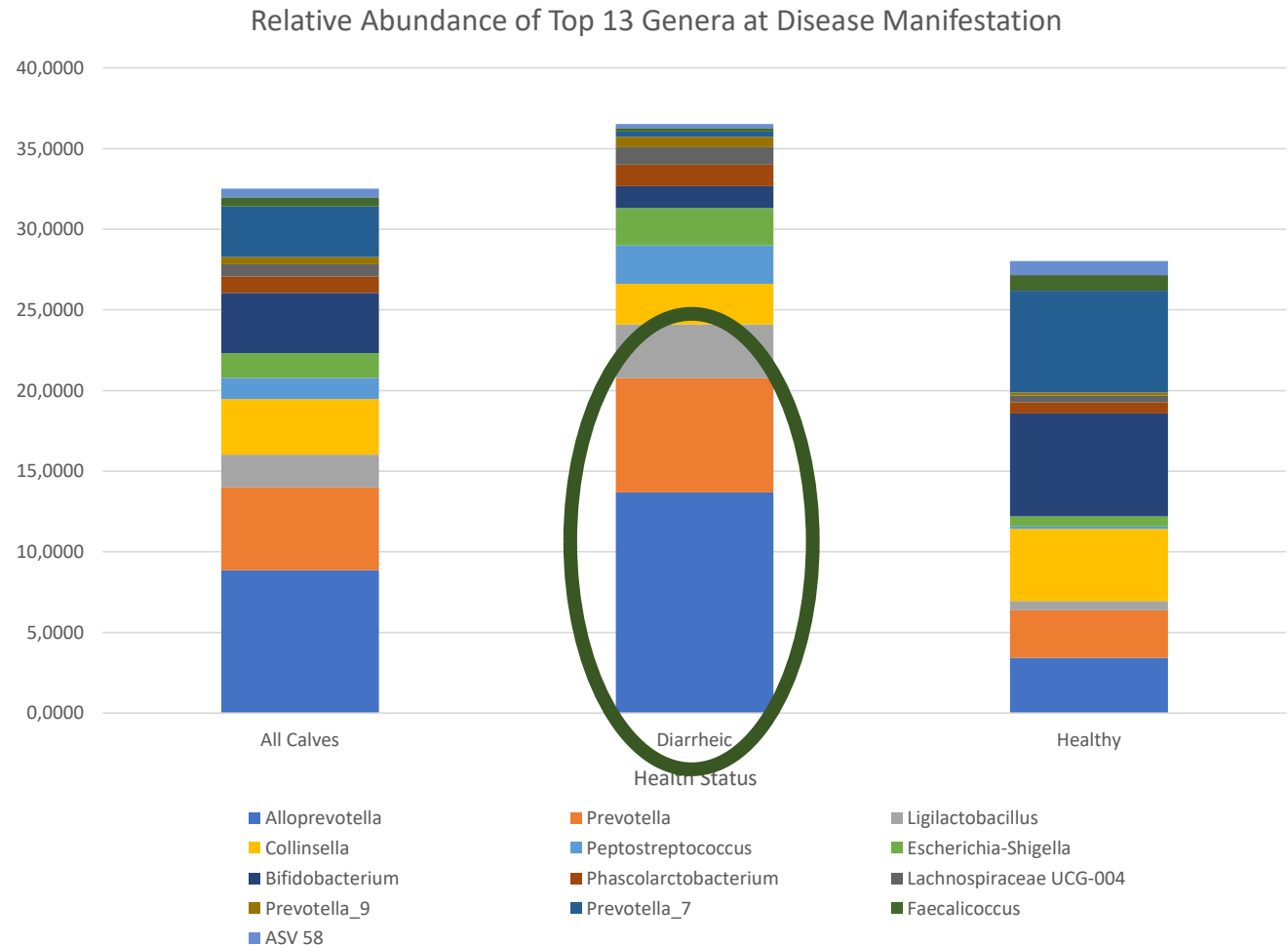
53% (n=27) morbidity  
2% (n=1) mortality  
Mean d of diarrheal disease: d22 (SE 0.70)



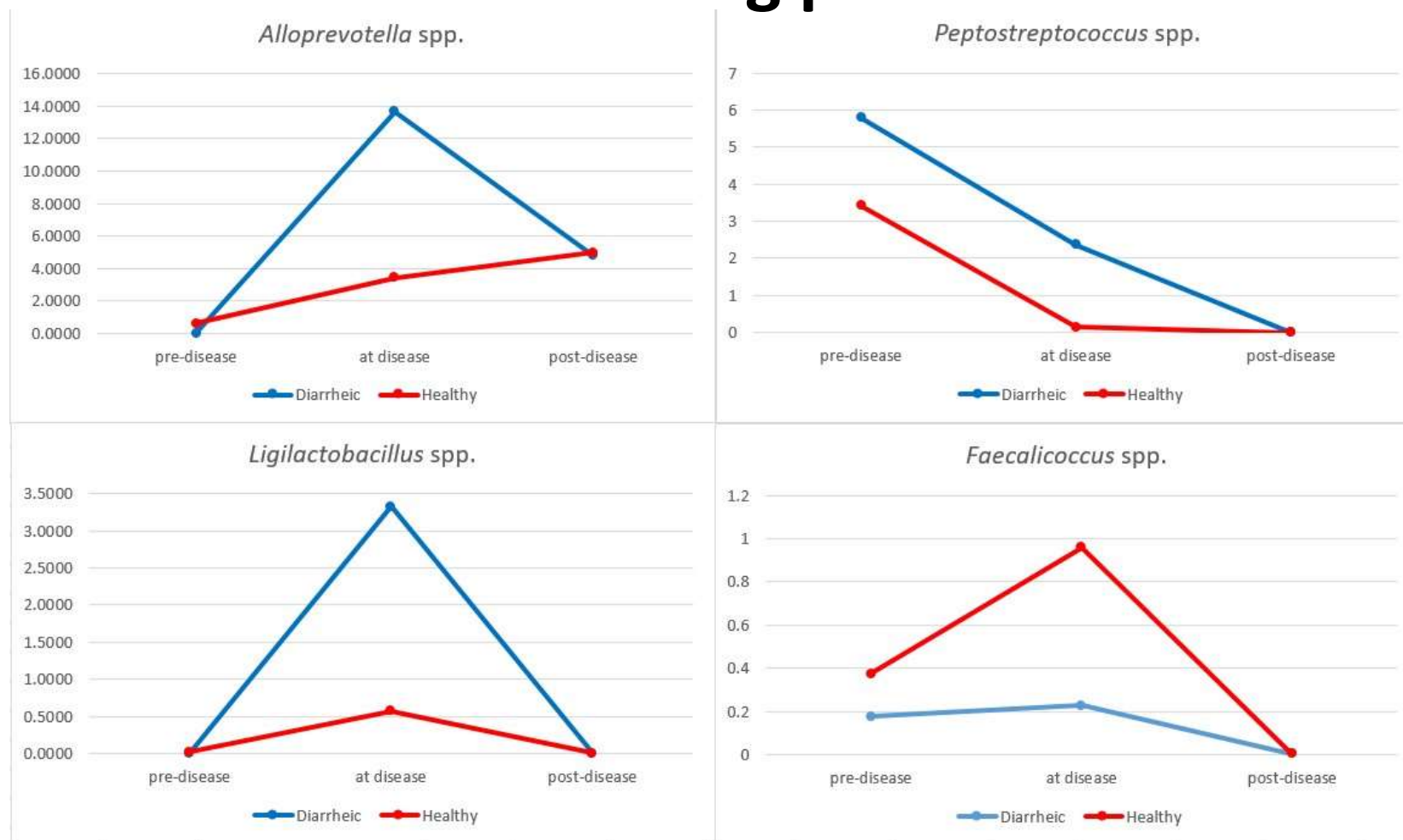


## Summary of results:

- **Changes in relative abundance of microbes during diarrhoeal incidence confirms bacterial dysbiosis**
  - *Alloprevotella* dominated the faecal microbiota of diarrheic calves at disease manifestation
  - *Bifidobacterium* dominated in healthy calves
- *Alloprevotella*, *Prevotella* both generally thought of as commensals/normal gut flora, found to be associated with GI disease



# Changes in relative abundance over the pre-weaning period

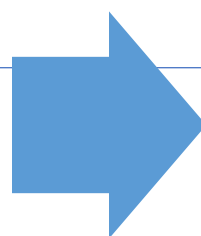


# Associations: intra-ASVs

## Intra-ASVs during disease manifestation

	<i>Alloprevotella</i>		<i>Bifidobacterium</i>	
	Negative	Positive	Negative	Positive
<b>Strong</b> ( $p \leq 0.01$ ) $r_s$ : 0.60-0.79	<i>Faecalicoccus</i> <i>Akkermansia</i> <i>Intestinibacter</i>	<i>Prevotella_9</i>	None	<i>Prevotella_7</i>
<b>Moderate</b> ( $p \leq 0.01$ ) $r_s$ : 0.40-0.59	<i>Bifidobacterium</i> <i>Prevotella_7</i> <i>Flavonifractor</i> <i>Dialister</i>	<i>Peptostreptococcus</i> <i>Prevotella</i> <i>Ligilactobacillus</i>	<i>Ligilactobacillus</i> <i>Prevotella</i> <i>Peptostreptococcus</i>	<i>Colinsella</i> <i>Faecalicoccus</i> <i>Flavonifractor</i> <i>Dialister</i> <i>Intestinibacter</i>
<b>Weak</b> ( $p \leq 0.01$ )	<i>Butyricimonas</i> <i>Desulfovibrio</i>	<i>Alisonella</i>	<i>Escherichia-Shigella</i>	[f] <i>Ruminococcaceae</i> <i>Erysipelatoclostridium</i>

ASVs observed in diarrheic calves were negatively correlated to ASVs found to be associated with good gut health



ASVs observed in healthy calves have previously been associated with good gut health and are positively associated with one another



# Applications and future work



- Depicting dysbiosis of the hindgut microbiota:
  - development targeted treatments and preventative practices
- Exploring intra-ASV relationships:
  - Clearer image of bacterial interactions
  - Better products for good hindgut health and diarrhoea prevention
- Future work:
  - The function of these microbes in the gut
  - Changes in these functions and diarrhoeal disease

# Conclusions

- Supporting animal health in early life is critical to long term animal health
  - Supporting good gut microbiome development is a key component of this
- Diversity and composition of the microbiota change based on time **AND** animal health status
- Changes in %RA **pre-disease to diarrhoeal incidence** confirms microbial dysbiosis
- *Alloprevotella* was negatively associated with genera associated with good gut health
- Correlations intra-ASVs describe changes in the hindgut microbiota and the dysbiosis associated with diarrhoea





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# Thank you for your time

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