

Synthetic
BIOLOGICS



Protecting the Gut Microbiome from Antibiotics

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Digestive Disease Week

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San Diego, CA

Forward-Looking Statements

This presentation includes forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995, as amended, on Synthetic Biologics' current expectations and projections about future events. In some cases forward-looking statements can be identified by terminology such as "may," "should," "potential," "continue," "expects," "anticipates," "intends," "plans," "believes," "estimates," "indicates," and similar expressions. These statements are based upon management's current beliefs, expectations and assumptions and are subject to a number of risks and uncertainties, many of which are difficult to predict and include statements regarding benefits to be derived from use of SYN-004 (ribaxamase), SYN-006, and SYN-007. The forward-looking statements are subject to risks and uncertainties that could cause actual results to differ materially from those set forth or implied by any forward-looking statements. Important factors that could cause actual results to differ materially from those reflected in Synthetic Biologics' forward-looking statements include, among others, our product candidates demonstrating safety and effectiveness, as well as results that are consistent with prior results, our ability to initiate clinical trials and if initiated, our ability to complete them on time and achieve the desired results and benefits, our clinical trials continuing enrollment as expected, our ability to obtain regulatory approval for our commercialization of product candidates or to comply with ongoing regulatory requirements, regulatory limitations relating to our ability to promote or commercialize our product candidates for the specific indications, acceptance of our product candidates in the marketplace and the successful development, marketing or sale of our products, developments by competitors that render our products obsolete or non-competitive, our ability to maintain our license agreements, the continued maintenance and growth of our patent estate, our ability to become or remain profitable, our ability to establish and maintain collaborations, our ability to obtain or maintain the capital or grants necessary to fund our research and development activities, a loss of any of our key scientists or management personnel, and other factors described in Synthetic Biologics' annual report on Form 10-K for the year ended December 31, 2018, subsequent quarterly reports on Form 10-Qs and any other filings we make with the SEC. The information in this presentation is provided only as of the date presented, and Synthetic Biologics undertakes no obligation to update any forward-looking statements contained in this presentation on account of new information, future events, or otherwise, except as required by law.

The Gut Microbiome Regulates Human Physiology

Gut Microbiota Involved in

Digestion
Immune Regulation
Protection from pathogens

Metabolic, CV, Neuro, Immune,
Inflammatory, and other diseases

Reservoir of antibiotic resistance



Disrupted by



Antibiotics

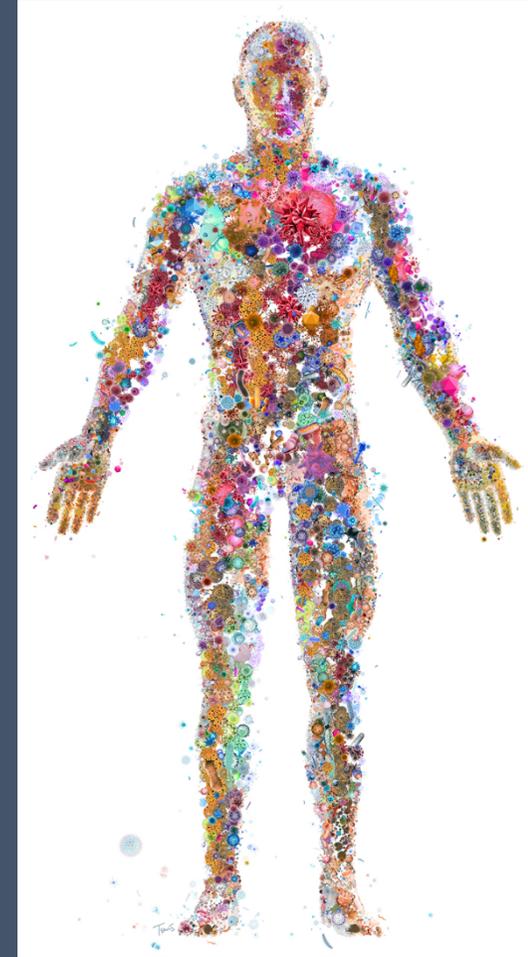
Opportunistic infections



C. difficile
VRE
MDR

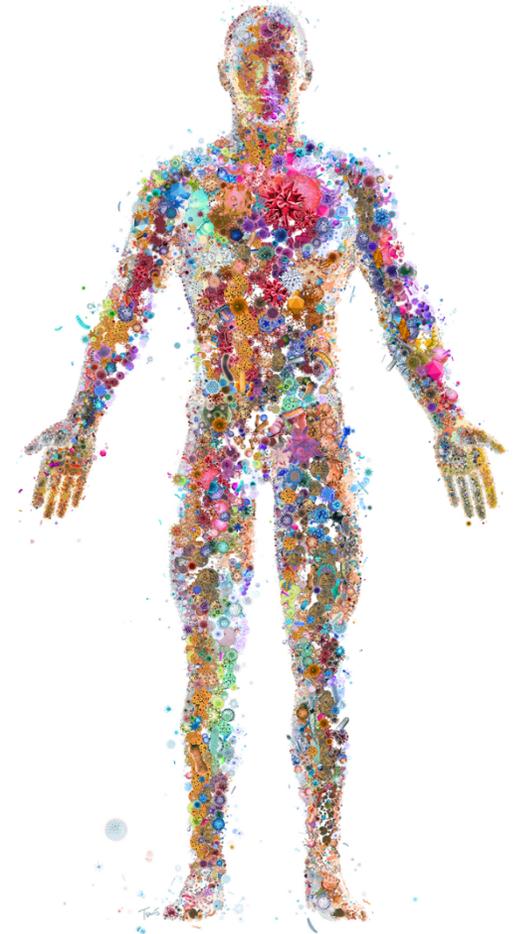
The Gut Microbiome Regulates Human Physiology

Synthetic Biologics is developing therapies designed to protect the gut microbiome from antibiotic collateral damage



Beta-Lactamases: From Enemies to Therapies

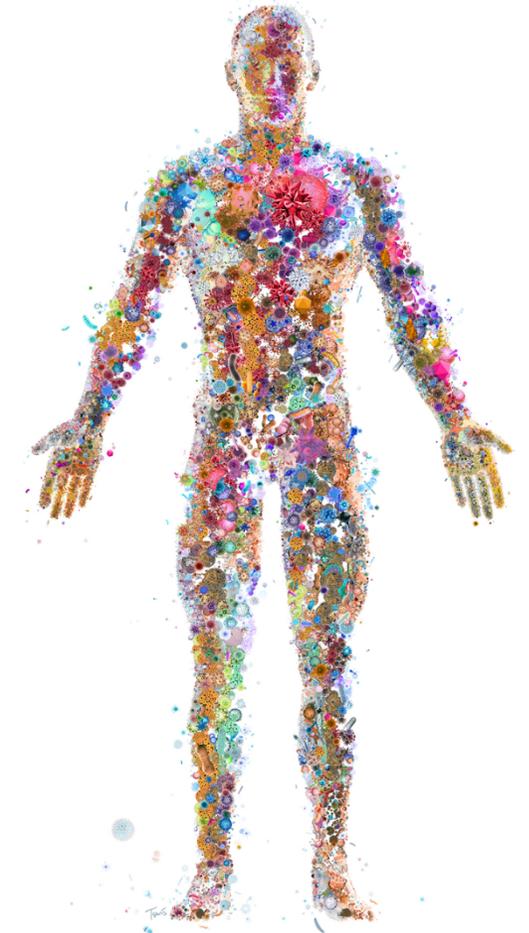
- SYN-004 (ribaxamase) is a beta-lactamase enzyme
- Formulated for oral delivery
- For use with selected IV beta-lactam antibiotics
- Released in the upper small intestine
- Intended to degrade antibiotics in the GI tract
- To protect gut microbiome



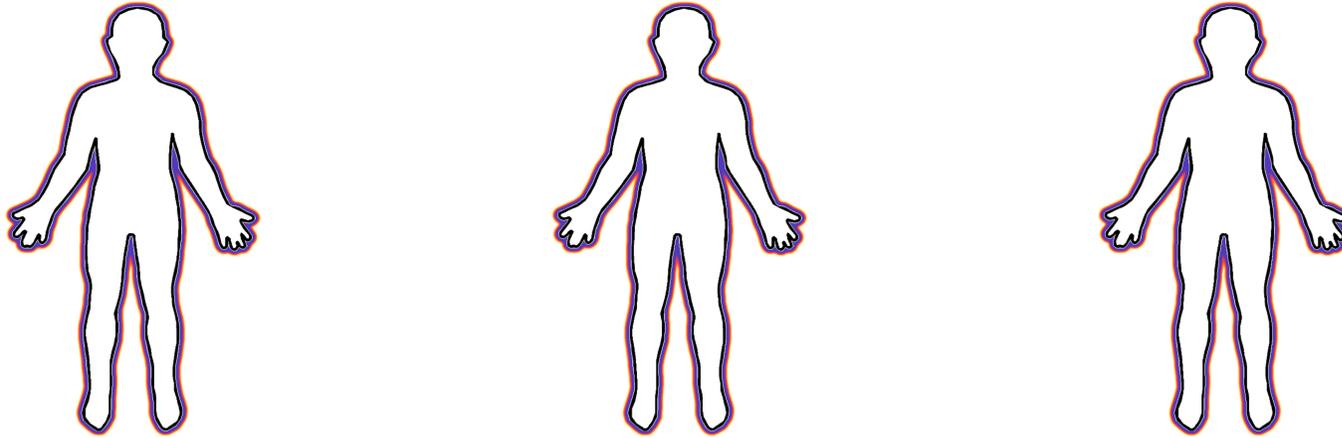
Beta-Lactamases: From Enemies to Therapies

Ribaxamase is intended to degrade residual antibiotics in the GI tract without affecting antibiotic infection control efficacy

- Protect the gut microbiome
- Prevent opportunistic infections (*C. difficile*)
- Reduce antibiotic resistance

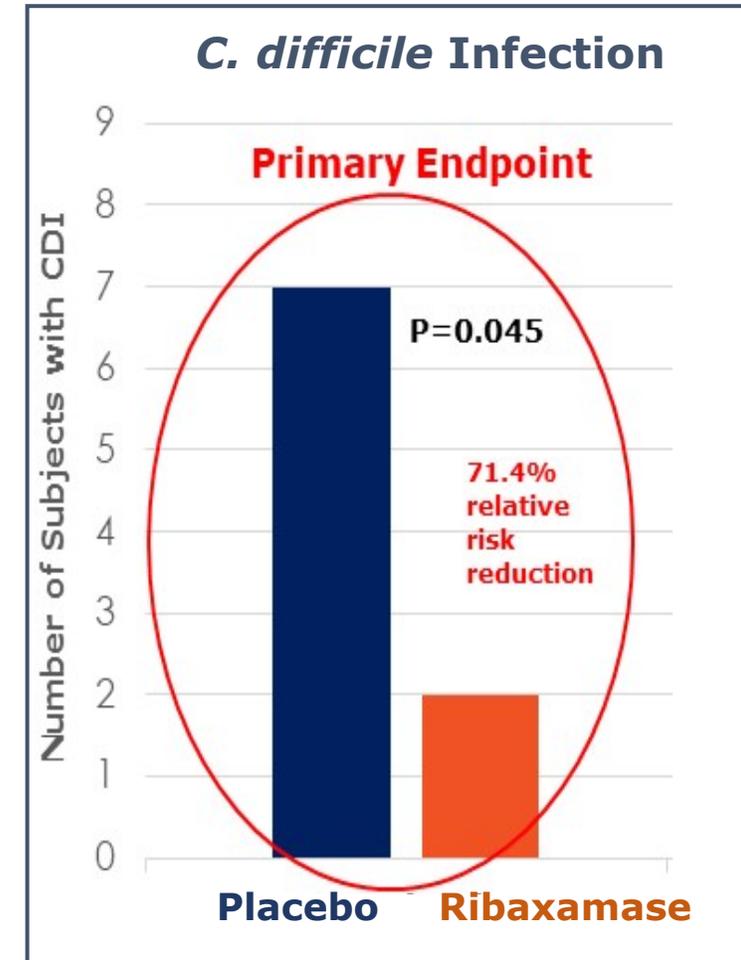


Ribaxamase Phase 2b Proof of Concept Clinical Study



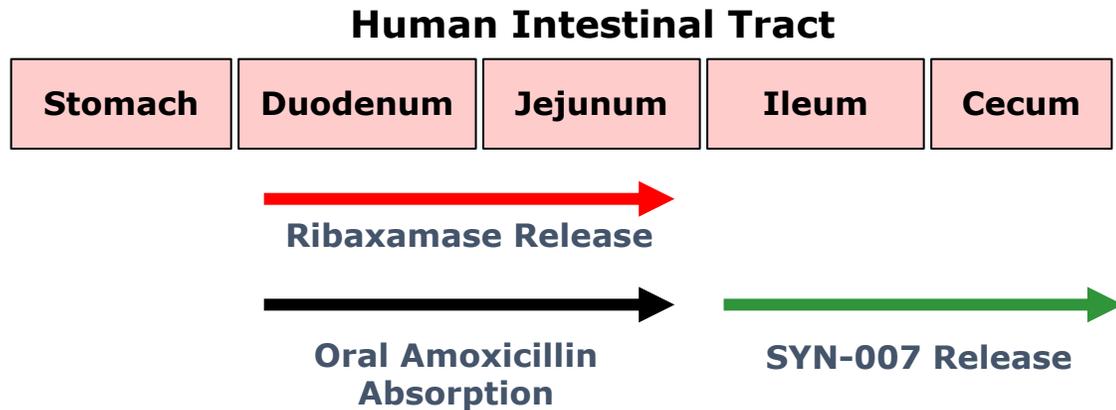
Patients received IV ceftriaxone for a lower respiratory infection + ribaxamase or placebo

- **Met primary endpoint** significant reduction in *C. difficile* disease
- **Significantly reduced** new colonization by VRE
- **Protected the gut microbiome** from antibiotic damage
- **Reduced emergence** of antibiotic resistance
- **Did not compromise** pulmonary infection control



SYN-007: Delayed Release Formula for Use with Oral Beta-Lactams

Ribaxamase is intended for use with selected IV penicillins and cephalosporins



SYN-007 → Use with oral antibiotics

- Delayed-released formulation of ribaxamase
- Intended for release distal to site of oral antibiotic absorption
- Tested in canine model

SYN-007 → Canine Study

Oral amoxicillin or oral amox/clavulanate +/- SYN-007 TID, 16 doses

Serum amox PK, after first and last dose

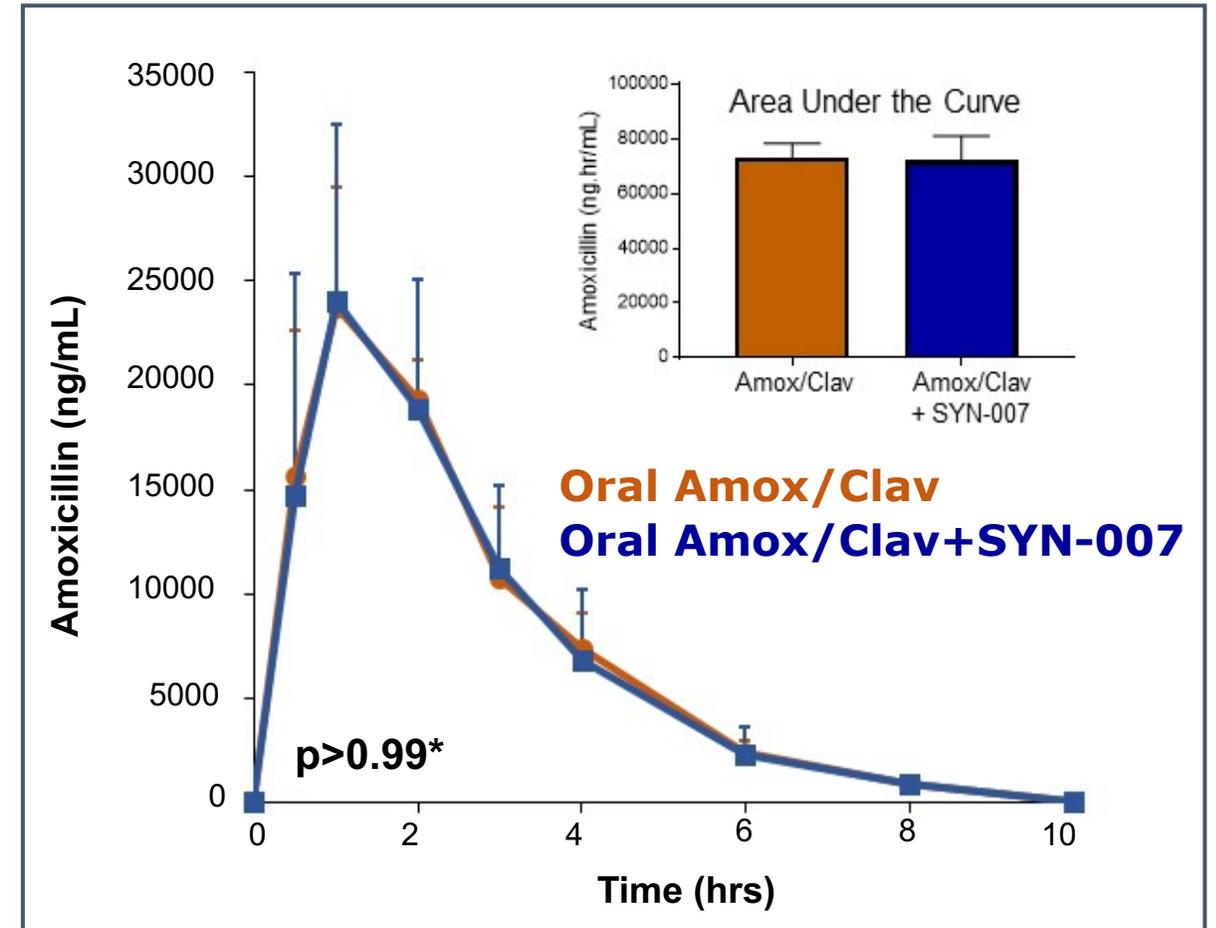
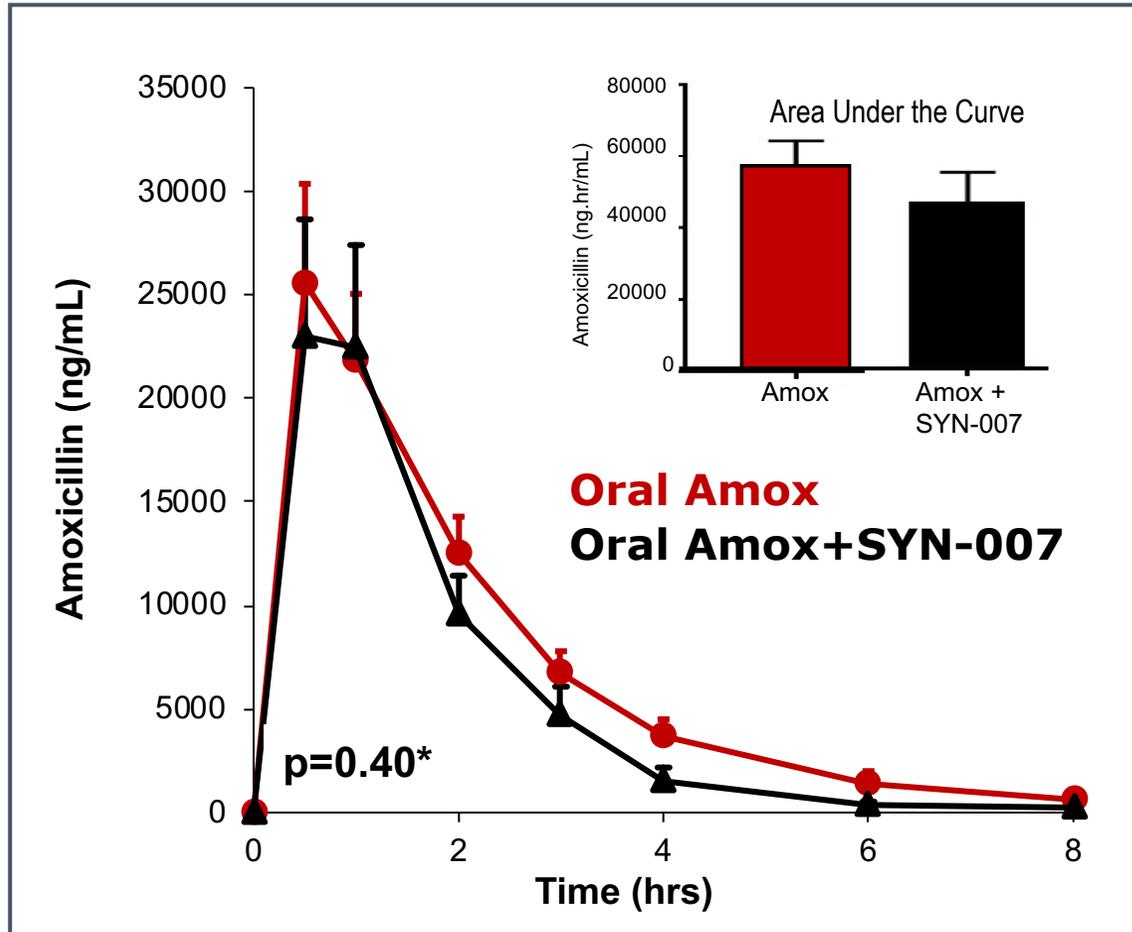
Feces for metagenomic analyses collected before and after treatment



SYN-007 Allows Oral Amoxicillin Absorption in Dogs



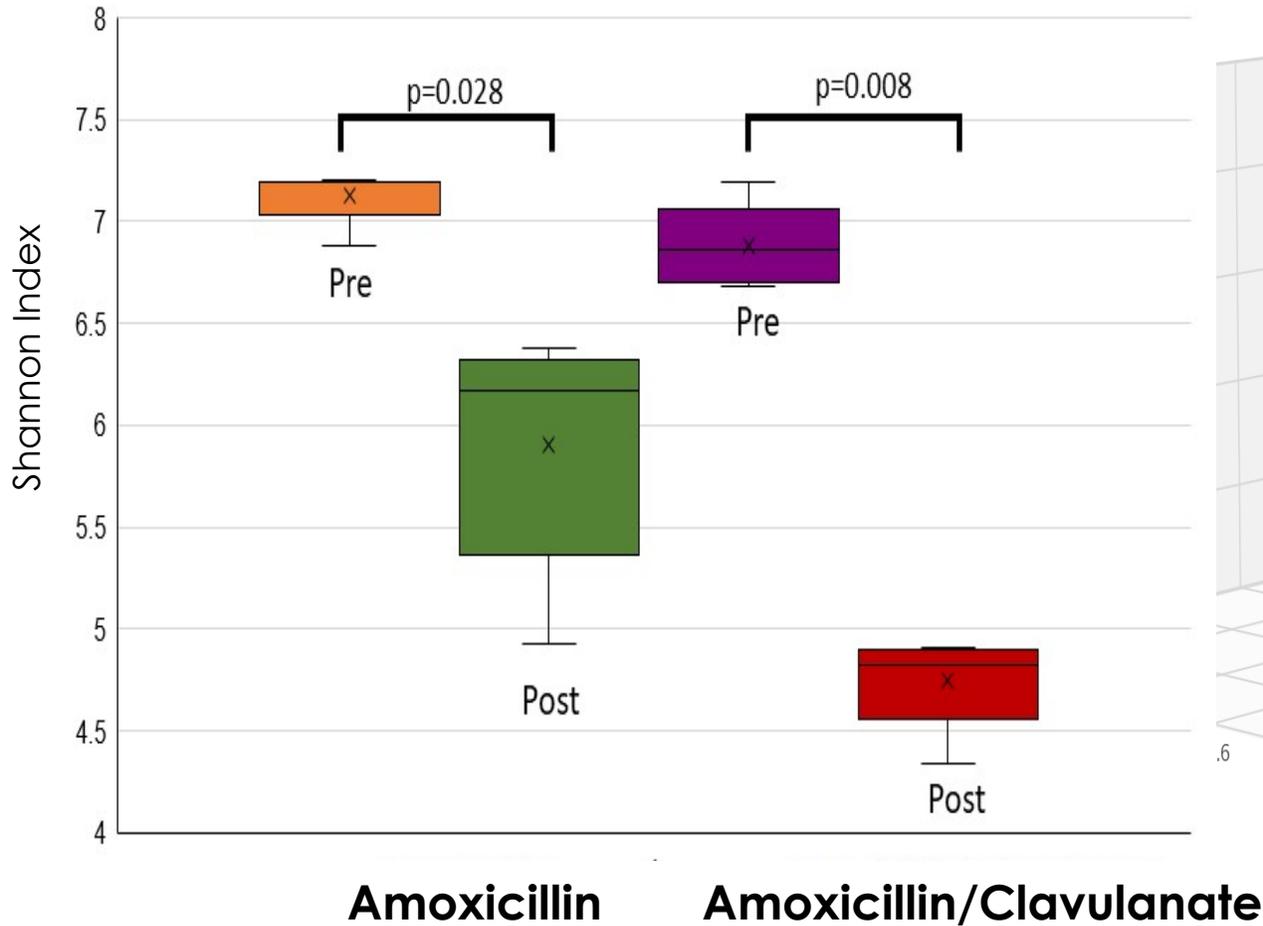
Amoxicillin Serum PK After 16 Doses



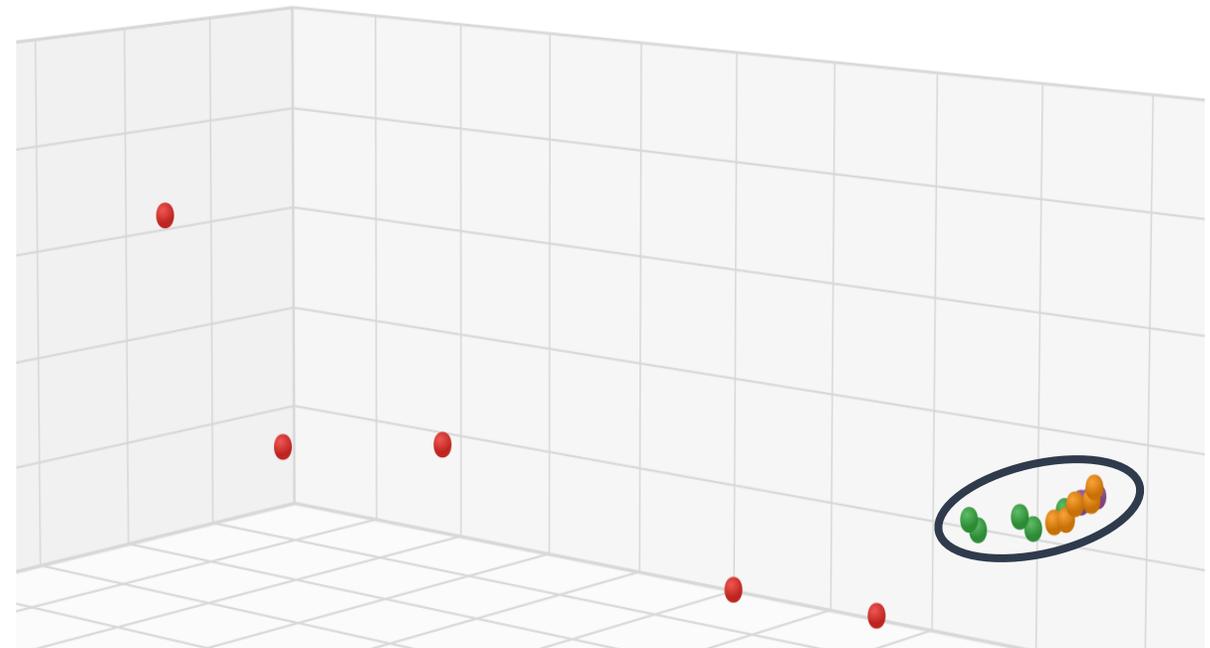
*Kruskal-Wallis nonparametric ANOVA with Dunn's multiple comparisons test

Amox/Clav Damages the Gut Microbiome More Than Amox Alone

Shannon Alpha Diversity



Principal Coordinate Analysis (Jaccard)

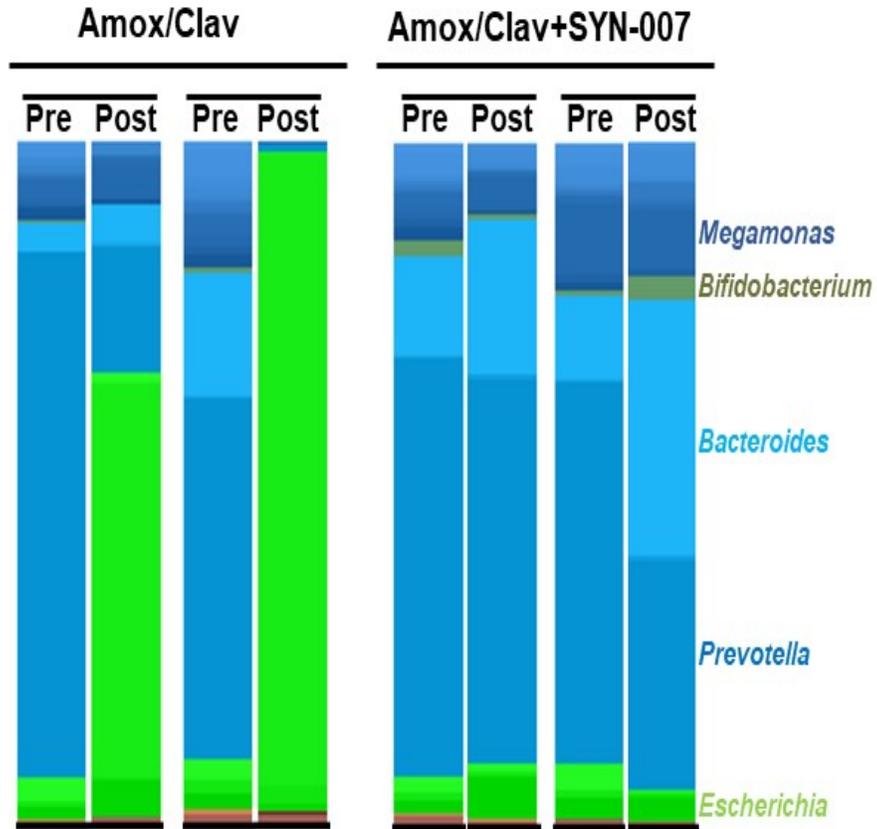


Pretreatment: Amoxicillin
Amoxicillin/Clavulanate

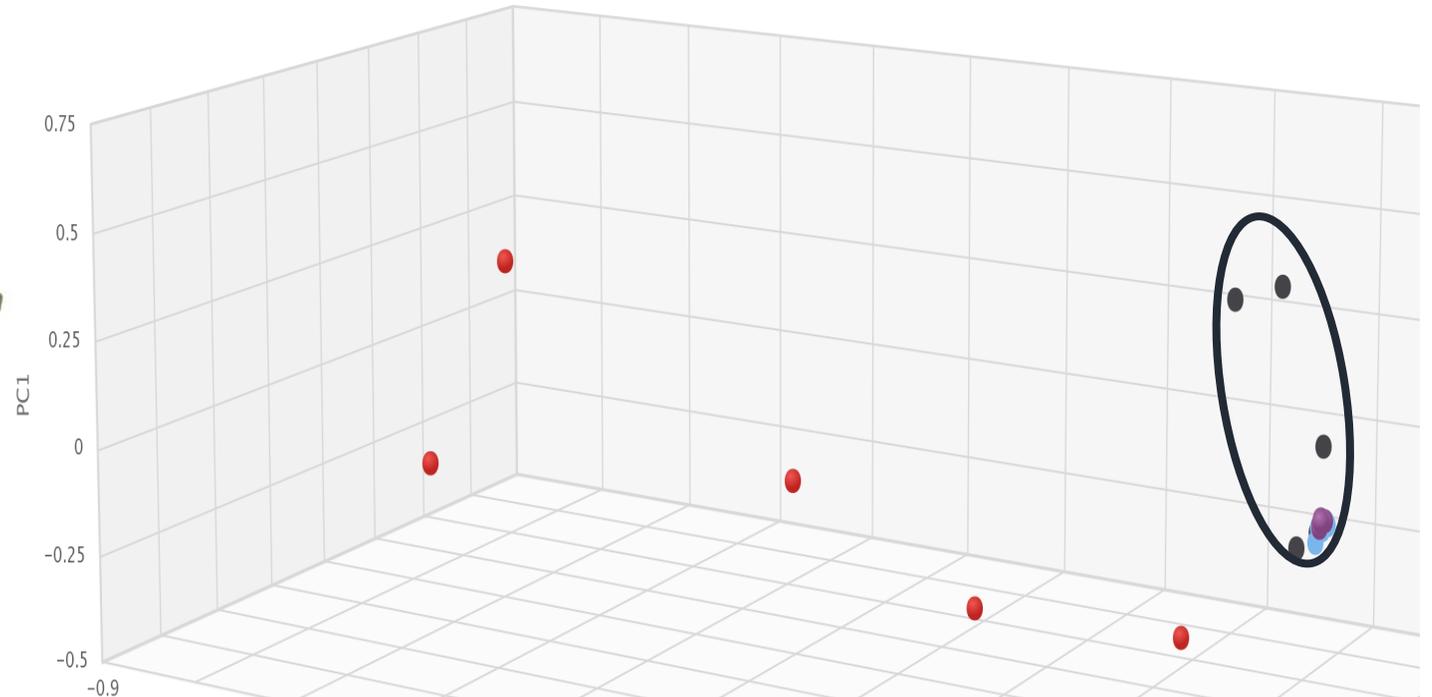
Post-treatment: Amoxicillin
Amoxicillin/Clavulanate

SYN-007 Protects Gut Microbiome from Amox and Amox/Clav in Dogs

Stack Bar Chart (Genus Level)



Principal Coordinate Analysis (Jaccard)



Pretreatment:

Amoxicillin/Clavulanate

Amoxicillin/Clavulanate + SYN-007

Post-treatment:

Amoxicillin/Clavulanate

Amoxicillin/Clavulanate + SYN-007

SYN-007 Reduces Emergence of Antibiotic Resistance Genes in Dogs



Summary

Ribaxamase is intended for use with selected IV beta-lactam antibiotics

SYN-007 is intended to expand microbiome protection to include selected oral beta-lactams

SYN-007

- Oral ribaxamase delayed release formulation
- Did not interfere with oral amoxicillin absorption in dogs
- Activity was not inhibited by clavulanate in the GI tract of dogs
- Protected the gut microbiome in dogs
- Reduced antibiotic resistance gene emergence in dogs



Ribaxamase and SYN-007 have the potential to protect the gut microbiome from antibiotic collateral damage and to mitigate emergence and spread of antibiotic resistance

Antibiotic inactivation represents a new treatment paradigm for preservation of the gut microbiome and reduction of antibiotic resistance



Acknowledgements

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Research and Development

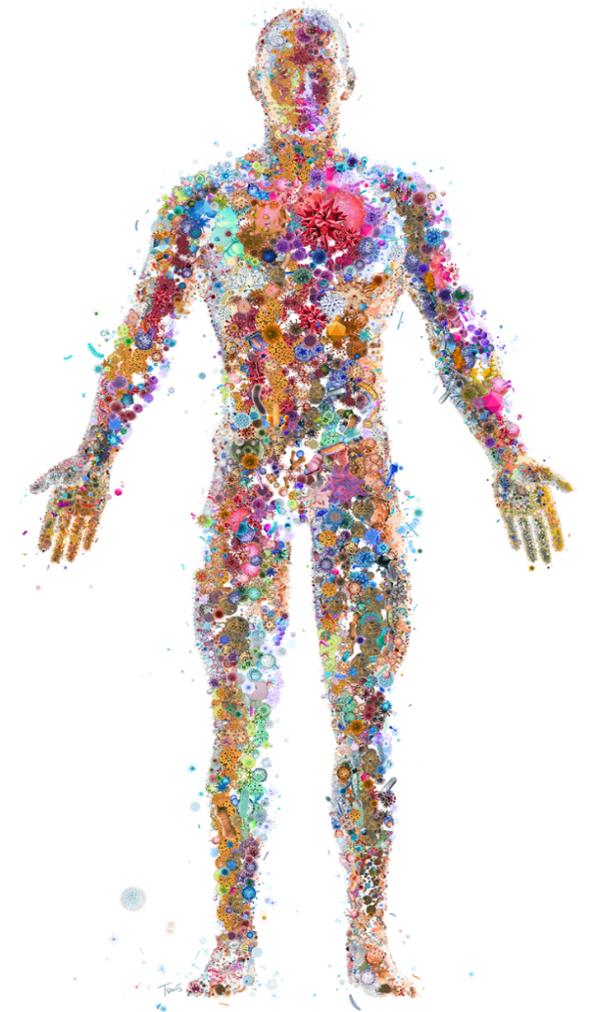
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Thank You

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