VITICUSGROUP™
WVC ANNUAL CONFERENCE
MARCH 2 - 5, 2025 | LAS VEGAS, NV

Prescription poop

The microbiome, dysbiosis and FMT

Fabio Procoli

DVM, MVetMed, DACVIM, DECVIM

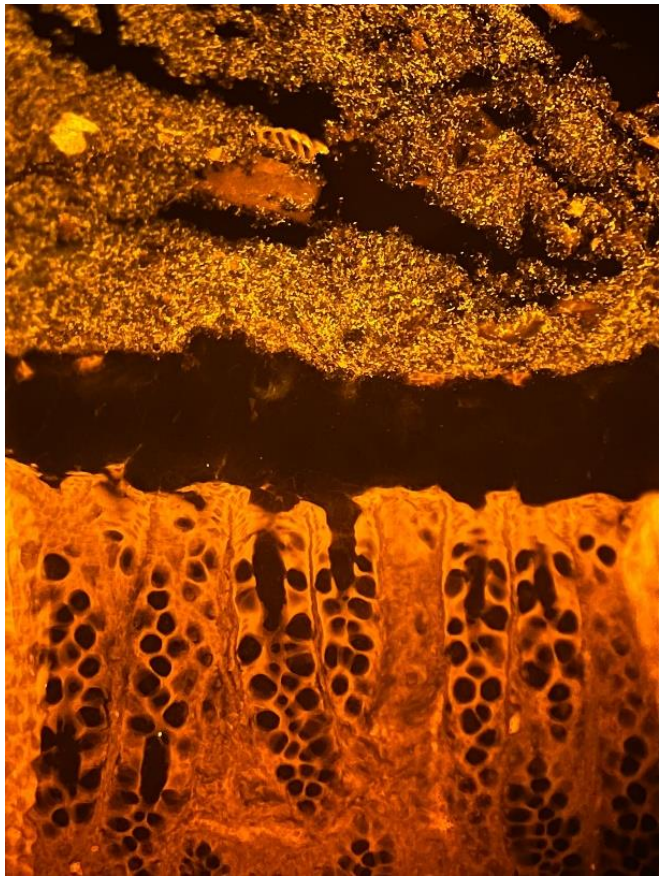
Financial Disclosure

I have received a speaker honorarium from IDEXX for delivering this session

The opinions expressed are mine and do not necessarily reflect the views of IDEXX

Intestinal microbiota

Courtesy of Jan Suchodolski GI LAB Texas A&M



Highly diverse and balanced ecosystem

Bacteria most represented with100 x 10^{12} microorganisms from >1000 species

Metabolic function

Beneficial metabolites

Short chain fatty acids (SCFA) – from dietary NFE/fiber

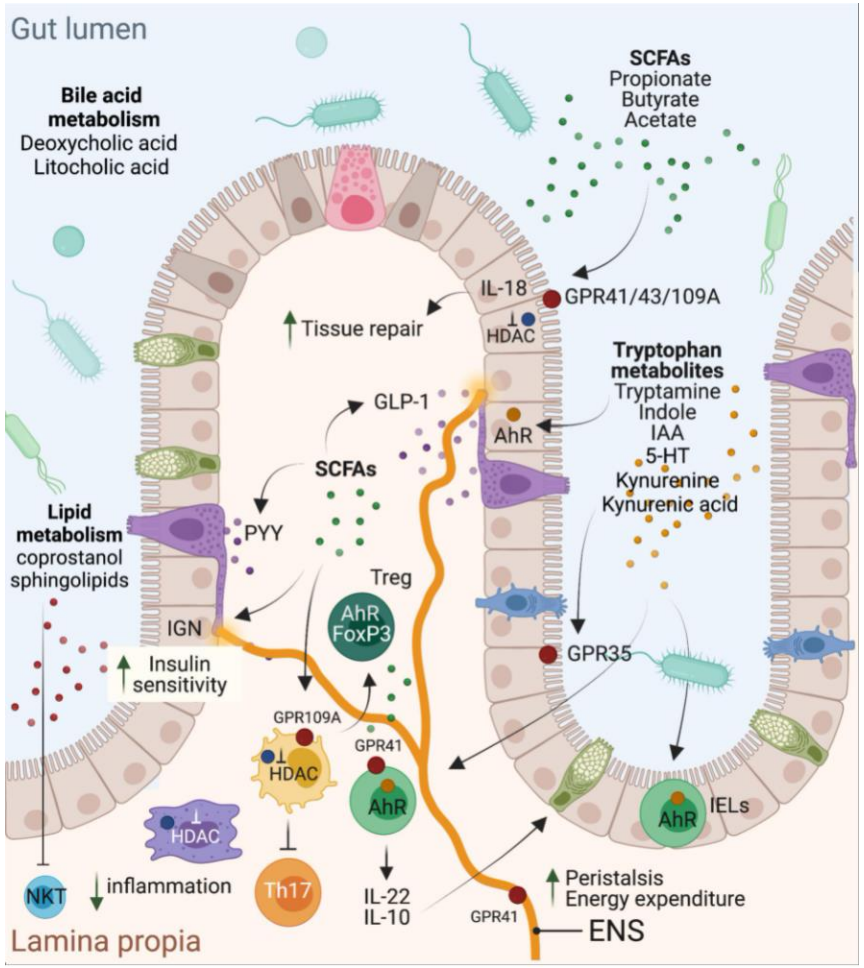
Faecalibacterium prausnitzii & others

Tryptophan + lipid metabolites (indole, kynurenine and kynurenic acid, sphingolipids)

Many bacterial species

Secondary bile acids (SBA) – from primary bile acids

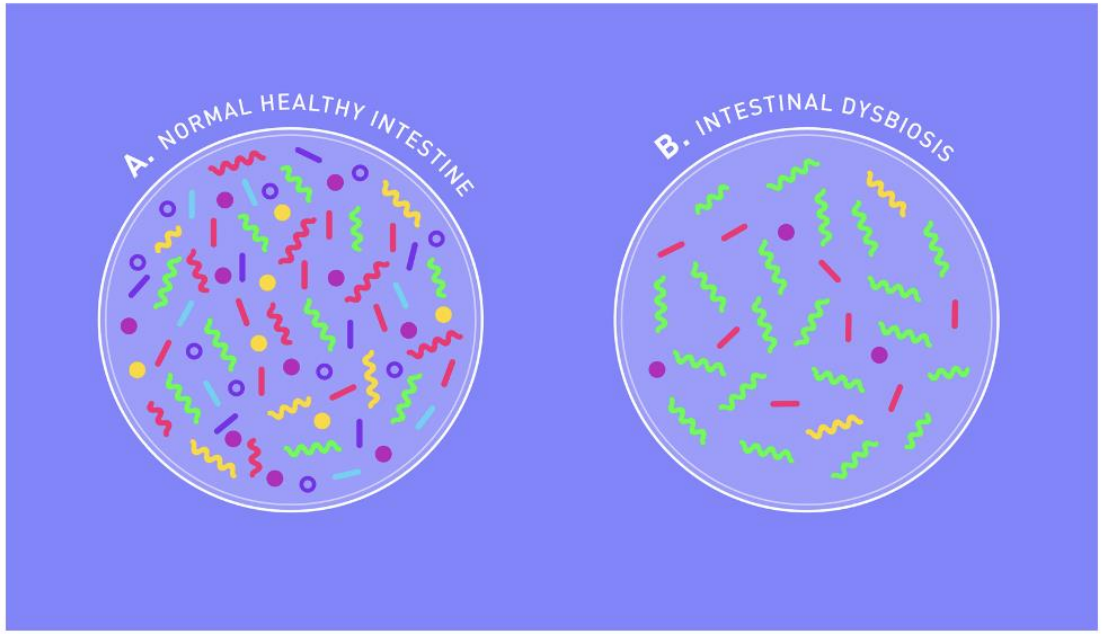
Peptacetobacter (once known as Clostridium) hiranonis (dogs & cats)



Tudela H, Claus SP, Saleh M. Front Cell Dev Biol. 2021;9:719072

Intestinal dysbiosis

Changes in composition and/or function of the intestinal microbiota



DeGruttola AK, et al. Inflamm Bowel Dis. 2016 May;22(5):1137-50

Disruptors of GI homeostasis

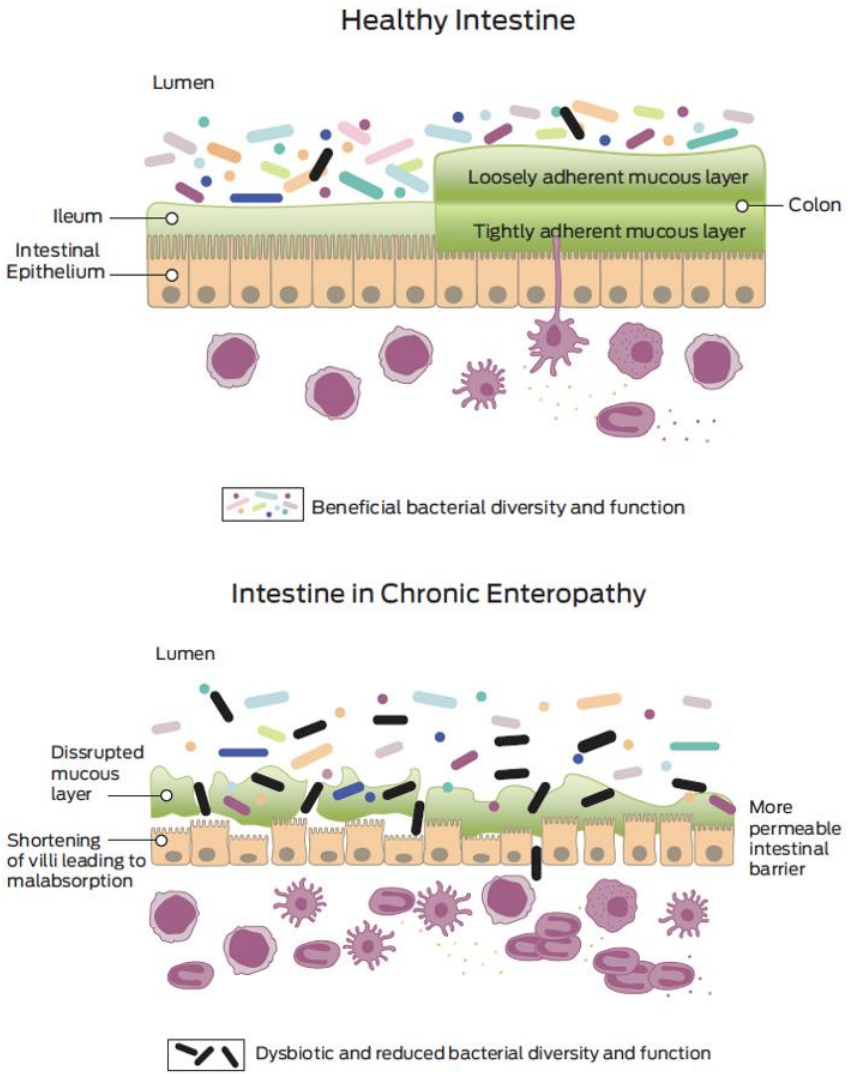
Poor quality diet*

Enteropathogens (CPV, FPV, FeCV)*

Antimicrobials*, NSAIDs, PPIs

Chronic enteropathy

especially early in life*



Suchodolski JS - In “Purina Institute - Canine and Feline Clinical Nutrition Handbook, 2023 edition”

Dysbiosis

1

↑ Number of bacteria

→ more bacterial metabolites → inflammation

2

Increased mucosa adhering bacteria

→ inflammatory stimulus

3

Excess/abnormal substrates in the intestinal lumen (nutrients, medications)

→ increased bacterial fermentation → osmotic diarrhea

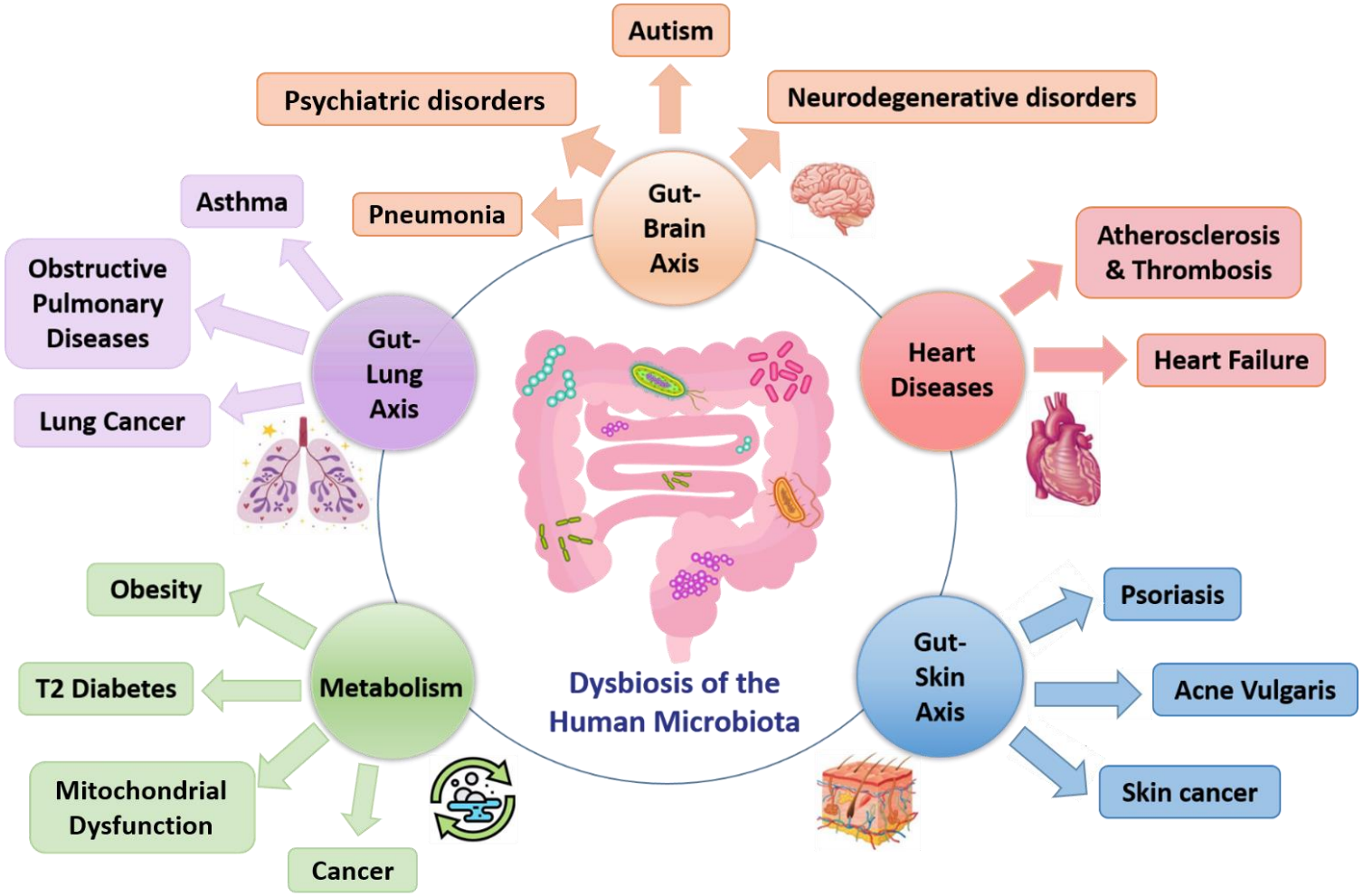
4

Shift in the microbiome

Lack of beneficial bacteria (e.g., P. hiranonis)

→ lack of secondary bile acids, overgrowth of pathobionts → inflammation

Related diseases in people



Gebrayel, P, *et al. J Transl Med* **20**, 111 (2022)

Intestinal dysbiosis in inflammatory bowel disease

Nirmal Kaur,[1,†] Chun-Chia Chen,[2,†] Jay Luther[1] and John Y. Kao[1,*]

Review

Gastrointestinal Microbiota and Type 1 Diabetes Mellitus: The State of Art

Marilena Durazzo *, Arianna Ferro and Gabriella Gruden

Review

Role of gut microbiota in type 2 diabetes pathophysiology

Manoj Gurung[a,1], Zhipeng Li[a,1], Hannah You[a,1], Richard Rodrigues[b], Donald B Jump[c], Andrey Morgun[b,*], Natalia Shulzhenko[a,*]

Review: The Role of Intestinal Dysbiosis in Parkinson's Disease

Yiying Huang[1†], Jinchi Liao[1†], Xu Liu[1], Yunxiao Zhong[1], Xiaodong Cai[2] and Ling Long[1*]*

Circulation Research

REVIEW

Gut Microbiota and Cardiovascular Disease

Marco Witkowski, Taylor L. Weeks, Stanley L. Hazen

Related diseases in dogs & cats

Antibiotic therapy

Exocrine pancreas insufficiency (EPI)

Chronic inflammatory enteropathies

Food indiscretion/acute enteropathies

Obesity

Diabetes mellitus

CKD

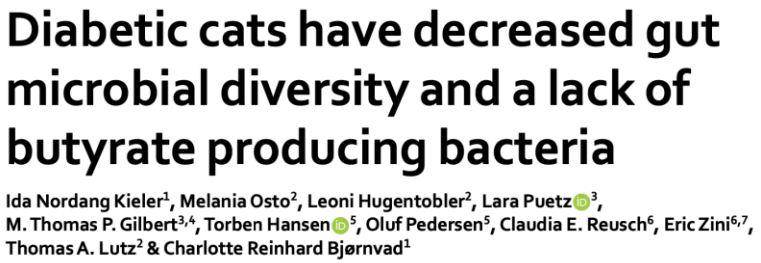
Atopic dermatitis


TOPIC HIGHLIGHT

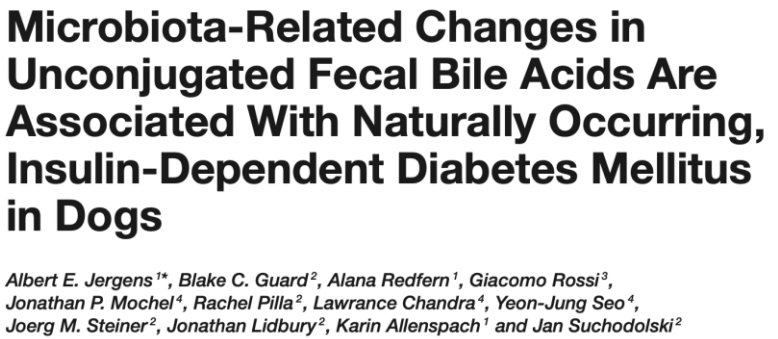
WJG 20th Anniversary Special Issues (17): Intestinal microbiota

Microbiota alterations in acute and chronic gastrointestinal inflammation of cats and dogs

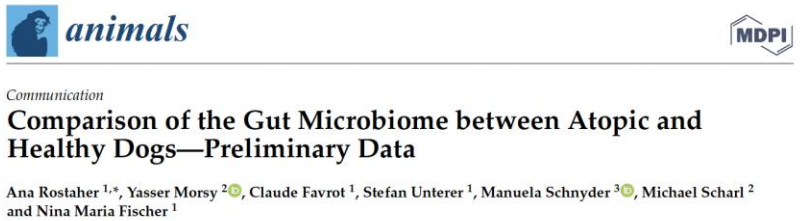
Julia B Honneffer, Yasushi Minamoto, Jan S Suchodolski


Diabetic cats have decreased gut microbial diversity and a lack of butyrate producing bacteria

Ida Nordang Kieler[1], Melania Osto[2], Leoni Hugentobler[2], Lara Puetz[3], M. Thomas P. Gilbert[3,4], Torben Hansen[5], Oluf Pedersen[5], Claudia E. Reusch[6], Eric Zini[6,7], Thomas A. Lutz[2] & Charlotte Reinhard Bjørnvad[1]


Microbiota-Related Changes in Unconjugated Fecal Bile Acids Are Associated With Naturally Occurring, Insulin-Dependent Diabetes Mellitus in Dogs

Albert E. Jergens[1], Blake C. Guard[2], Alana Redfern[1], Giacomo Rossi[3], Jonathan P. Mochel[4], Rachel Pilla[2], Lawrance Chandra[4], Yeon-Jung Seo[4], Joerg M. Steiner[2], Jonathan Lidbury[2], Karin Allenspach[1] and Jan Suchodolski[2]*


animals

MDPI

Communication

Comparison of the Gut Microbiome between Atopic and Healthy Dogs—Preliminary Data

Ana Rostaher [1,*], Yasser Morsy [2], Claude Favrot [1], Stefan Unterer [1], Manuela Schnyder [3], Michael Scharl [2] and Nina Maria Fischer [1]

Diagnosing dysbiosis in practice

TEXAS A&M UNIVERSITY
Gastrointestinal Laboratory

IDEXX

Fecal dysbiosis index (DI)

Rapid qPCR from fecal sample

Absolute abundance of **total bacteria** and 7 **key bacterial groups**

Data expressed as numerical index - DI

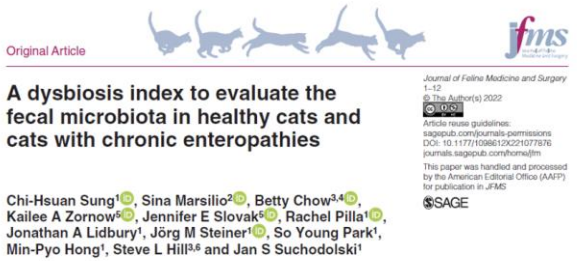
Absolute log count of 7 bacterial groups

Validated in dogs and cats!

RESEARCH ARTICLE

A dysbiosis index to assess microbial changes in fecal samples of dogs with chronic inflammatory enteropathy

MK AlShawaqfeh[1,2], B Wajid[1,3], Y Minamoto[1], M Markel[1], JA Lidbury[1], JM Steiner[1], E Serpedin[2] and JS Suchodolski[1,*]



Original Article

A dysbiosis index to evaluate the fecal microbiota in healthy cats and cats with chronic enteropathies

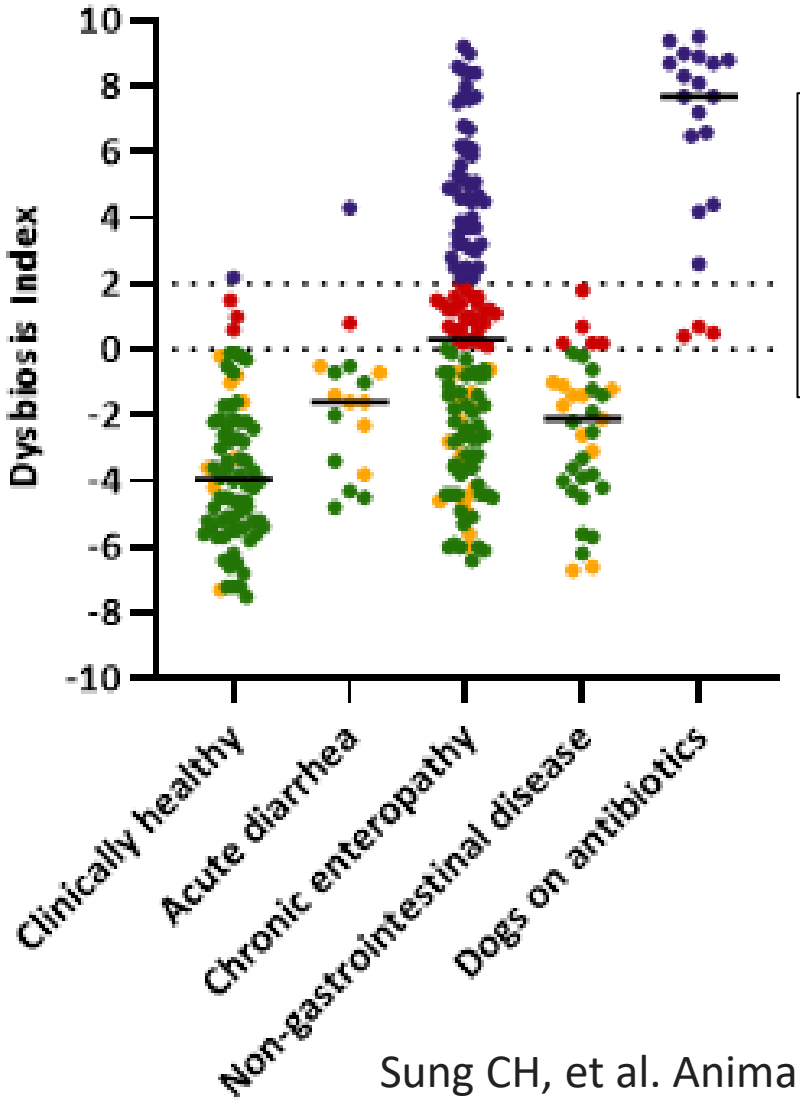
Chi-Hsuan Sung[1], Sina Marsilio[2], Betty Chow[3,4], Kailee A Zornow[5], Jennifer E Slovak[5], Rachel Pilla[1], Jonathan A Lidbury[1], Jörg M Steiner[1], So Young Park[1], Min-Pyo Hong[1], Steve L Hill[3,6] and Jan S Suchodolski[1]

Table 1. Reference intervals for dogs and cats

	Function	normal in Dogs	normal in Cats	Change in dysbiosis
Faecalibacterium	anti-inflammatory, production of SCFA	3.4 – 8.0	3.8 – 8.4	↓
Turicibacter	production of SCFA	4.6 – 8.1	4.4 – 9.0	↓
Blautia	production of SCFA	9.5 – 11.0	not measured	↓
Fusobacterium	production of SCFA	7.0 – 10.3	not measured	↓
Bifidobacterium	production of SCFA	not measured	3.2 – 8.7	↓
Bacteroides	production of SCFA	not measured	4.0 – 7.5	↓
Peptacetobacter hiranonis	conversion of primary to secondary bile acids	5.1 – 7.1	4.5 – 7.1	↓
Streptococcus	overgrowth associated with dysbiosis	1.9 – 8.0	1.6 – 5.2	↑
E. coli	pro-inflammatory	0.9 – 8.0	1.4 – 7.0	↑

Fecal DI – in practice

Dogs



significant dysbiosis (DI > 2) [**1 in cats]**

mild to moderate changes (DI between 0 and 2)

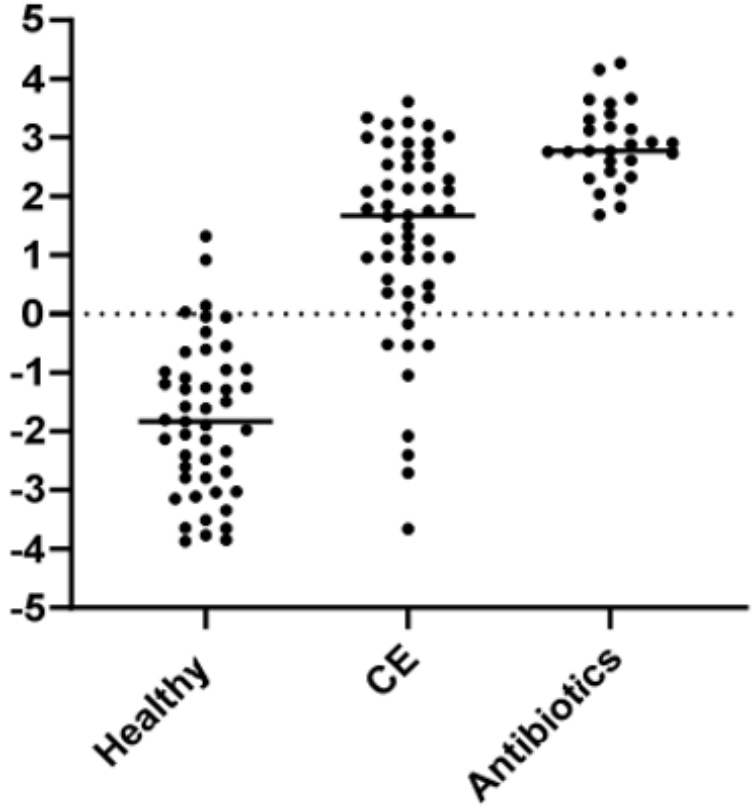
minor changes (DI < 0, some taxa abnormal)

normal (DI < 0, all taxa normal)

TEXAS A&M UNIVERSITY
Gastrointestinal Laboratory

IDEXX

Cats



https://vetmed.tamu.edu/gilab/

Sung CH, et al. Animals (Basel). 2023 Aug 11;13(16):2597.

Early marker of GI dysfunction in FCE

Variables	number (%)	total number evaluated
increased dysbiosis index (>0)	52 (76%)	68
decreased serum cobalamin (<290 ng/L)	21 (34%)	61
increased serum folate (>21.6 µg/L)	15 (28%)	53
increased fPLI (>3.5 µg/L)	14 (28%)	50
increased fTLI (>82 µg/L)	10 (21%)	47
decreased serum folate (<9.7 µg/L)	6 (11%)	53
decreased serum albumin (<2.5 g/dL)	2 (4%)	53

C Sung, JFMS, 2022

Clinical applications of fecal DI

Identify early changes in patients at risk – for early intervention

- Persistent clinical signs after antibiotic use

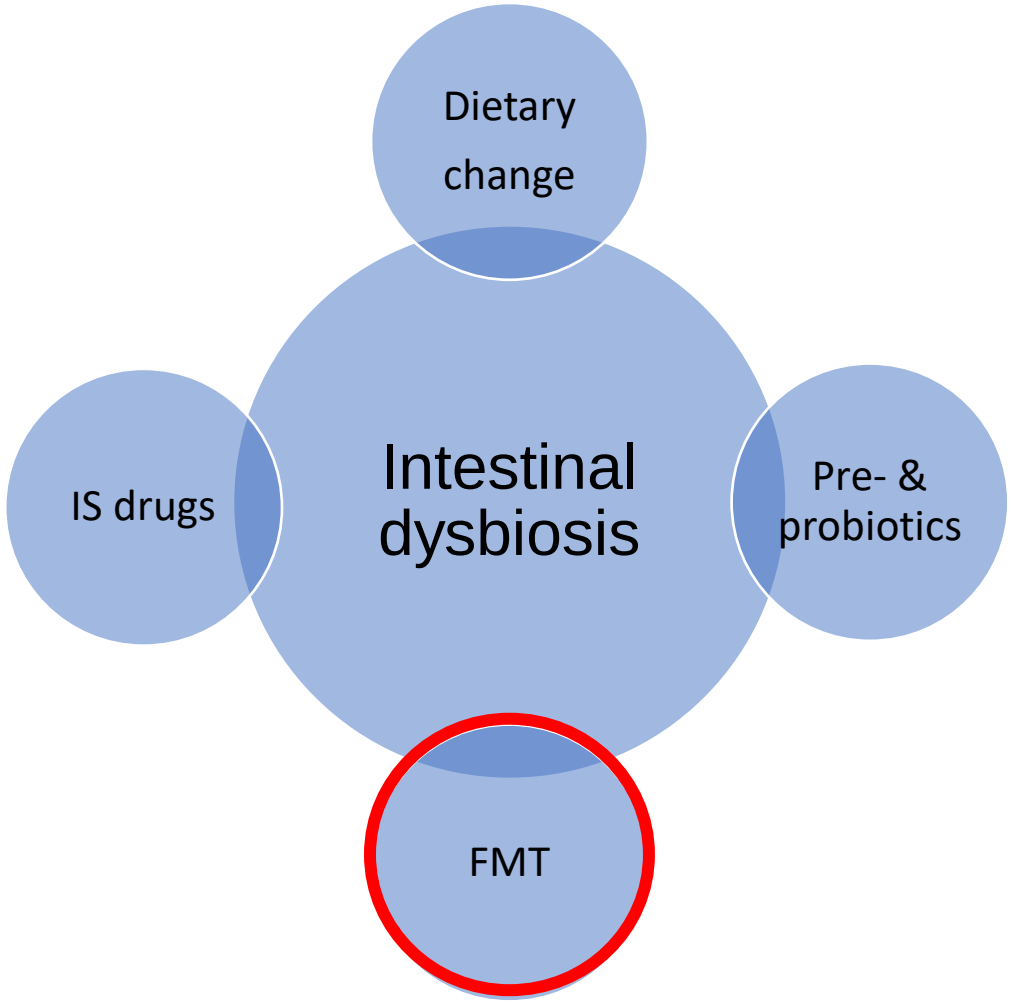
Based on severity and pattern of microbial shift (i.e. loss of *P. hiranonis*)

- Increase suspicion of chronic enteropathy in patient with recurrent/acute on chronic GI signs

Assess response to treatment

Screen for healthy fecal donors

Managing intestinal dysbiosis



Choice of strategy will depend on type/cause, duration and severity of dysbiosis

Multimodal versus sequential approach

Target (clinical remission versus cure) will depend on cause of dysbiosis

Fecal microbiota transplantation (FMT)

Infusion of **fecal matter** from a healthy donor into the gastrointestinal tract of a patient (to introduce or re-establish a stable microbial community) in order *to treat a dysbiosis-related disease*

Super poo: the emerging science of stool transplants and designer gut bacteria

Rawf8/Getty Images/iStockphoto

Major indication in people

Recurrent *Clostridiodes difficile infection* (CDI)

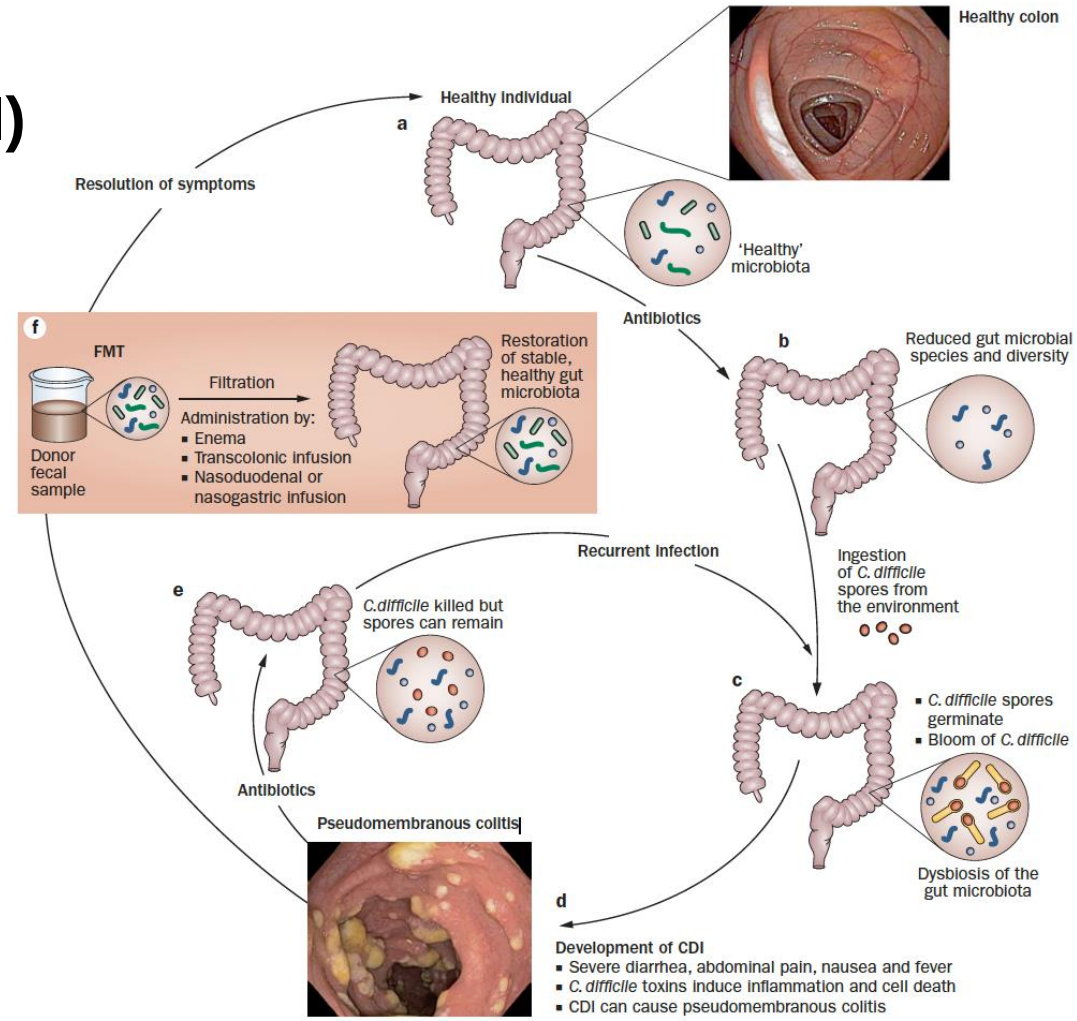
Acquired after antibiotic use + ingestion of environmental *CD* spores

Risk of relapse 20%
Chronic long-lasting CDI (antibiotic refractory)

Annual burden > 80,000$/patient

FMT therapeutic success rates > 90%

Very high safety profile



Borody TJ et al, Nat Rev Gastroenterol Hepatol. 2011: 20;9(2):88-96

Ongoing trials in people

Inflammatory bowel disease (IBD)

Irritable bowel syndrome (IBS)

Decolonisation from MDR organisms

Obesity

Metabolic syndrome

Neurological disorders

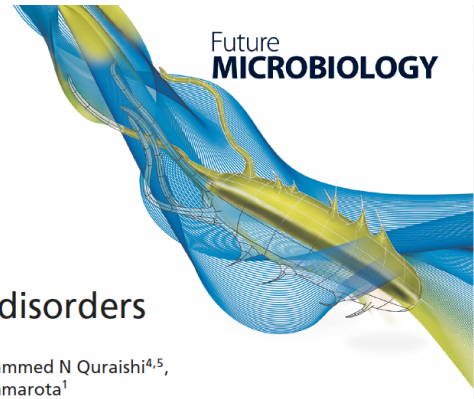
Autoimmune syndromes

Atopy and allergy

Liver disease and hepatic encephalopathy

Cancer

Chemo- and immunotherapy related GI signs



Review

For reprint orders, please contact: reprints@futuremedicine.com

Fecal microbiota transplantation in gastrointestinal and extraintestinal disorders

Gianluca Ianiro*[,1], Jonathan P Segal[2], Benjamin H Mullish[3], Mohammed N Quraishi[4,5], Serena Porcari[1], Ginevra Fabiani[1], Antonio Gasbarrini[1] & Giovanni Cammarota[1]

Efficacy of FMT in dogs and cats

Infectious diarrhea (*Parvovirus)* - dogs

Acute uncomplicated diarrhoea – dogs

Antibiotic-induced dysbiosis and diarrhoea – dogs, cats

Chronic GI signs refractory to diet/fibre - dogs, cats

SRE and NRE as adjunctive therapy (multimodal therapy) – dogs, cats

Retrospective
Under-powered
Uncontrolled studies
Clinical experience

Canine parvovirus infection

Pereira et al, 2019

66 puppies with CPVI

33 STD vs 33 STD + FMT

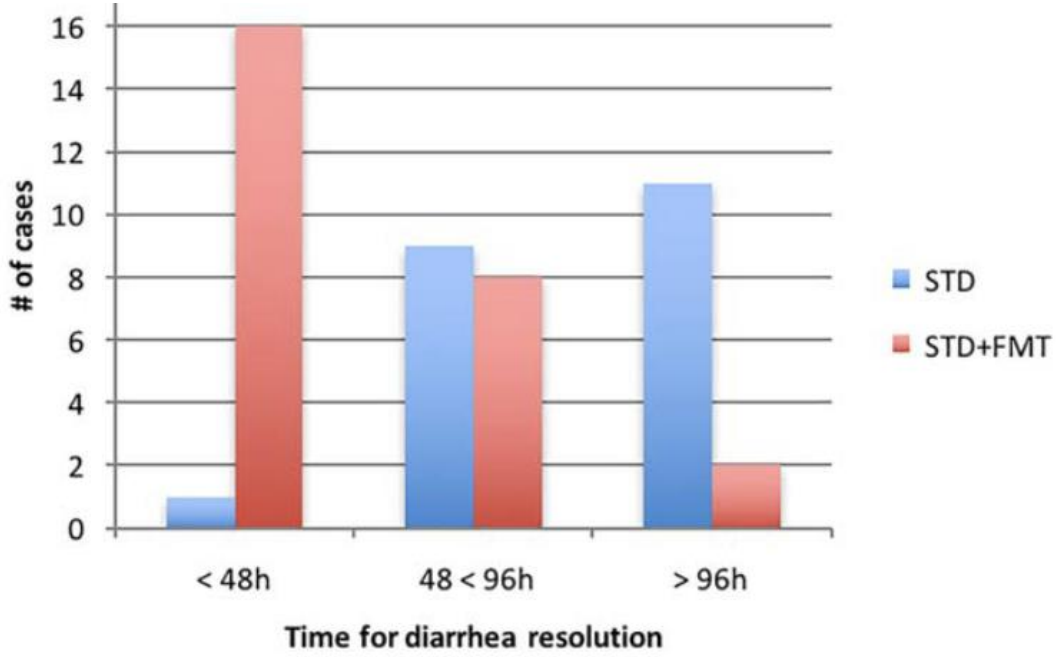
Faster resolution of diarrhoea in FMT

Shorter hospitalisation time

3 vs 6 days

No statistical difference in survival rates

For FMT, 10 g of feces from a healthy dog diluted in10 mL of saline were administered rectally 6-12 hours post-admission



Pereira GQ et al. *J Vet Intern Med* 2018

Acute uncomplicated diarrhoea

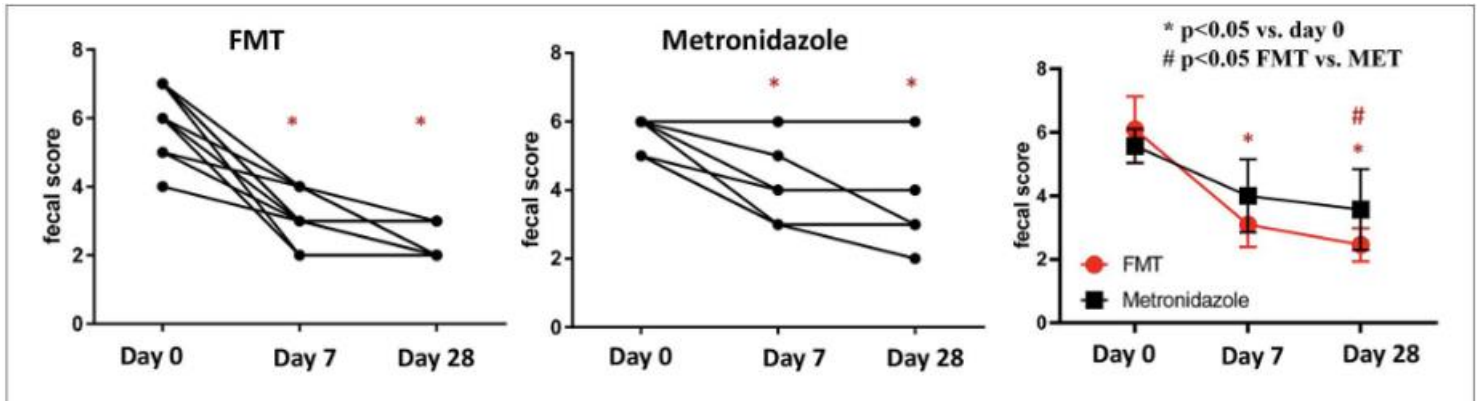
Chaitman et al, 2020

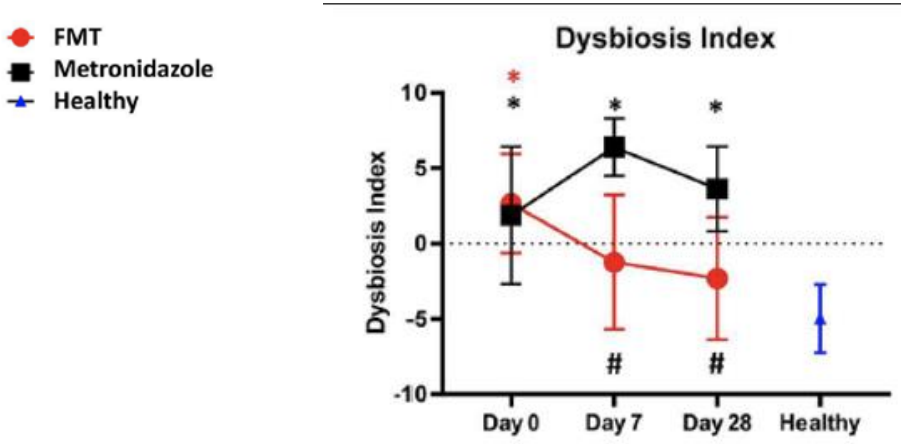
18 dogs treated with FMT (11) vs 7 days MTZ course (7)

Higher % of normal feces at D28 in FMT group

Resolution of dysbiosis in FMT group

Dysbiosis and disrupted metabolome in MTZ at day 28





Chaitman J et al. Front Vet Sci 2020;7:192

FMT for canine SRE

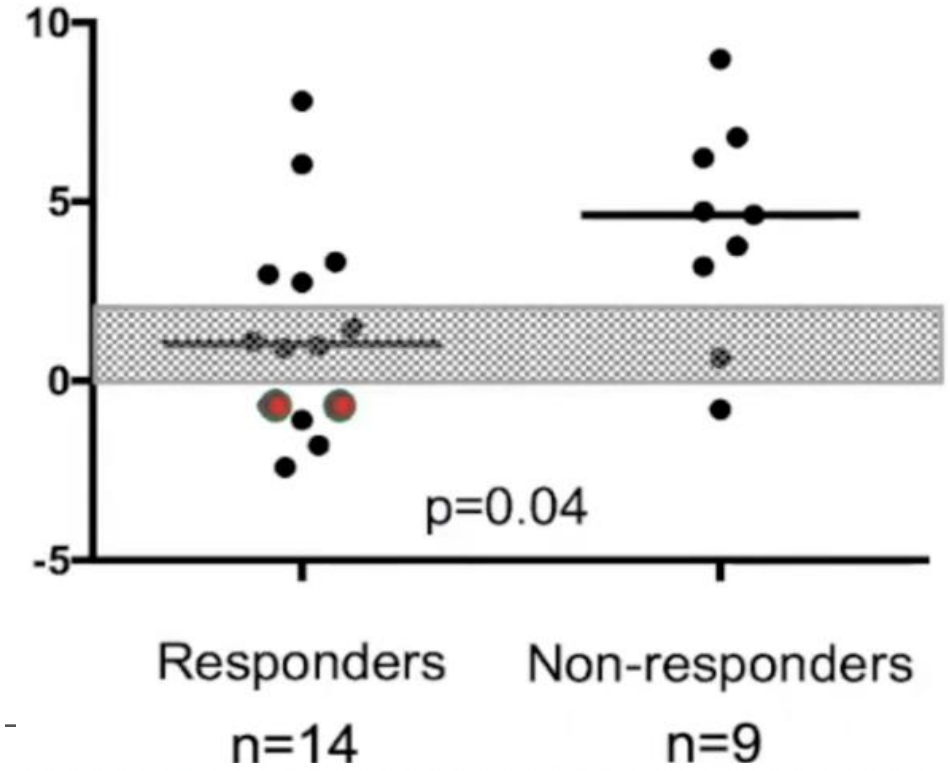
Toresson et al, 2022
Retrospective study of 41 dogs with SRE

Treated via – retention enema

Median 3 FMTs 14 days apart

72% of dogs showed satisfactory clinical response

Degree of dysbiosis (DI) predicted response to FMT



veterinary sciences

MDPI

Article

Clinical Effects of Faecal Microbiota Transplantation as Adjunctive Therapy in Dogs with Chronic Enteropathies—A Retrospective Case Series of 41 Dogs

Linda Toresson [1,2,*], Thomas Spillmann [1], Rachel Pilla [3], Ulrika Ludvigsson [2], Josefin Hellgren [2], Gunilla Olmedal [2] and Jan S. Suchodolski [3]

FMT in food refractory canine CE

AniCura
OSPEDALE VETERINARIO
I PORTONI ROSSI

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI SCIENZE MEDICHE VETERINARIE

Vecchiato C et al (ECVIM Congress 2023) – in press

20 dogs with idiopathic chronic GI signs

No response to 2-weeks trial with hydrolysed or single protein home cooked diet

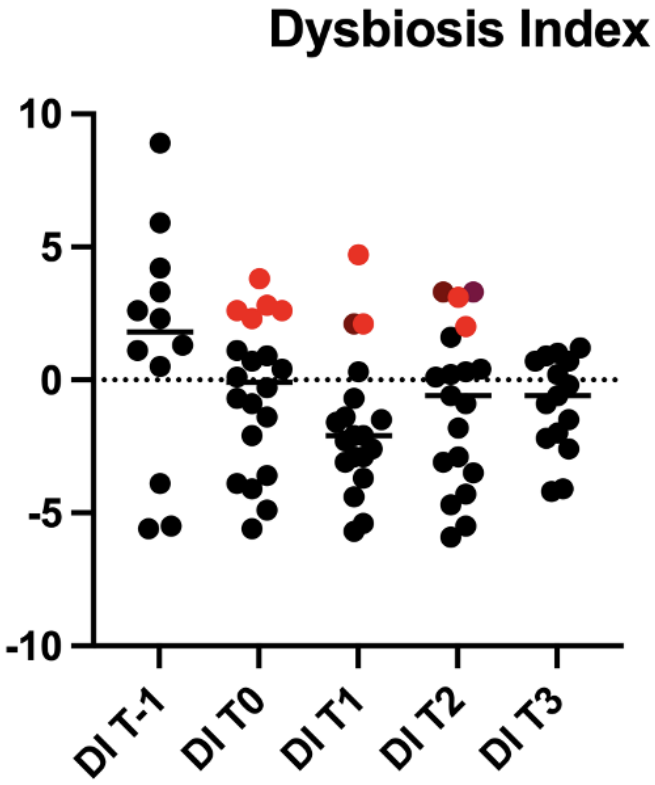
8 x 1 FMT - 12 x 2 FMTs

Clinical response in 20/20

FCS from 4 (1-7) to 2 (1-5) at 60 days

CIBDAI from 5 (1-9) to 1 (0-3) at 90 days

DI from 0.1 (range -5.6 to 3.8) – 2.1 (range -5.7 to 4.7)



Oral FMT canine CE

Innocente et al, 2022*

27 dogs enrolled in “Pet FMT Project”

(Italian crowdsourced project)

Improvement of clinical signs reported in 74% cases

Defined by drop in CCECAI by at least 2 points

15 days after end of FMT

Median CCECAI from 5 to 2

No difference in microbiome richness, diversity and composition after FMT compared to t0

- **No data beyond 15 days**

*Innocente G, et al *Veterinary Sciences* 2022

First Case Report of Fecal Microbiota Transplantation in a Cat in Israel

Furmanski, S.[1,*] and Mor, T.[2]

FMT (enema) as a last therapeutic option for cat before euthanasia

Immediate improvement in fecal texture, odor and color

Second FMT was performed 5 weeks later for relapse
Over a 3-month period gradual return to normal stools

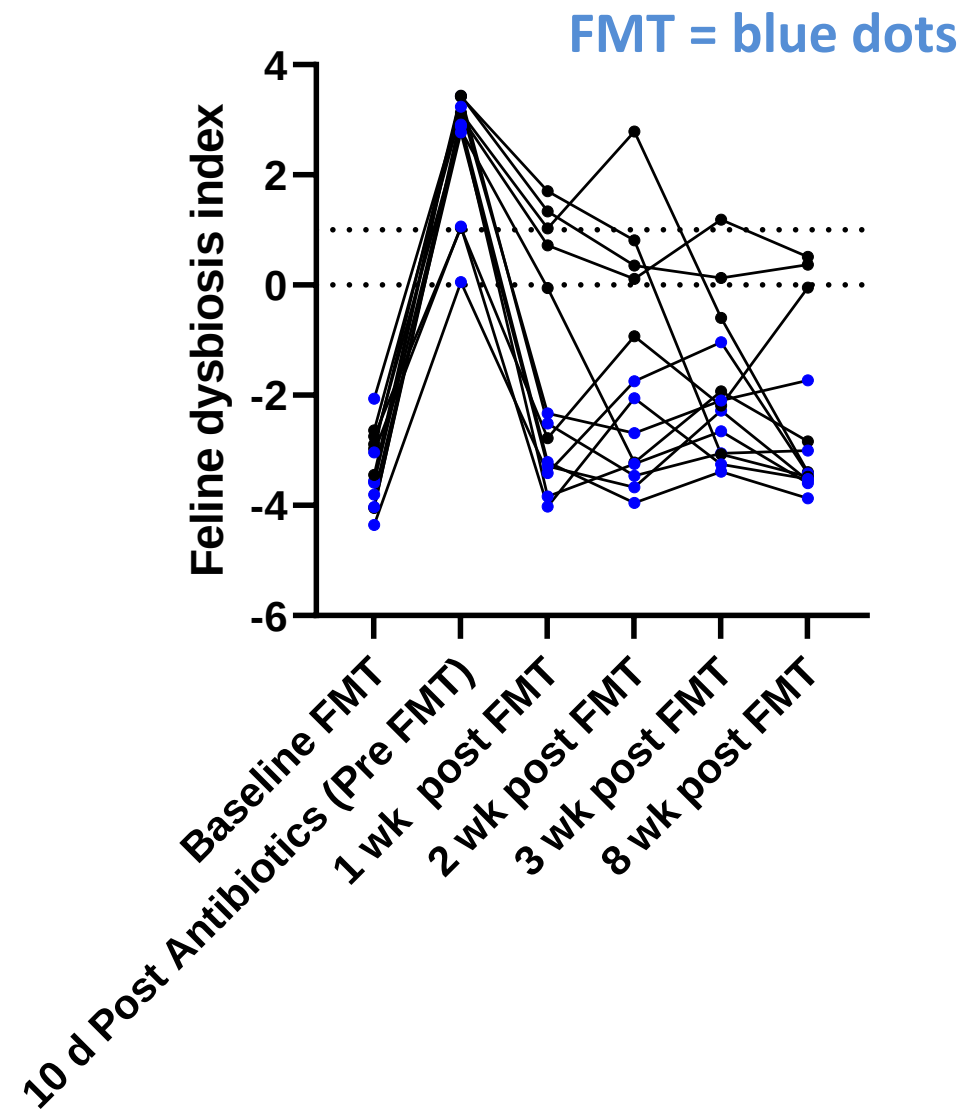
11 months after 2nd FMT cat in remission

FMT for antibiotic induced dysbiosis

Jamie Hui et al, *ACVIM abstract 2022*

Healthy cats treated for 10 days with amoxyclav

FMT via enema (**blue**) or placebo (**black**) after last day of antibiotic



Oral FMT for chronic GI signs in cats

Rojas et al, 2022

No data beyond 15 days

68 cats experiencing chronic vomiting, diarrhea, and/or constipation

35 FCE, 13 possible FCE, 20 other causes for GI signs (presumed diagnoses)

50% had/were receiving antibiotics

Owners' questionnaires 2 weeks after last cps

- Improved 77% (52/68)
- No changes 16% (11/68)
- Worsened 7% (5/68)

animals

MDPI

Microbiome responses to fecal microbiota transplantation in cats with chronic digestive issues

Connie A. Rojas[1,2], Zhandra Entrolezo[3], Jessica K. Jarett[3], Guillaume Jospin[3], Dawn D. Kingsbury[3], Alex Martin[3], Jonathan A. Eisen[1,2], Holly H. Ganz[3]*

Instruction for use

Donor screening & preparation

Clinical guidelines

Companion Animal FMT Consortium

FMT Guidelines for Clinical Practice

- Donor Screening & Selection
- FMT Preparations
- FMT Dosing & Clinical Applications

ARTICLE IN PRESS

Advances in Small Animal Care ■ (2024) ■–■

ADVANCES IN SMALL ANIMAL CARE

Clinical Guidelines for Fecal Microbiota Transplantation in Companion Animals

Jenessa A. Winston, DVM, PhD, DACVIM (Small Animal Internal Medicine)[a,*],
Jan S. Suchodolski, DrMedVet, PhD, DACVM, AGAF[b],
Frederic Gaschen, DrMedVet, Drhabil, DACVIM (Small Animal Internal Medicine), DipECVIM-CA[c],
Kathrin Busch, DVM, Dr Med Vet, DECVIM[d],
Sina Marsilio, Dr med vet, PhD, DACVIM (Small Animal Internal Medicine), DipECVIM-CA[e],
Marcio C. Costa, DVM, DVSc, PhD[f], Jennifer Chaitman, VMD, DACVIM (Small Animal Internal Medicine)[g],
Emily L. Coffey, DVM, DACVIM (Small Animal Internal Medicine), PhD[h],
Julien R.S. Dandrieux, BSc, Dr Med Vet, PhD, DACVIM (Small Animal Internal Medicine)[i],
Arnon Gal, DVM, MSc, PhD, DACVIM, DACVP[j],
Tracy Hill, DVM, PhD, DACVIM (Small Animal Internal Medicine)[k], Rachel Pilla, DVM, PhD[b,l],
Fabio Procoli, DVM, MVetMed, DACVIM, DipECVIM-CA, MRCVS[m],
Silke Salavati Schmitz, Dr Med Vet, PhD, DipECVIM-CA, FHEA, FRCVS[i],
M. Katherine Tolbert, DVM, PhD, DACVIM (Small Animal Internal Medicine, Small Animal Nutrition)[b],
Linda Toresson, DVM, PhD[n], Stefan Unterer, DVM, Dr med vet, Dr habil, DECVIM-CA[o],
Érika Valverde-Altamirano, DVM[p], Guilherme G. Verocai, DVM, MSc, PhD, DACVM (Parasitology)[q],
Melanie Werner, Dr Med Vet, Dipl ECVIM-CA (Internal Medicine)[r], Anna-Lena Ziese, Dr Med Vet[s]

Preparation

Fresh (within 2-6 hours from voiding)

Fresh-frozen (processed as soon as possible after voiding

- can be kept refrigerated at 4°C for up to 2 days before)

Addition of cryopreservant before freezing (glycerol 1:10)

Processing can be done in aerobic environment

Our method

2.5-5 gr feces /kg b.w. of recipient

Blend in 1:1 or 1:2 with 0.9% NaCl solution by hand in a zip bag

Filtered on fine kitchen sieve

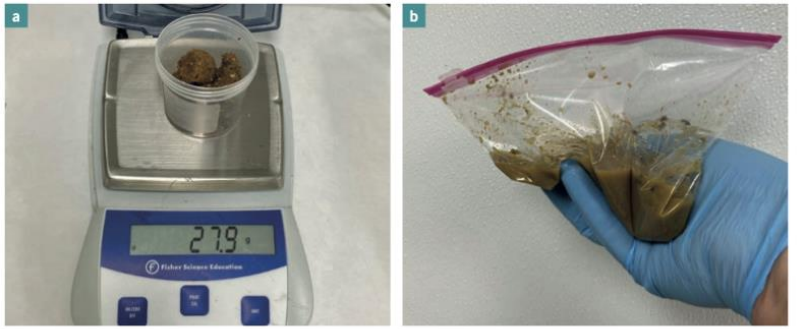
Freeze after adding glycerol 1:10 for later use

Administer after thawing with 20-60 cc syringe through wide bore soft rectal catheter (12 Fr)

With or without sedation (usually needed in cats)

No food and no walk for 4-6 hours (dogs)

Keep in hospital for 4-6 hours (cats)



Repeat 1-2 weeks apart

Some real-life case examples

Meet Chloe

5 yrs old FN Maltese

Life long intermittent GI signs
Continuously over last 2 months

Failed
Diet trials (hydrolysed, single/novel protein)
Metronidazole (no longer in use)
Single strain probiotic (no longer in use)

RVS recommended endoscopic GI biopsies prior to glucocorticoids trial – owner requested 2nd opinion

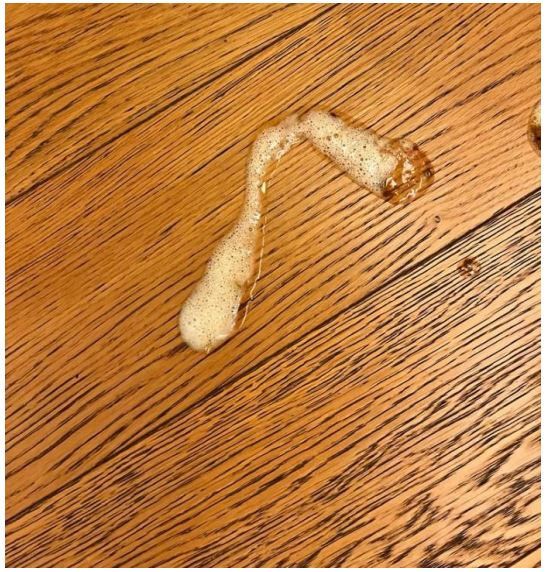
At the time of presentation

Stable weight, BCS 5/9

Daily vomiting (mostly bilious)
Liquid stools with blood and mucus (PFS 5-7/7) + tenesmus

Nocturnal swallowing fits

Selective appetite
on chicken based home cooked diet



Clinical staging

Severe clinical disease activity (CIBDAI score 9) – severe disease

Fecal flotation - negative

CBC + serum biochemistry
Mild ALT activity increase

cTLI and basal cortisol – within normal limits

Serum cobalamin < 150 ng/L

Abdominal ultrasound: indicative of non-specific mild enteropathy

What to do?

GI endoscopy + biopsies?

New dietary trial?

- New hydrolysate
- Low fat vs Fibre enriched

Multi strain high dose probiotic?

Glucorticoids?

Initial treatment strategy

Awaiting - fecal DI

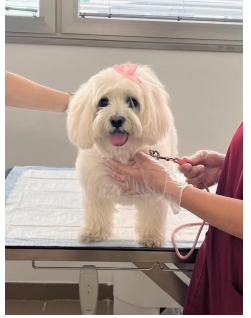
Eliminate all extras from daily diet

Hydrolysed soy diet

Multistrain high dose probiotic

Oral cobalamin 0.5 mg PO q 24 hours

What we opted for Chloe



Home cooked single protein low fat diet

Multistrain high dose probiotic

Oral cobalamin 0.5 mg PO q 24 hours

Awaiting - fecal dysbiosis index

Protein (% d.m.)	36
Fat %	12
Ratio omega-6/omega-3 FAs	13.0
Ca %	0.7
P %	0.6
Dietary fiber	1.3

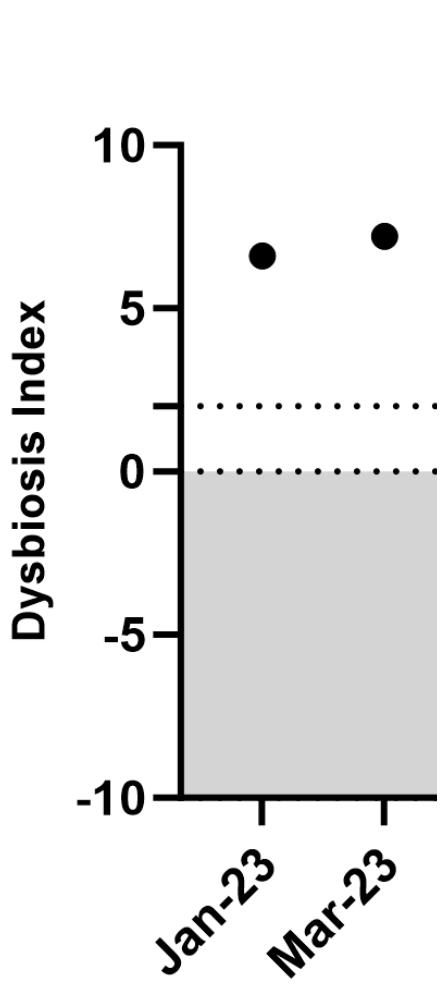
Initial response – 2 wks

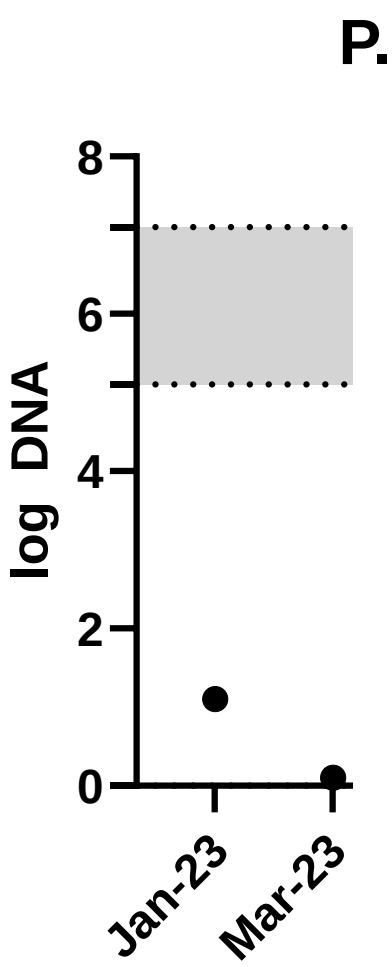
Clinical improvement (CIBDAI 3)

Purina fecal score 3/7

Occasional (less frequent) bilious vomiting + colitis

Chloe's DI





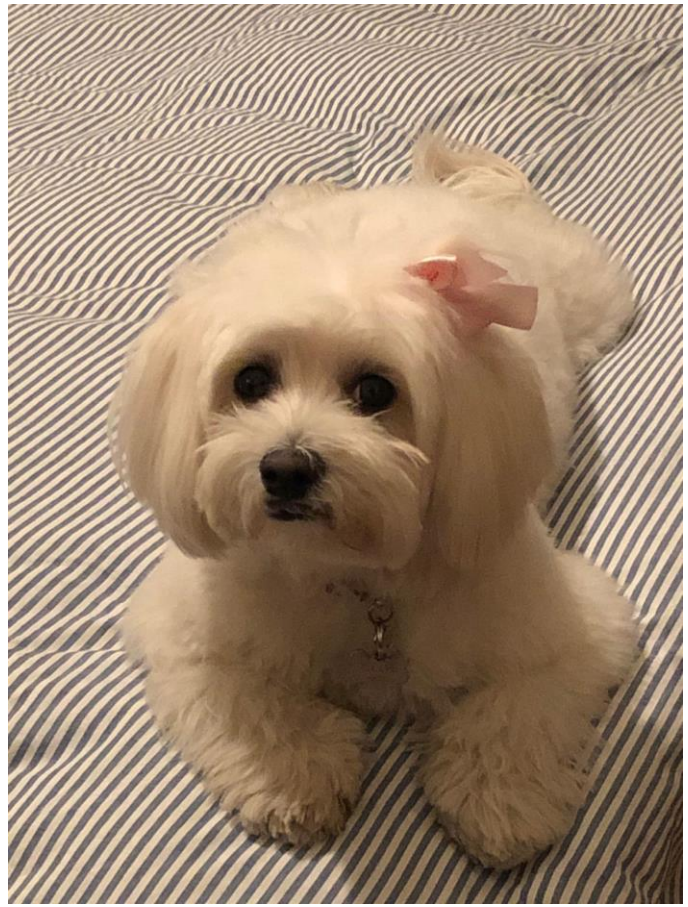
Although less frequently clinical signs still present

What to do now?

Stay put

Start glucocorticoids

Address clinical consequences of dysbiosis



Post FMT

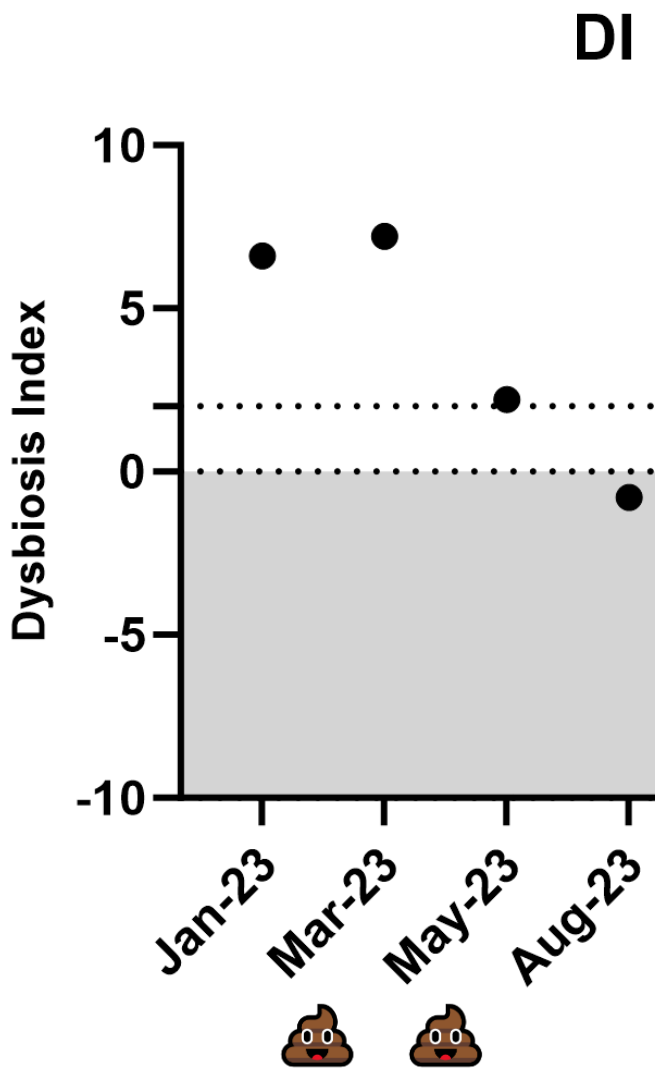
Complete clinical remission

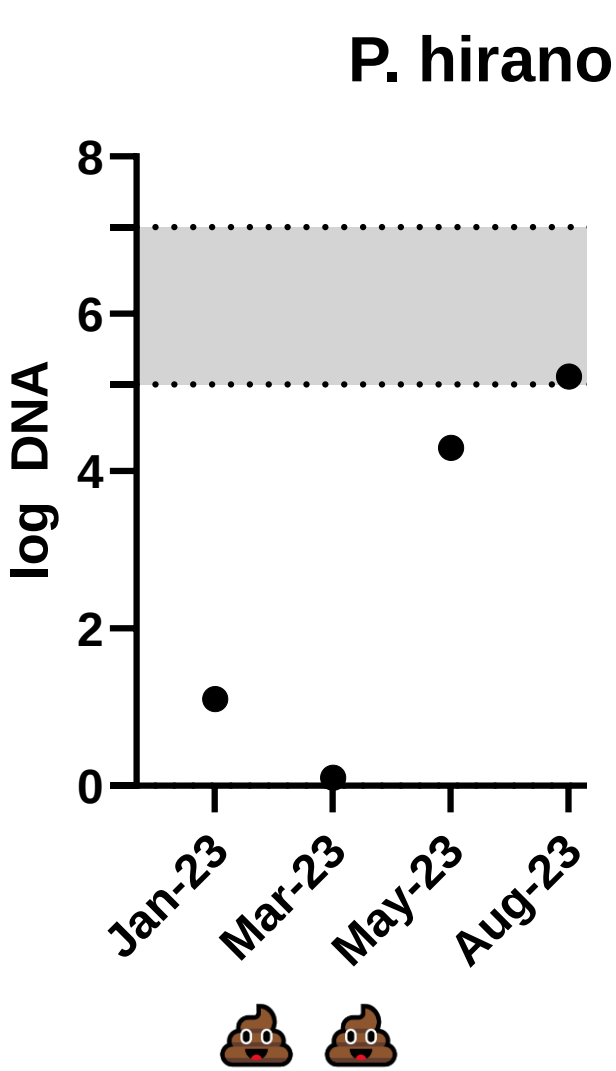
CIBDAI 0

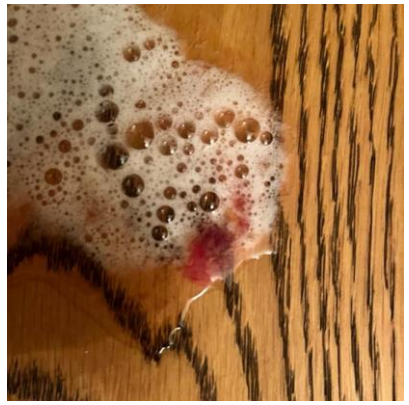
Purina fecal score 2/7

No more vomiting episodes

Follow-up


DI
Dysbiosis Index
10
5
0
-5
-10
Jan-23
Mar-23
May-23
Aug-23


P. hiranonis
log DNA
8
6
4
2
0
Jan-23
Mar-23
May-23
Aug-23



Lupin

2 yrs old MN DSH

Chronic small intestinal diarrhea, 2-3 times a day

No identifiable cause

Refractory to fiber enriched-, highly digestible, hydrolyzed diets and probiotics

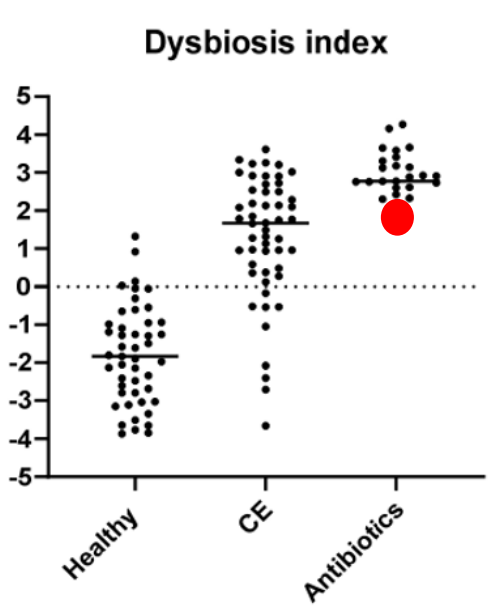
Responsive to amoxicillin clavulanate

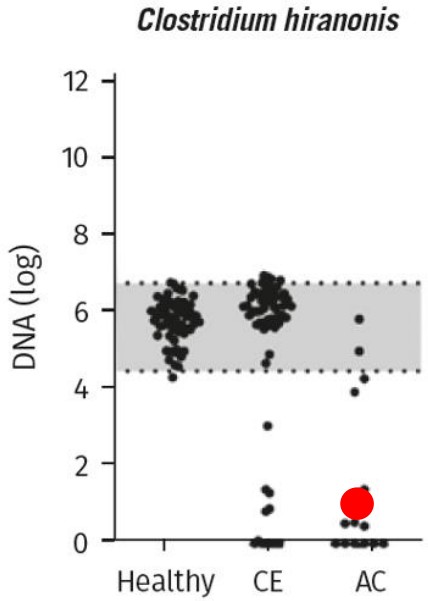
Gradual return to liquid stools when discontinued

Lost responsiveness with time

Fecal DI – 1 month off antibiotics

DI	2.2	< 0
Clostridium hiranonis	**0.8**	4.5-7.1
Bacteroides	5.9	4.0-7.5
Bifidobacterium	6.2	3.2-8.7
Turicibacter	4.8	4.4-9.0
Faecalibacterium	3.9	3.8-8.4
Streptococcus	2.8	1.6-5.2
E. coli	3.9	1.4-7.0





https://vetmed.tamu.edu/gilab/

1 + 4 weeks post FMT

Pre- and post-FMT Dysbiosis index

DI	2.2	0.8	< 0
Clostridium hiranonis	0.8	4,4	4.5-7.1
Bacteroides	5.9	5.3	4.0-7.5
Bifidobacterium	6.2	7.1	3.2-8.7
Turicibacter	4.8	6.4	4.4-9.0
Faecalibacterium	3.9	4.0	3.8-8.4
Streptococcus	2.8	2.2	1.6-5.2
E. coli	3.9	5.4	1.4-7.0

Take home messages

Treatment strategies for intestinal dysbiosis should depend on the underlying cause and will often require a multimodal approach

Cure is possible in mild cases (provided the eliciting cause is eliminated) or in antibiotic-induced dysbiosis (as sole treatment)

Clinical remission is a reasonable target in CE-associated dysbiosis (multimodal strategy)

Based on current available evidence, a dietary trial should be attempted first in dogs and cats with chronic GI signs and should always be part of multimodal treatment strategies

Take home messages

Besides inducing antimicrobial resistance, antibiotics are detrimental to gut and microbiome health

They should not be routinely used for the diagnostic approach and treatment of GI signs

FMT appears to be efficacious especially in young dogs and cats with mild dysbiosis or antibiotic-induced dysbiosis and associated GI signs

The use of FMT in CE appears promising for clinical remission, especially in the context of a multimodal approach

Any questions?

Fabio.Procoli@Anicura.it

IG: @fabioprothevet