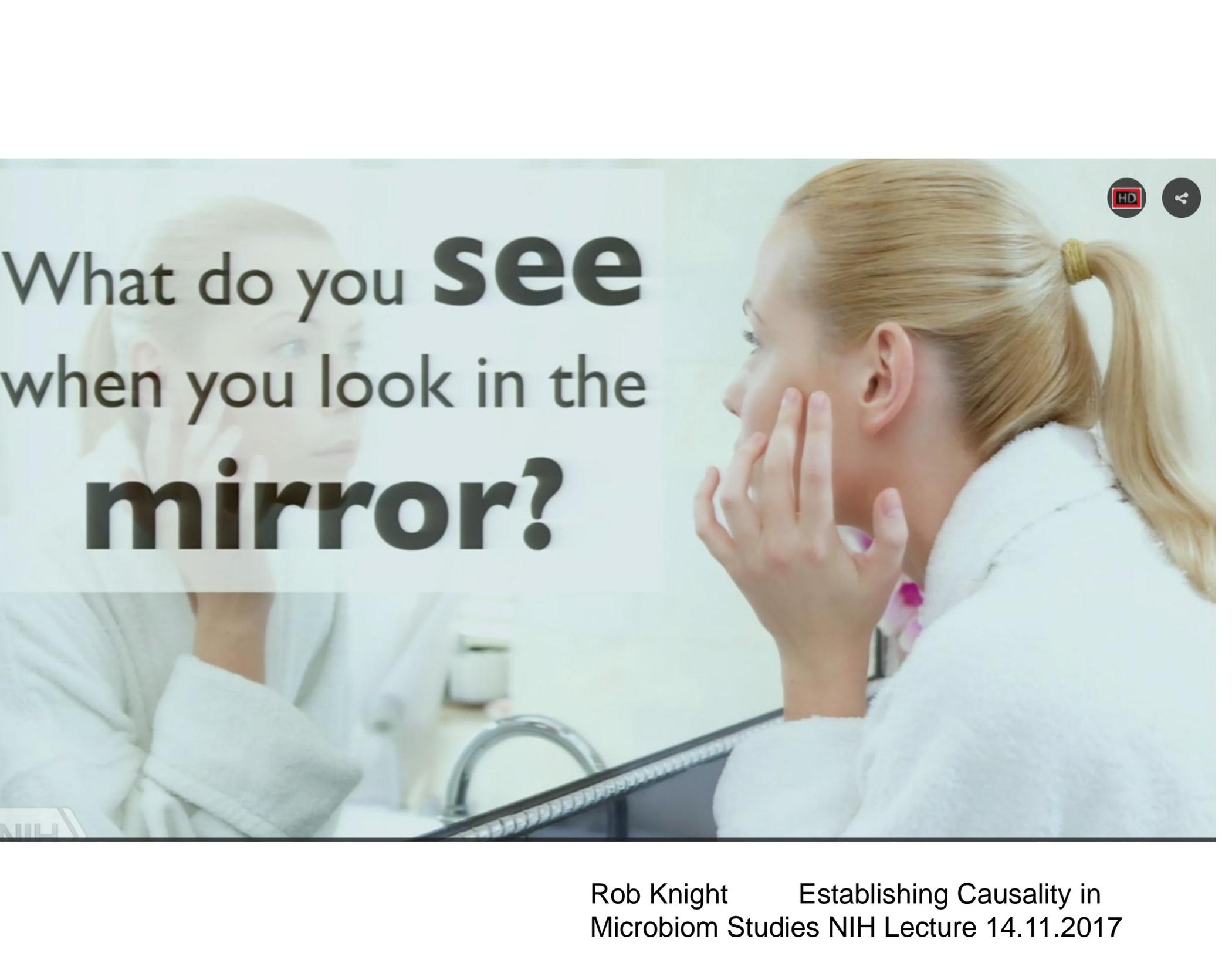


МИКРОБИОМ-НОВОЕ ВНУТРИ НАС: МУЛЬТИДИСЦИПЛИНАРНЫЙ ПОДХОД



Олег Медведев
МГУ им. Ломоносова
НИЦ «Здоровое питание»



What do you **see**
when you look in the
mirror?

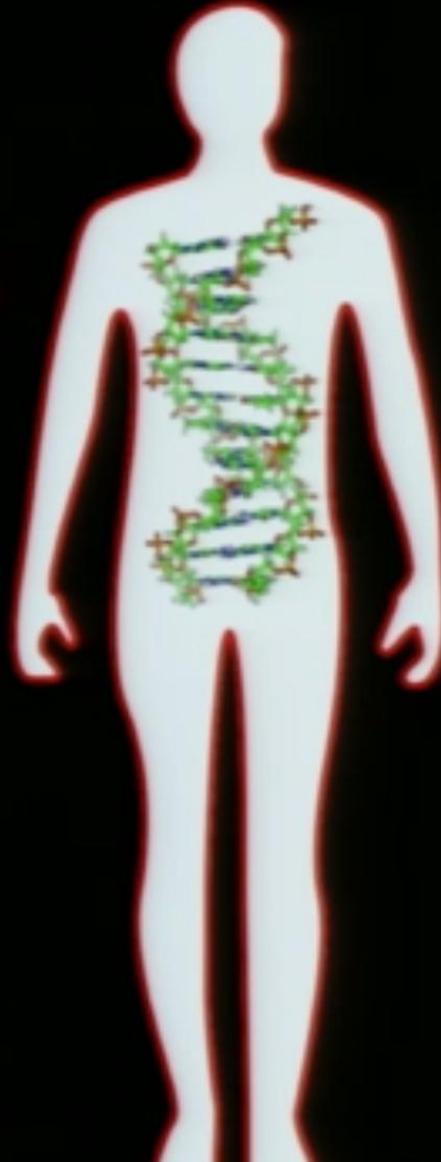


We see an organism that is

43% human



20,000
human genes



2-20 million
microbial genes

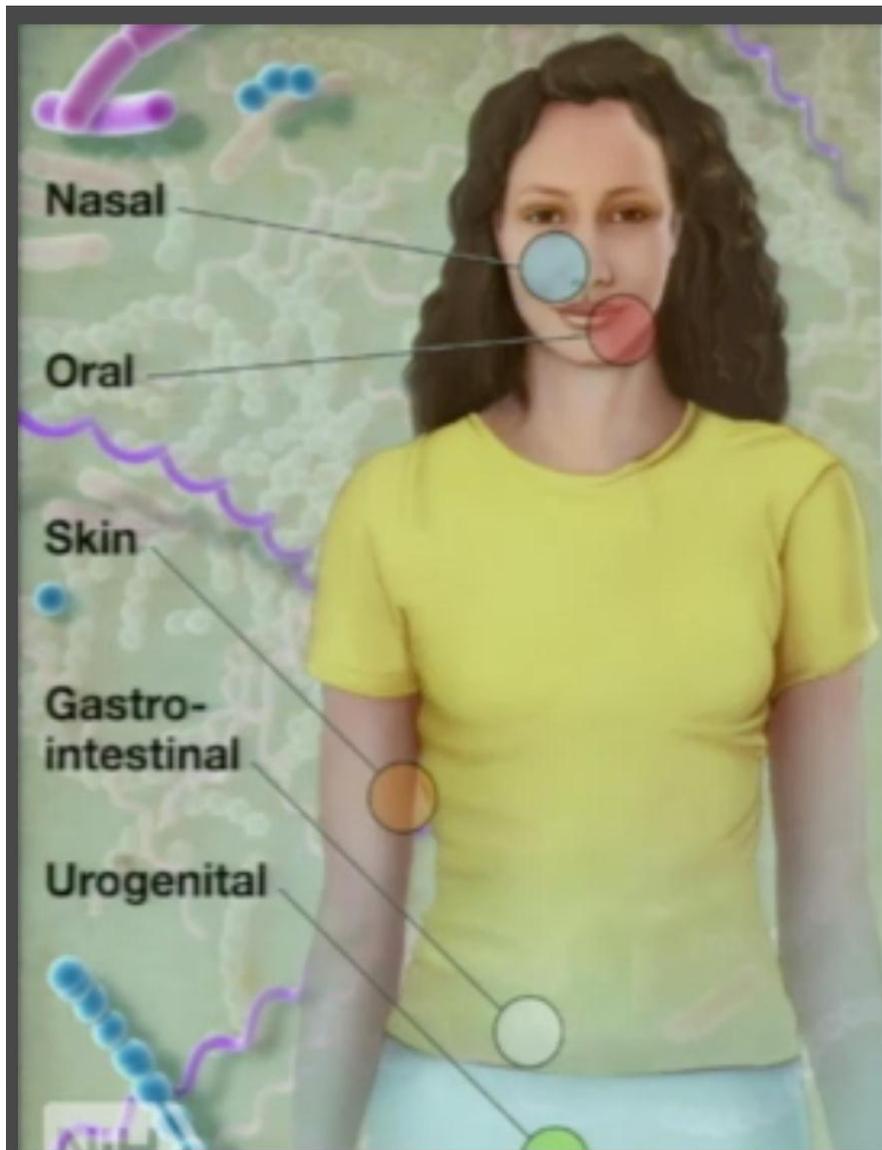
1%

We neglect 99%
of the system!



Human Genome
\$3.8 Billion

“Every dollar we spent to map the human genome has returned \$140 to our economy — \$1 of investment, \$140 in return.”
—President Obama, Remarks by the President on the BRAIN Initiative and American Innovation, April 2, 2013



NIH HUMAN
MICROBIOME
PROJECT

HD



\$173M

up to 18 sites

242 people

up to 3 timepoints

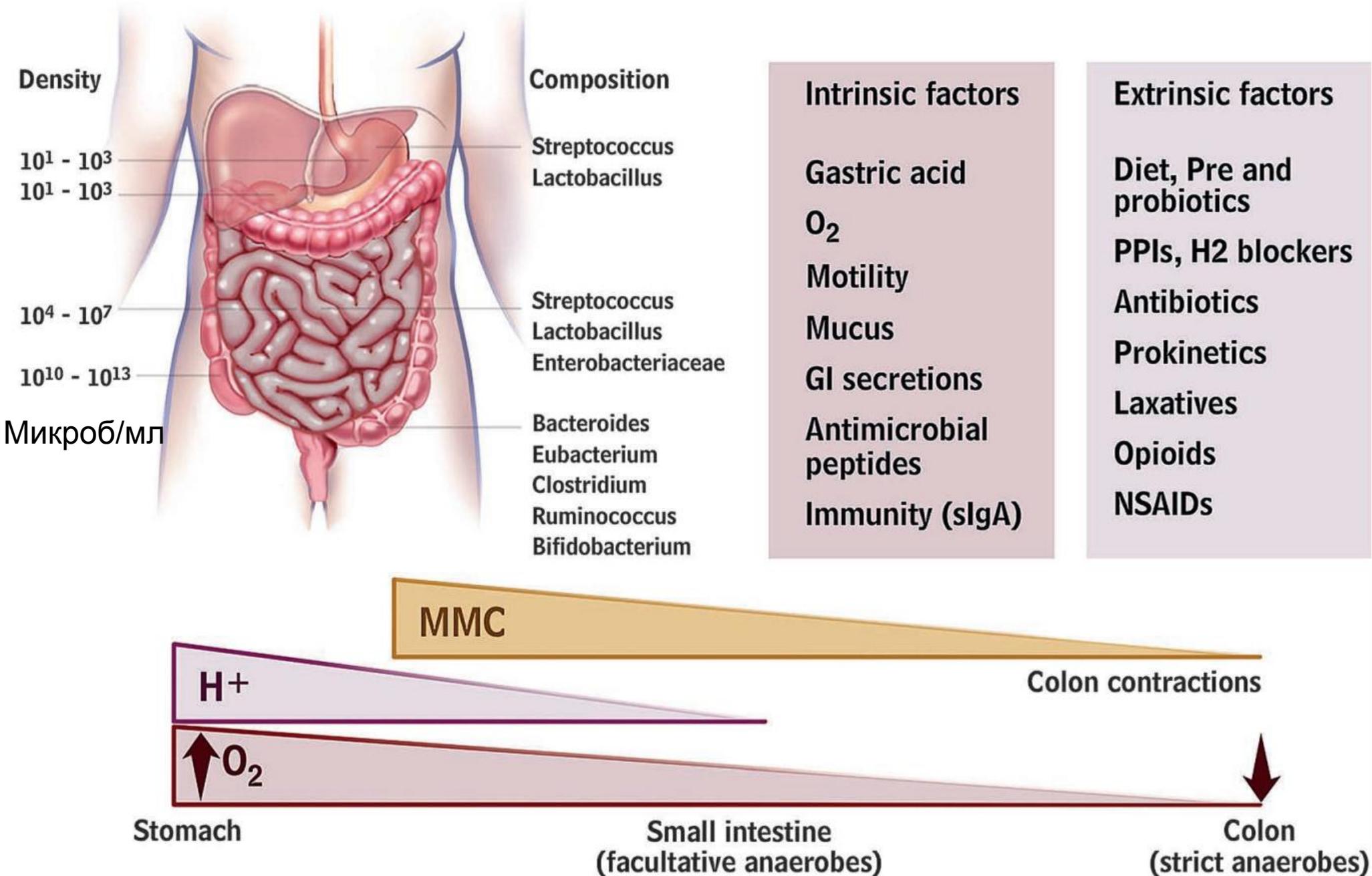
4.5 trillion bases

Shotgun + 16S

Как стать участником проекта «Американский микробиом» (народный научный проект)

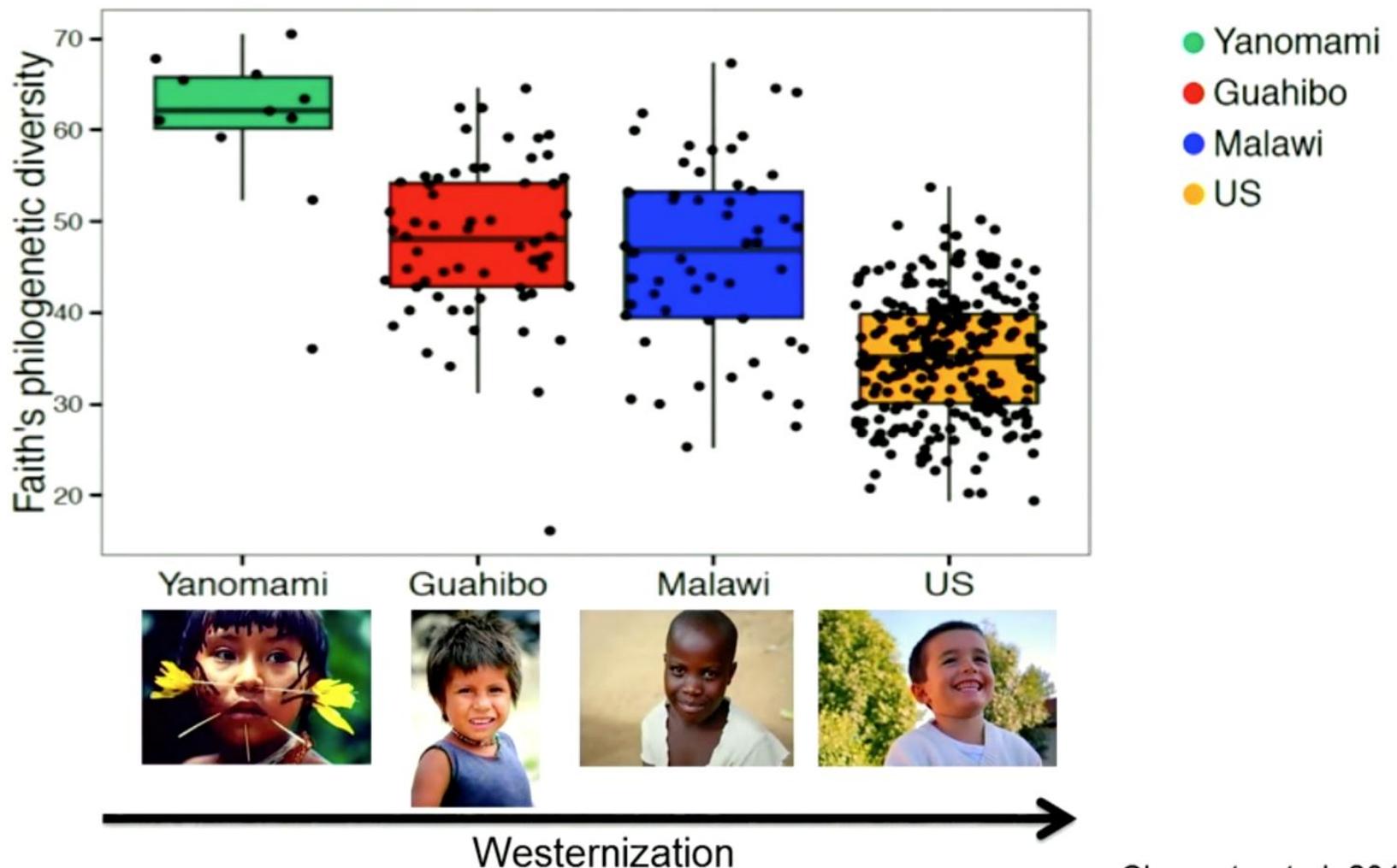
1. Переведите на счет проекта сумму, которая покрывает стоимость подготовки пробы, проведение генетического анализа и анализ полученных данных
2. Мы вышлем Вам набор для сбора био-образца по почте
3. Собери свои образцы, ответь на несколько вопросов о стиле жизни и отправь набор с пробой в наш адрес
4. Мы проанализируем образцы и загрузим результаты на Ваш индивидуальный портал

Состав и плотность микробиоты



Разнообразие микробиома у представителей разных культур

Fecal microbiome alpha diversity across cultures



Микробиом на 2-й день после рождения вагинального (слева) и путем Кесарева сечения (справа)

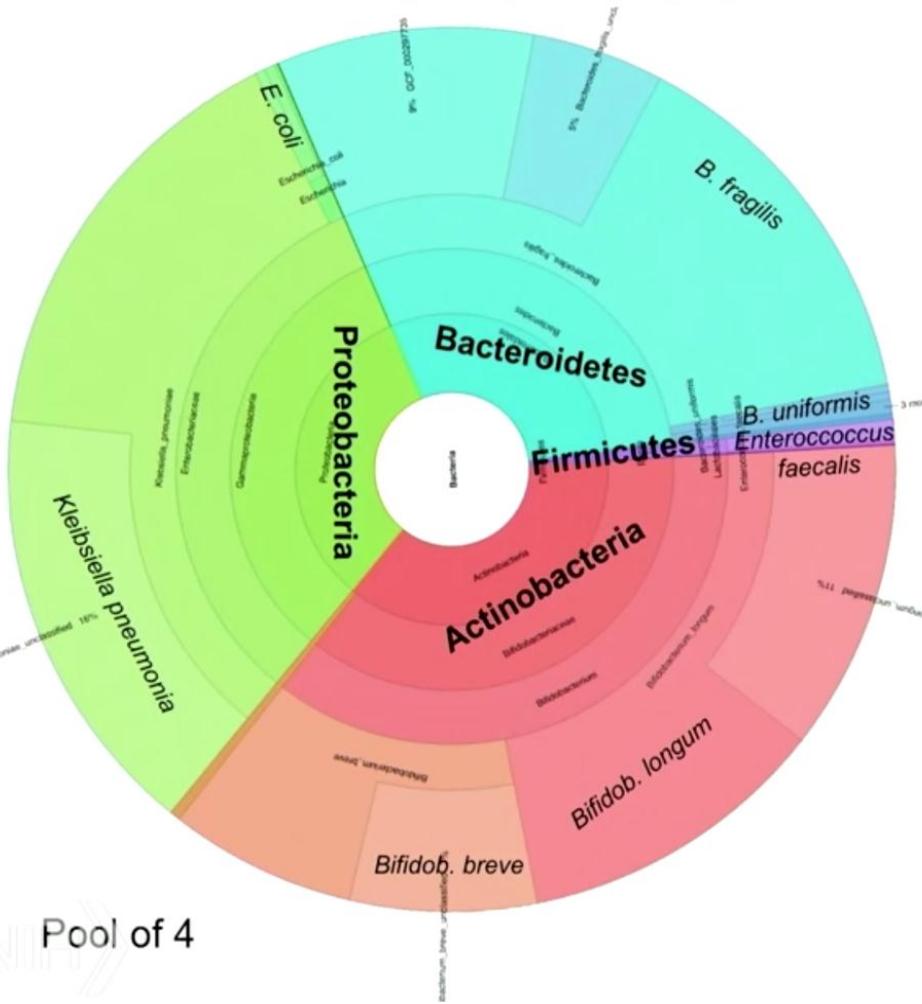
Feces baby–vaginal (day 2)

Feces baby–C-section (day 2)

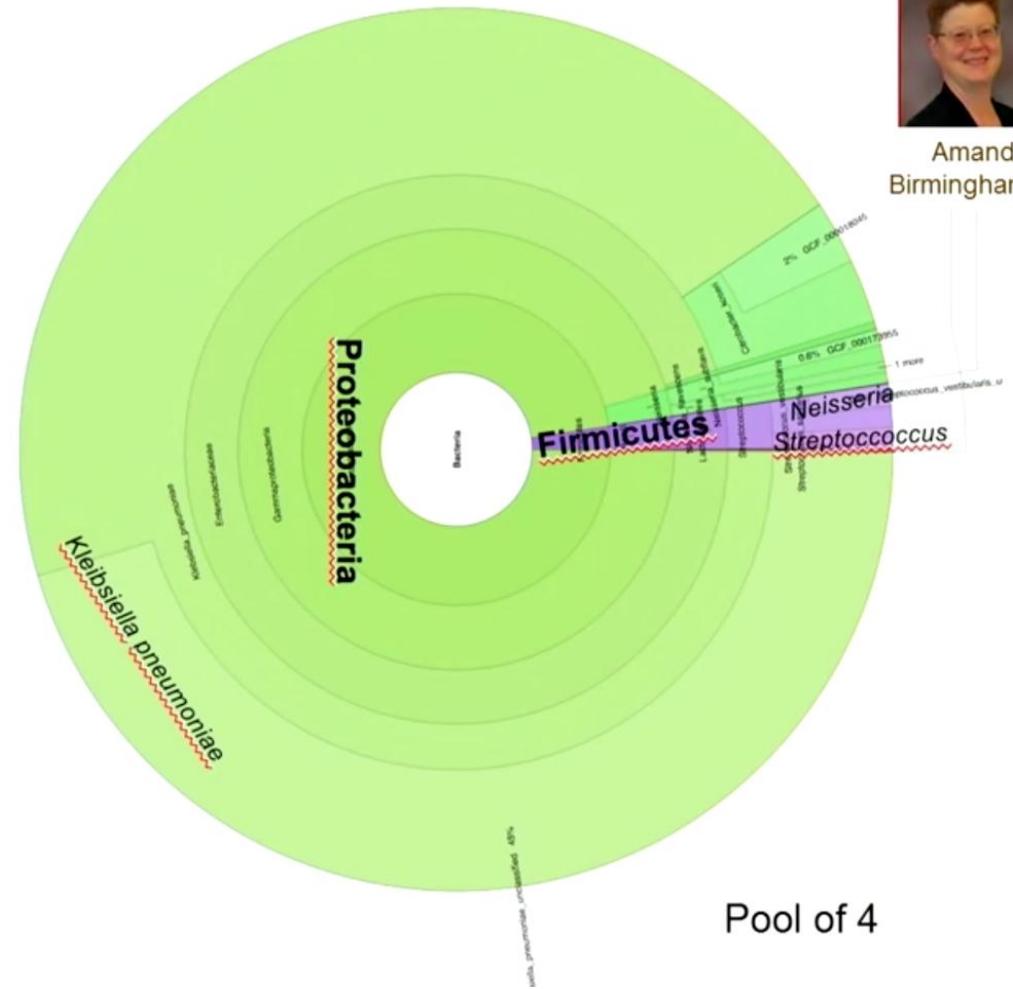
Keith Martinez



Amanda Birmingham



Pool of 4



Pool of 4

Dominguez-Bello “Microbiom impacts and restoration” Lecture at NIH 08.08.2017

Much Larger Drop in Microbiome Ecology Diversity Following Surgery Than Following Colonoscopy



Diversity Across Time: PD Whole Tree



Surgery. 1958 Nov;44(5):854-9.

Fecal enema as an adjunct in the treatment of pseudomembranous enterocolitis.

EISEMAN B, SILEN W, BASCOM GS, KAUVAR AJ.

PMID: 13592638



- Ben Eiseman, MD, surgeon in Denver in 1958
- 4 patients with pseudomembranous colitis (preceded identification of *Clostridium difficile*)
- Treated with fecal enemas from healthy individuals
- All 4 responded and were discharged within days

55 years later...

The NEW ENGLAND
JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

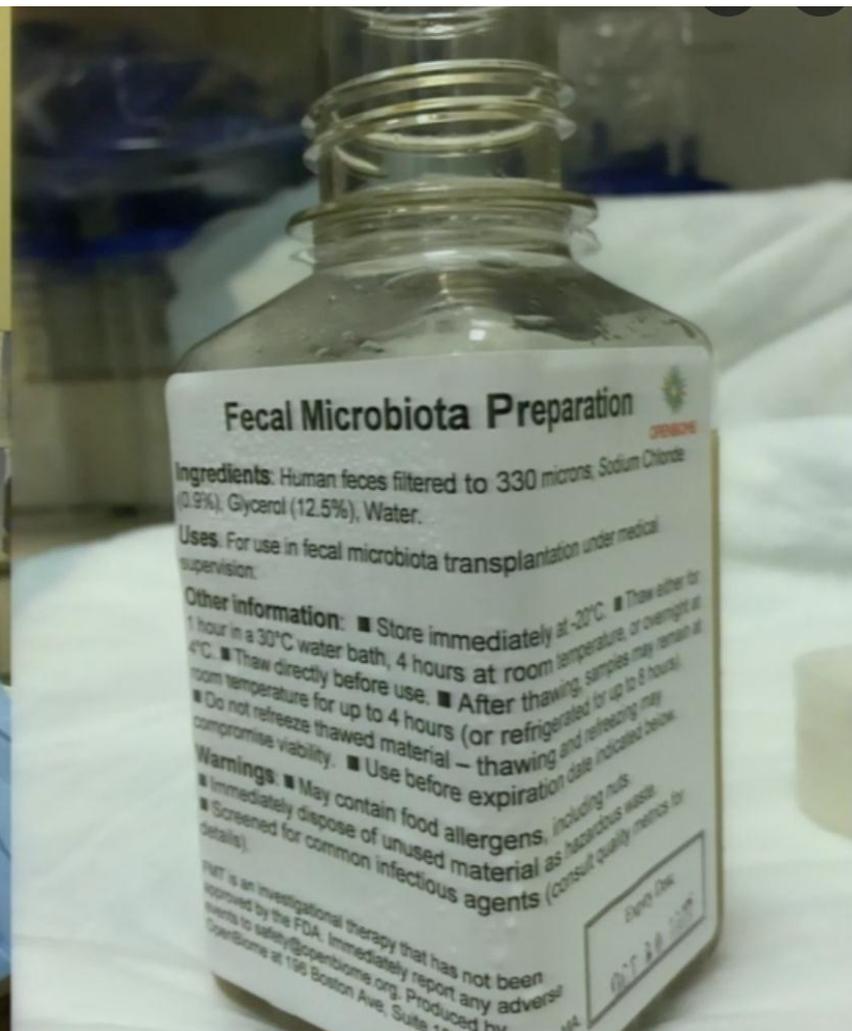
JANUARY 31, 2013

VOL. 368 NO. 5

Duodenal Infusion of Donor Feces for Recurrent
Clostridium difficile

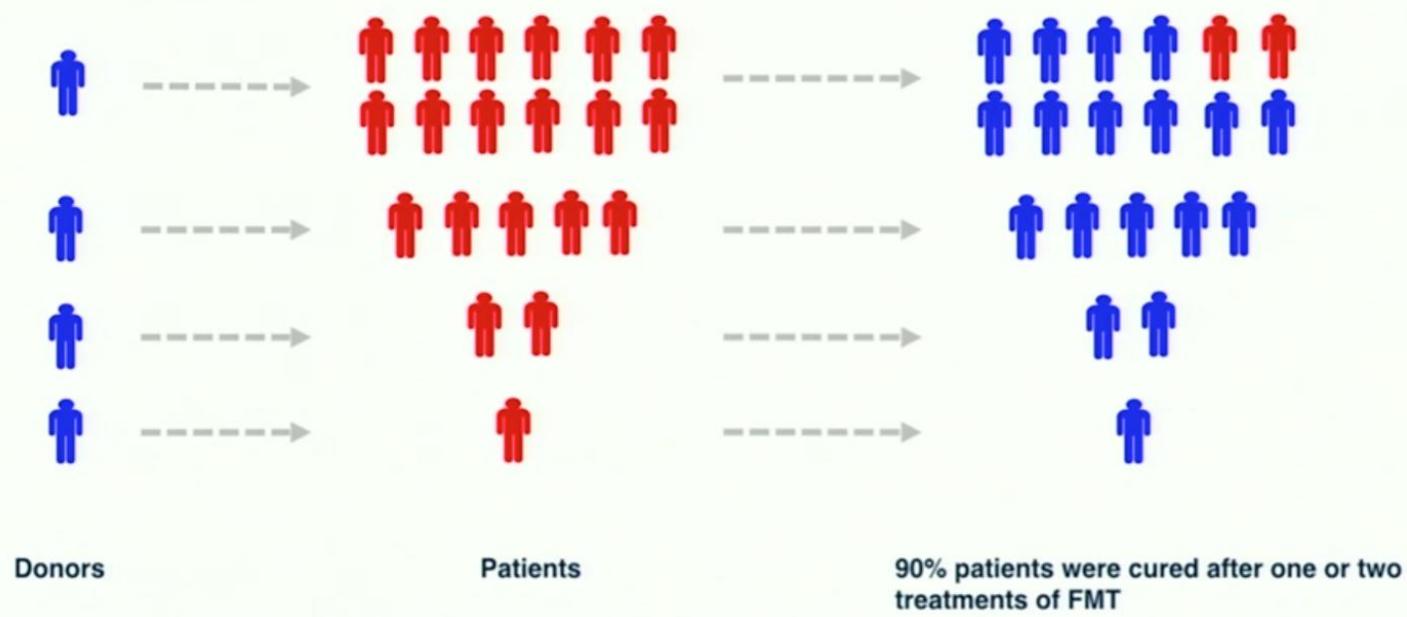
Els van Nood, M.D., Anne Vrieze, M.D., Max Nieuwdorp, M.D., Ph.D., Susana Fuentes, Ph.D.,
Erwin G. Zoetendal, Ph.D., Willem M. de Vos, Ph.D., Caroline E. Visser, M.D., Ph.D., Ed J. Kuijper, M.D., Ph.D.,
Joep F.W.M. Bartelsman, M.D., Jan G.P. Tijssen, Ph.D., Peter Speelman, M.D., Ph.D.,
Marcel G.W. Dijkgraaf, Ph.D., and Josbert J. Keller, M.D., Ph.D.

Наука «докатилась»



FMT: an open-label metagenomic study

Youngster *et al.*, Clin Infect Dis 2014



Funded by National Institute of Allergy and Infectious Diseases

Libby Hohmann, M.D. (MGH)
Ilan Youngster, M.D. (MGH)
Jenny Sauk, M.D. (MGH)



Dirk Gevers (Broad)
Ramnik Xavier (Broad, MGH)



treated patients are distinct from donor and pre-FMT self



Chris Smillie
CSBi graduate



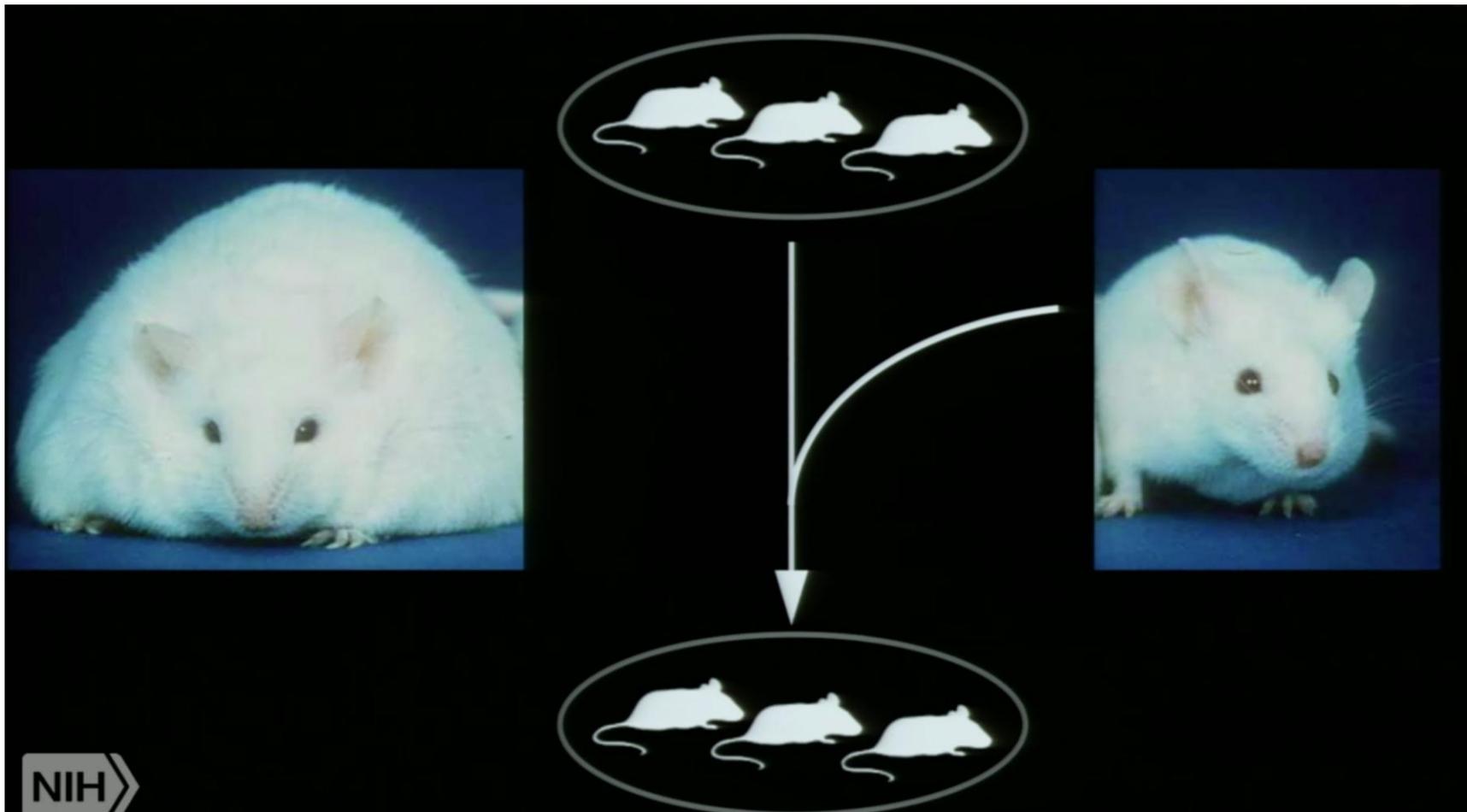
Rob Knight Establishing Causality in
Microbiom Studies NIH Lecture 14.11.2017

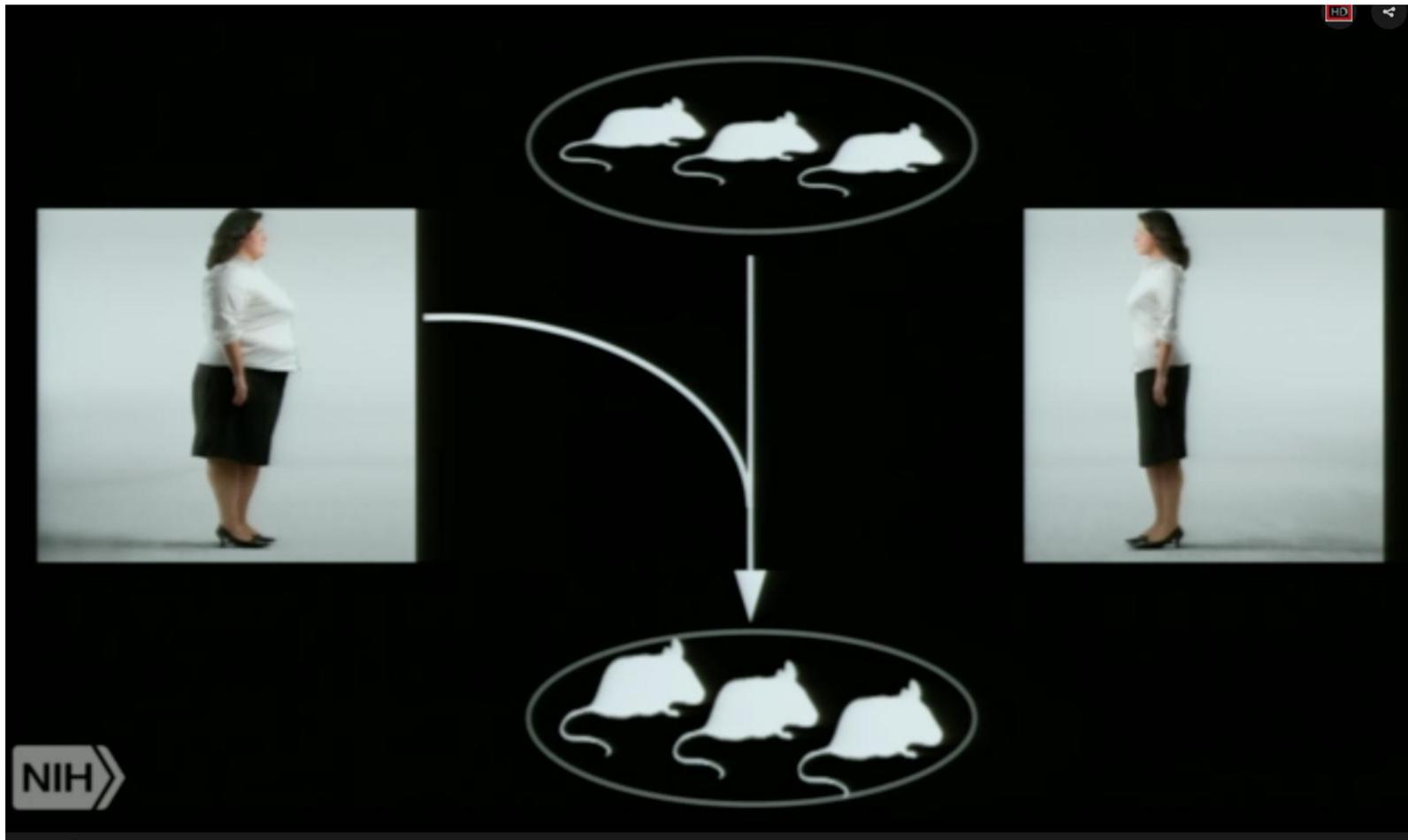
Classifying lean/obese:

57% accuracy from human genes

vs

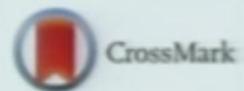
90% accuracy from microbial genes





RESEARCH

Open Access

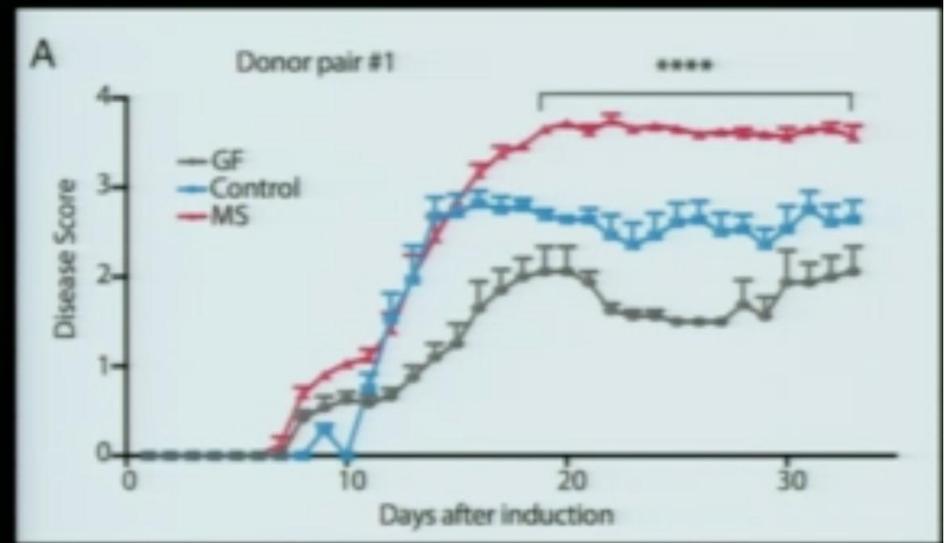


Microbiota Transfer Therapy alters gut ecosystem and improves gastrointestinal and autism symptoms: an open-label study

Dae-Wook Kang^{1†}, James B. Adams^{2†}, Ann C. Gregory^{3,15†}, Thomas Borody⁴, Lauren Chittick^{5,15}, Alessio Fasano⁶, Alexander Khoruts^{7,8,9}, Elizabeth Geis², Juan Maldonado¹, Sharon McDonough-Means¹⁰, Elena L. Pollard², Simon Roux^{5,15}, Michael J. Sadowsky^{8,11}, Karen Schwarzberg Lipson¹², Matthew B. Sullivan^{3,5,15,16*}, J. Gregory Caporaso^{12,13*} and Rosa Krajmalnik-Brown^{1,14*} 

Gut bacteria from multiple sclerosis patients modulate human T cells and exacerbate symptoms in mouse models

Egle Cekanaviciute^{a,1,2}, Bryan B. Yoo^{b,1}, Tessel F. Runia^{a,3}, Justine W. Debelius^c, Sneha Singh^a, Charlotte A. Nelson^a, Rachel Kanner^a, Yadira Bencosme^d, Yun Kyung Lee^{b,4}, Stephen L. Hauser^a, Elizabeth Crabtree-Hartman^a, Ilana Katz Sand^d, Mar Gacias^d, Yungjiao Zhu^d, Patrizia Casaccia^{d,e}, Bruce A. C. Cree^a, Rob Knight^c, Sarkis K. Mazmanian^b, and Sergio E. Baranzini^{a,5}

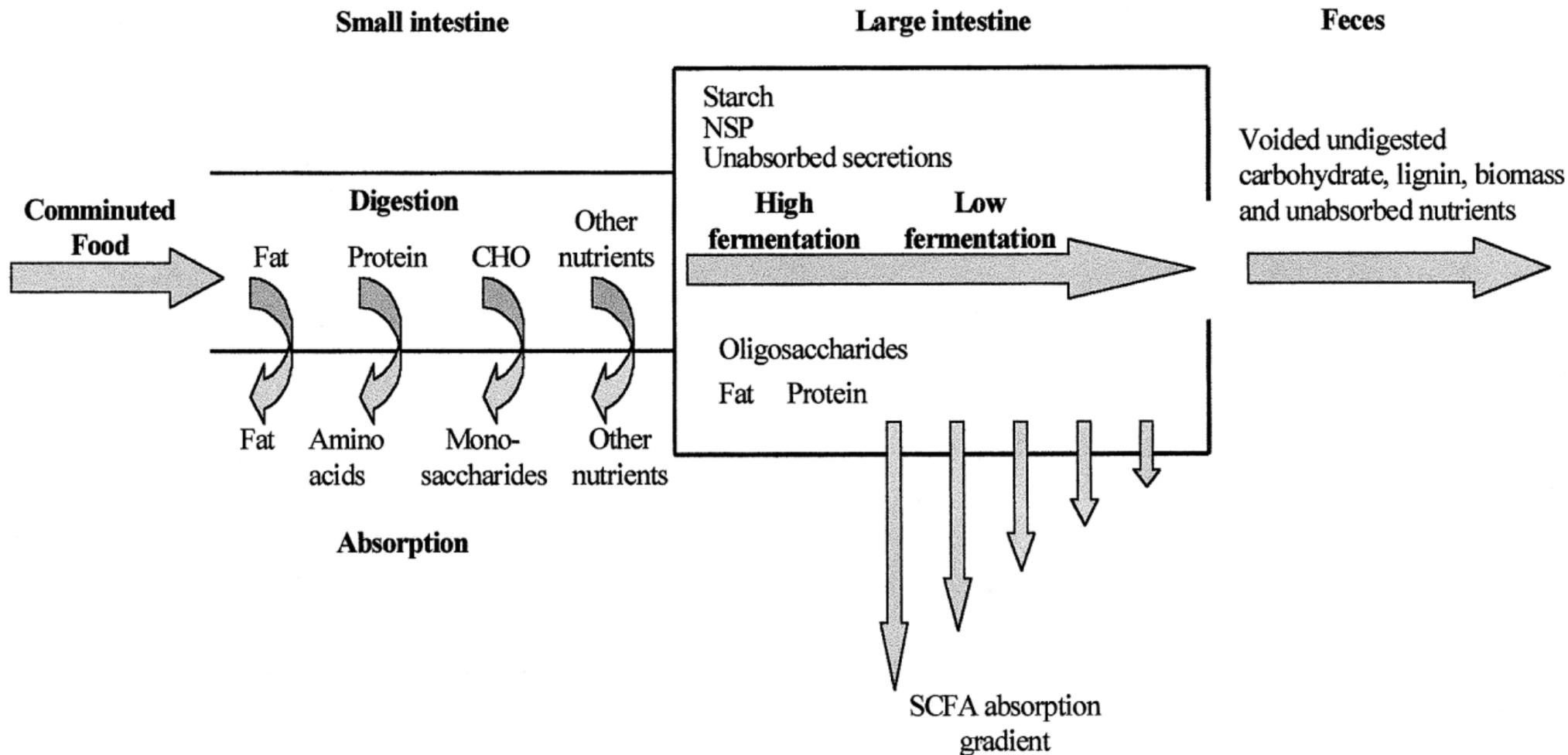


Процесс ферментации волокон, крахмала и других сложных углеводов в толстом кишечнике

July 2001

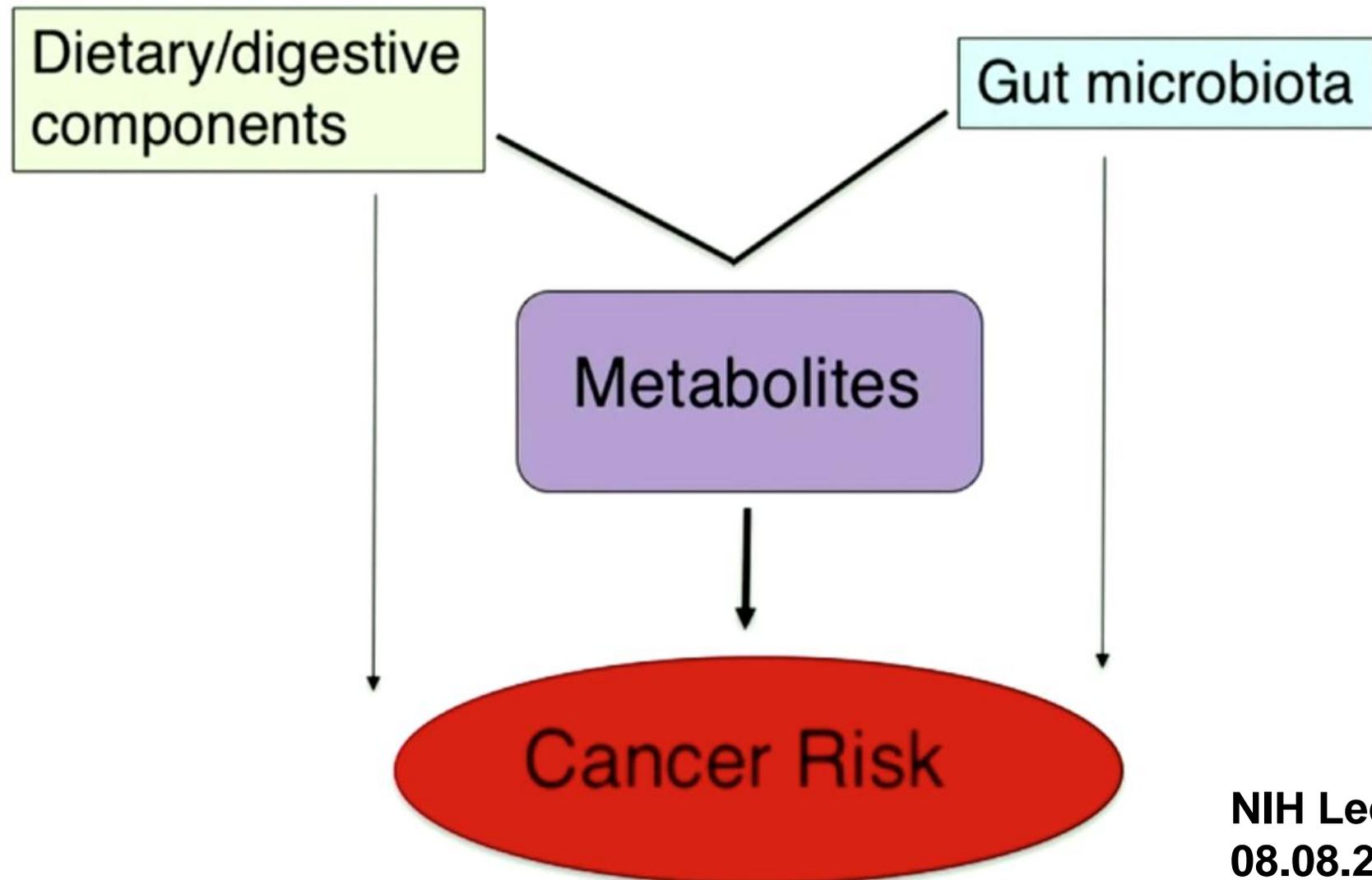
SHORT-CHAIN FATTY ACIDS AND HUMAN COLONIC FUNCTION

1

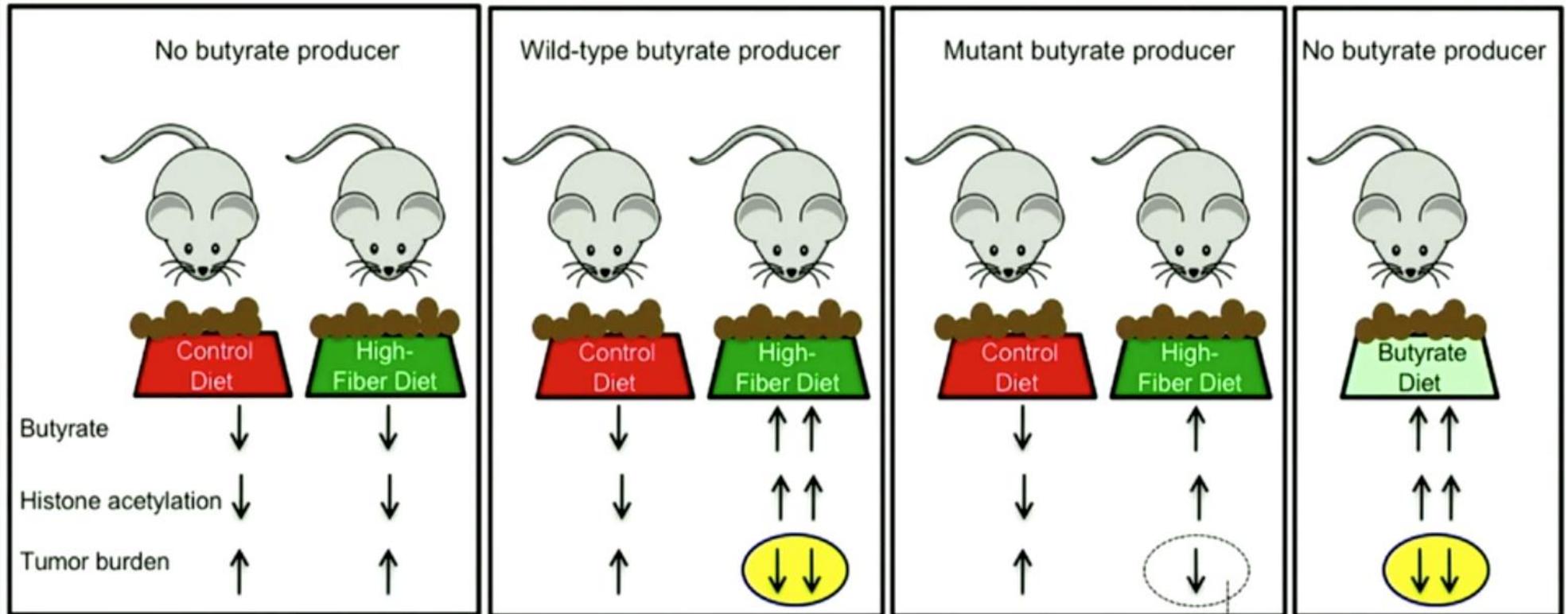


Gut Microbial Metabolites & Cancer Prevention

Scott Bultman, Department of Genetics, Lineberger Comprehensive Cancer Center, UNC-Chapel Hill

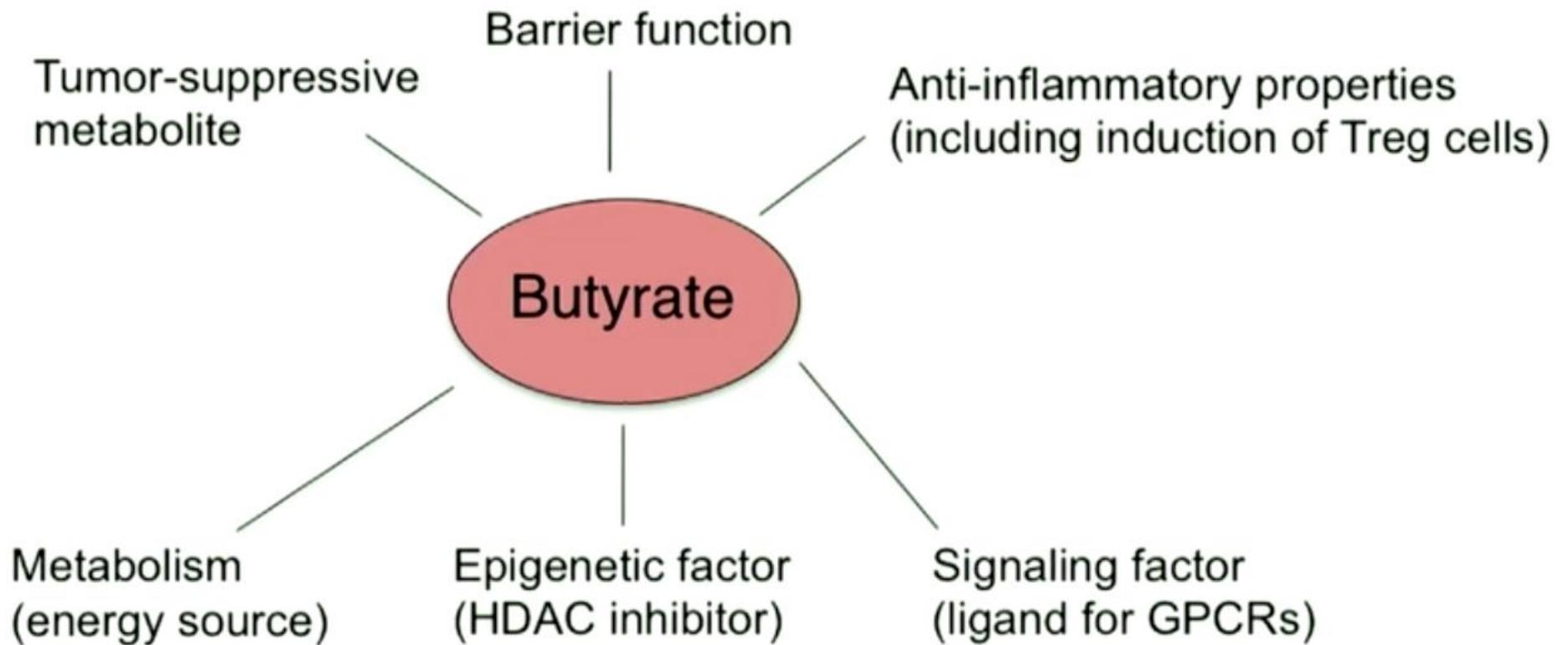


Butyrate is a Causal Factor



attenuated tumor-suppressive effect

Pleiotropic Metabolites Act Via Multiple Mechanisms



Science

\$15
5 JANUARY 2018
sciencemag.org



GUT MICROBES AND CANCER

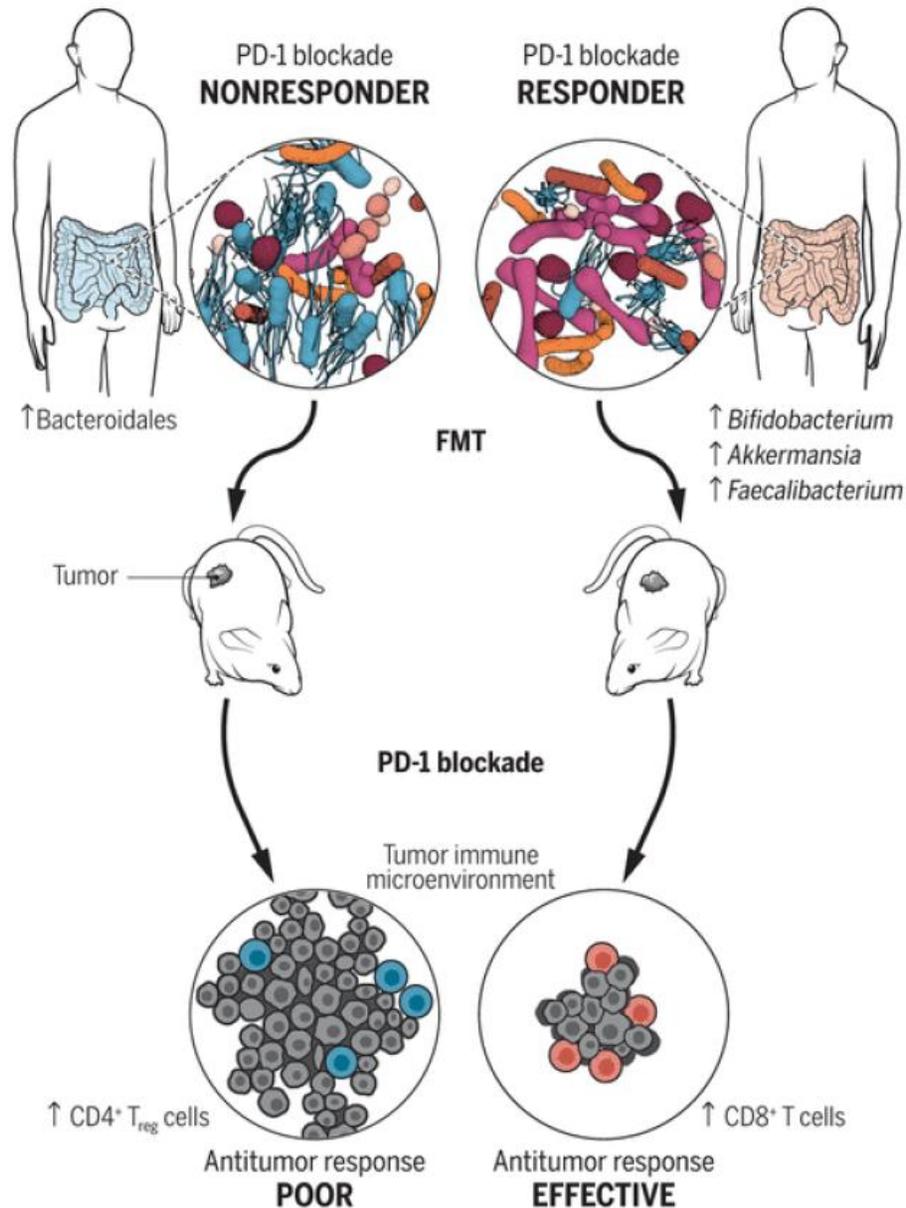
The microbiome influences patient
response to immunotherapy

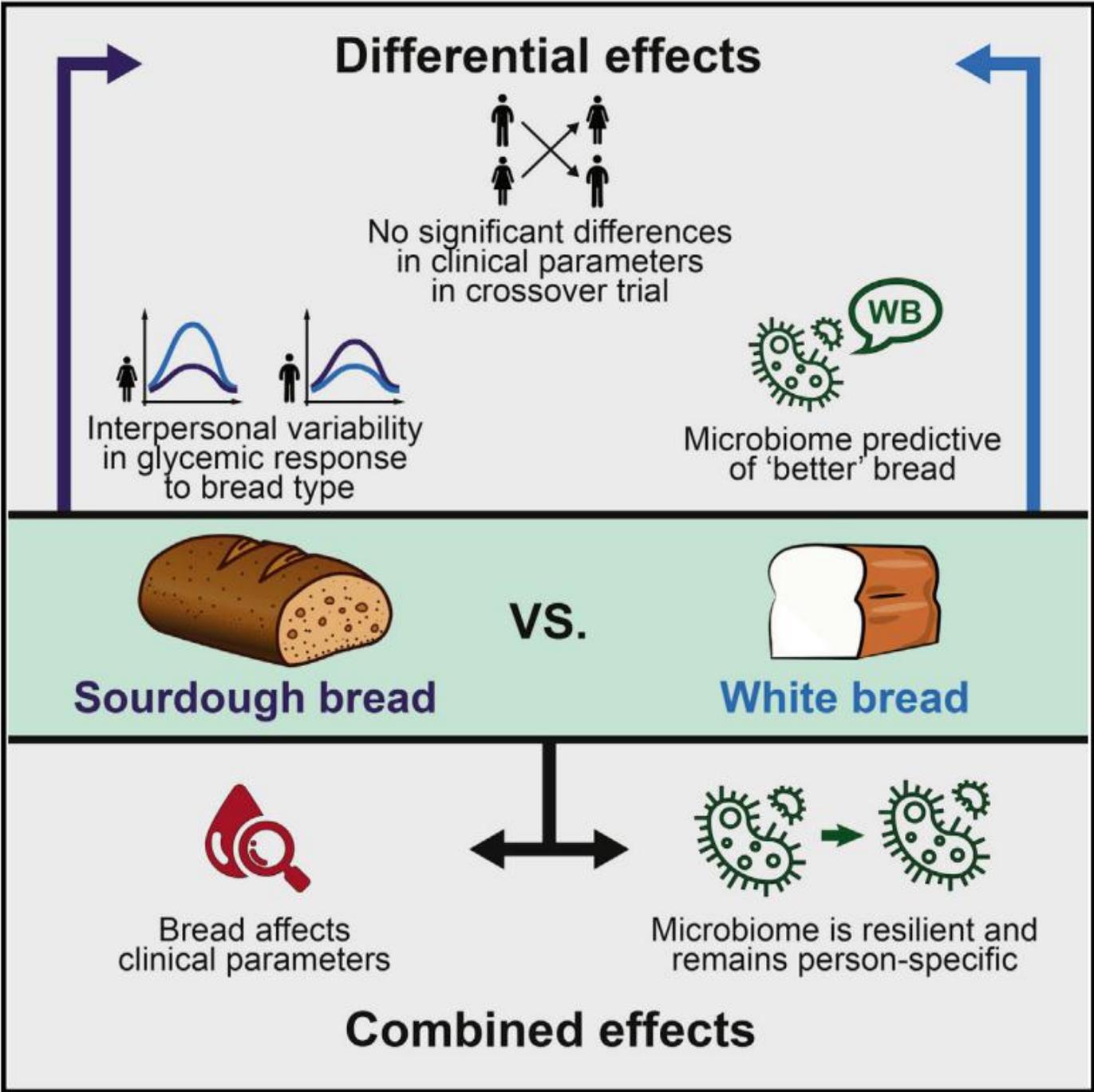
pp. 32, 91, 97, & 104



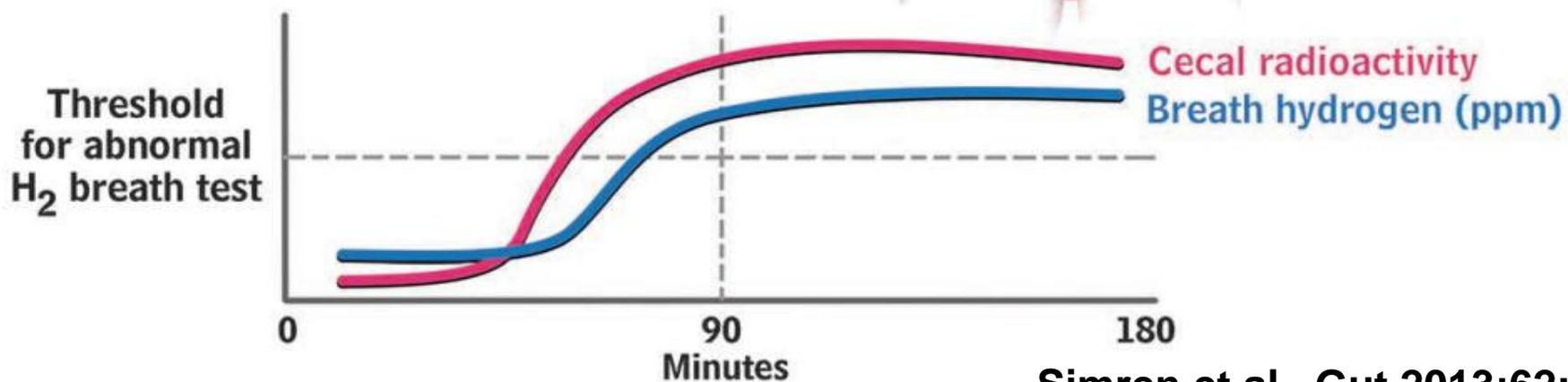
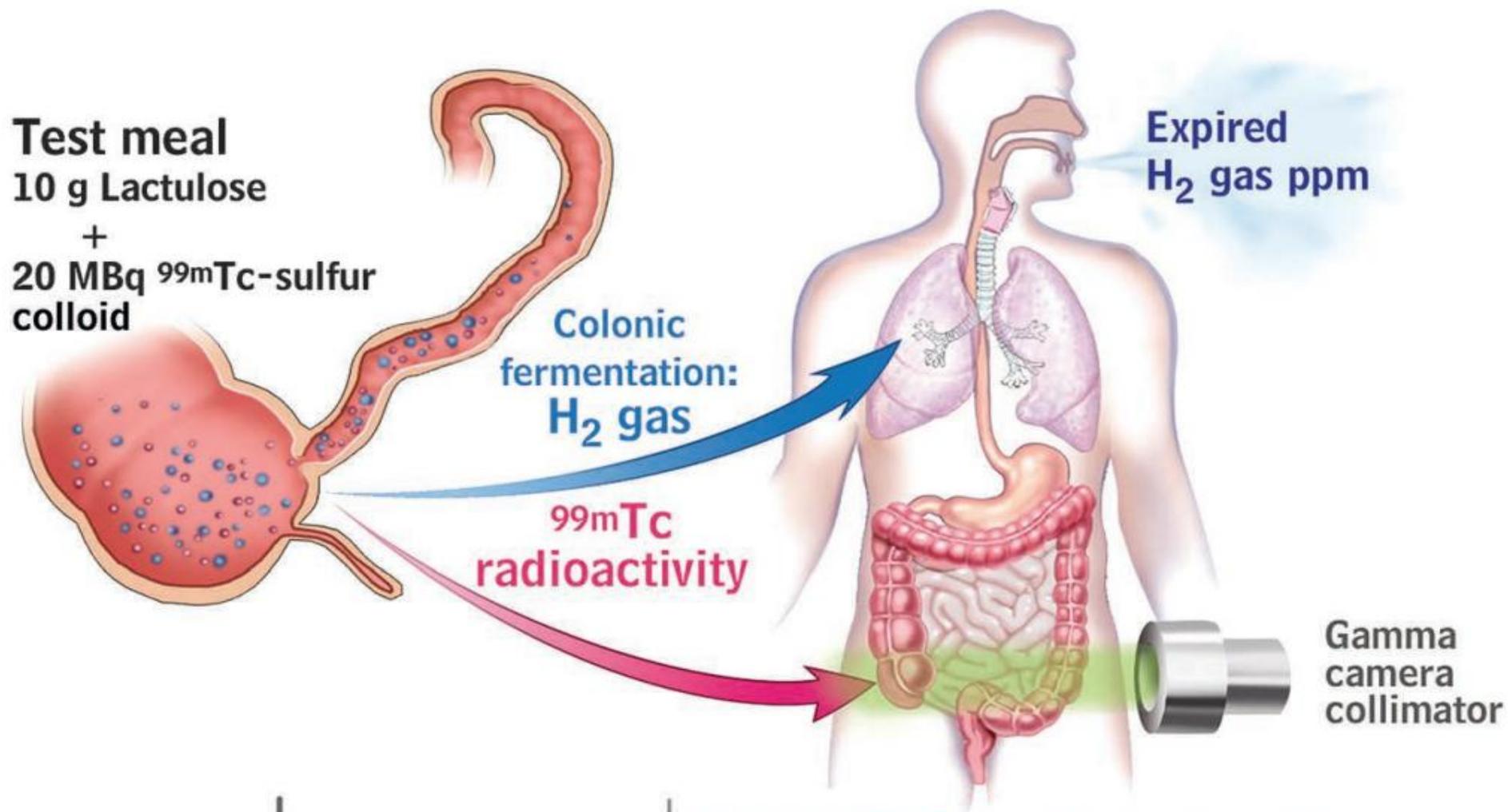
The intestinal microbiota influences the efficacy of PD-1 blockade

The enrichment of specific microbial taxa in intestines correlates with response to PD-1 blockade in cancer patients. FMT from responders into tumor-bearing mice improved responses to anti-PD-1 therapy and correlated with increased antitumor CD8⁺ T cells in the tumors. Mice receiving FMT from nonresponders did not respond to anti-PD-1 therapy, and tumors had a high density of immunosuppressive CD4⁺ T_{reg} cells.

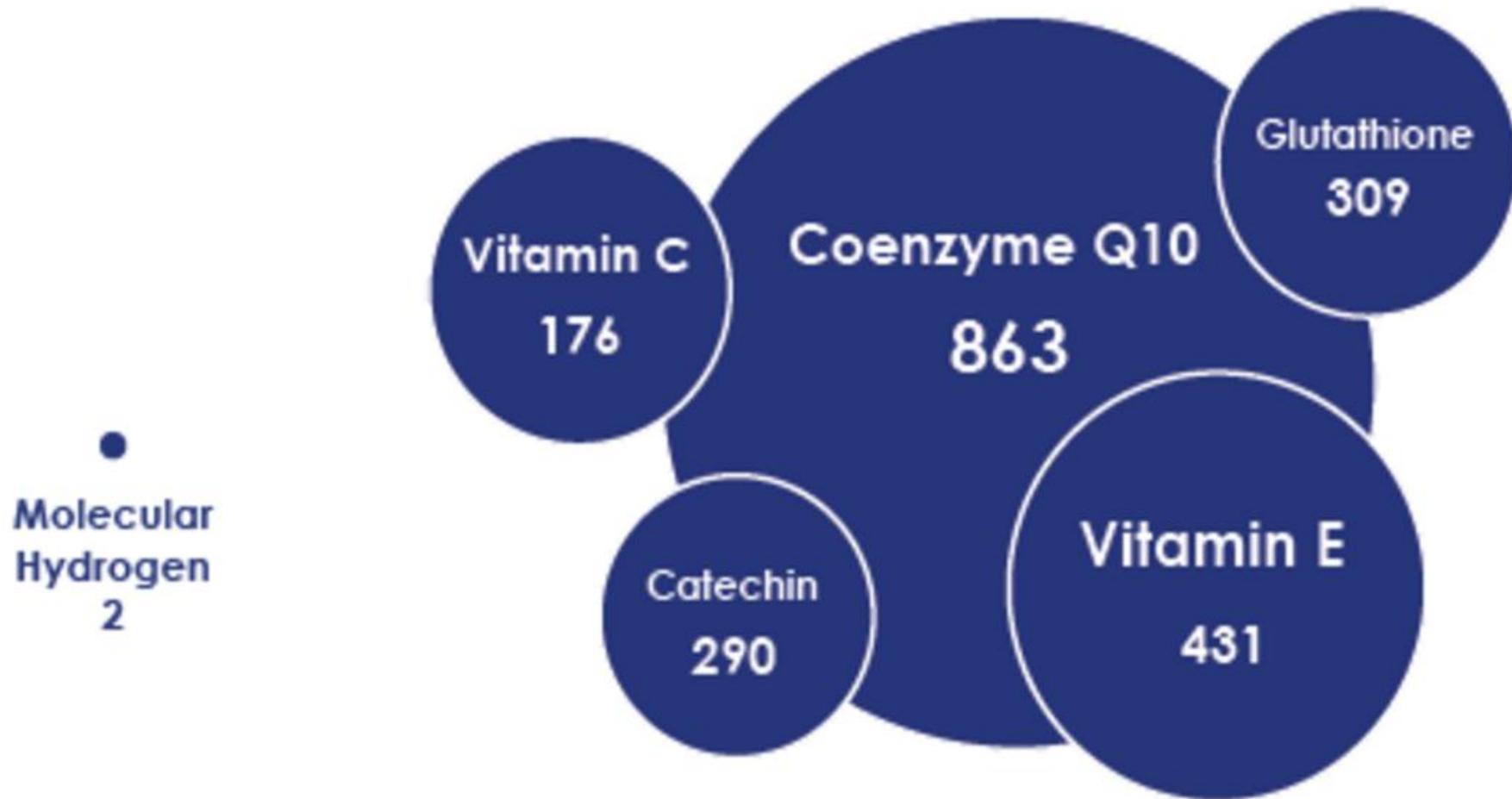




Тест на лактазную недостаточность



Сравнительные размеры различных антиоксидантов



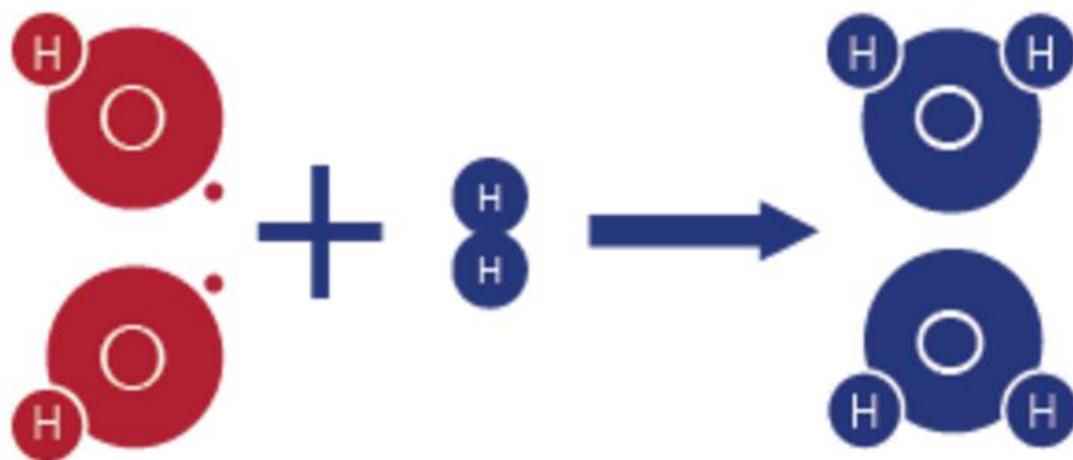
Relative Sizes of Antioxidants

Xuejun Sun · Shigeo Ohta
Atsunori Nakao *Editors*

Hydrogen Molecular Biology and Medicine

 Springer

Взаимодействие молекулярного водорода с гидроксил радикалом образует воду



H₂ Neutralizes Two Hydroxyl Radicals Into Two Water Molecules

Механизмы действия молекулярного водорода

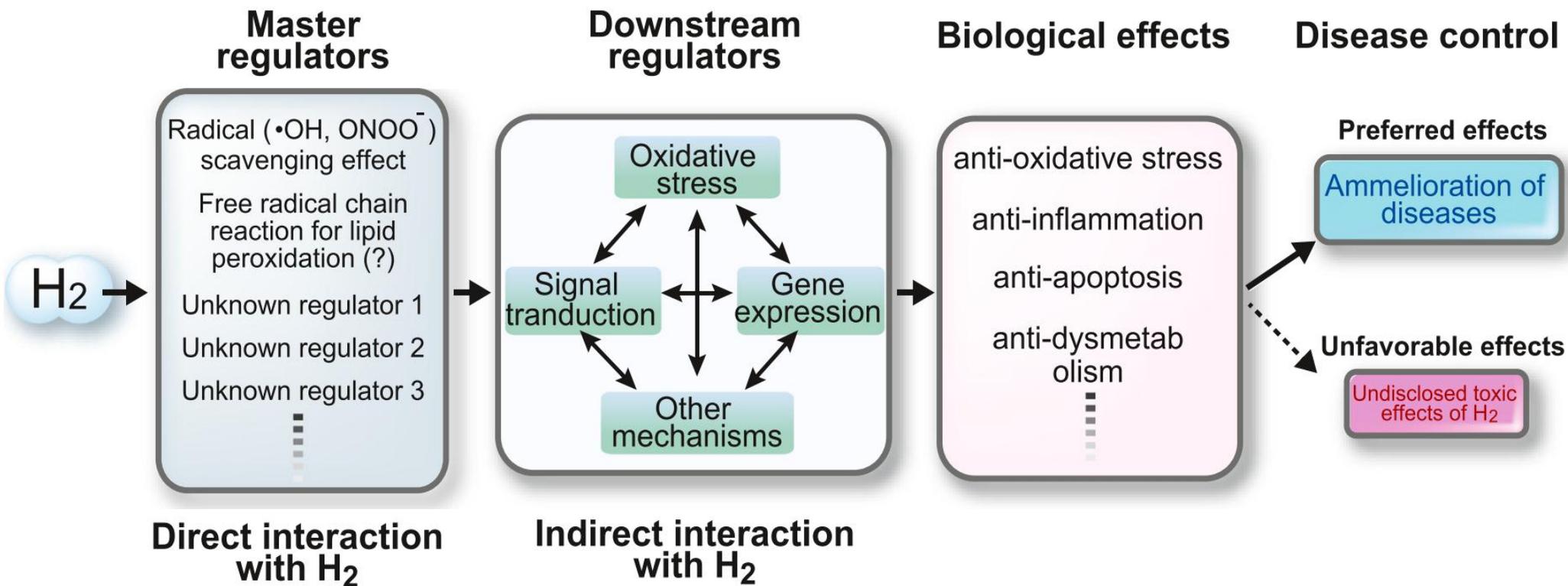
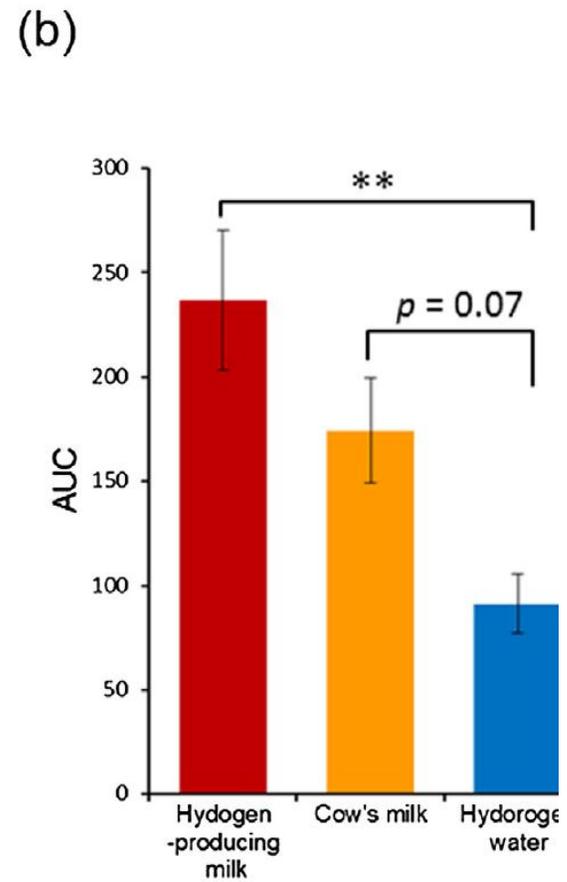
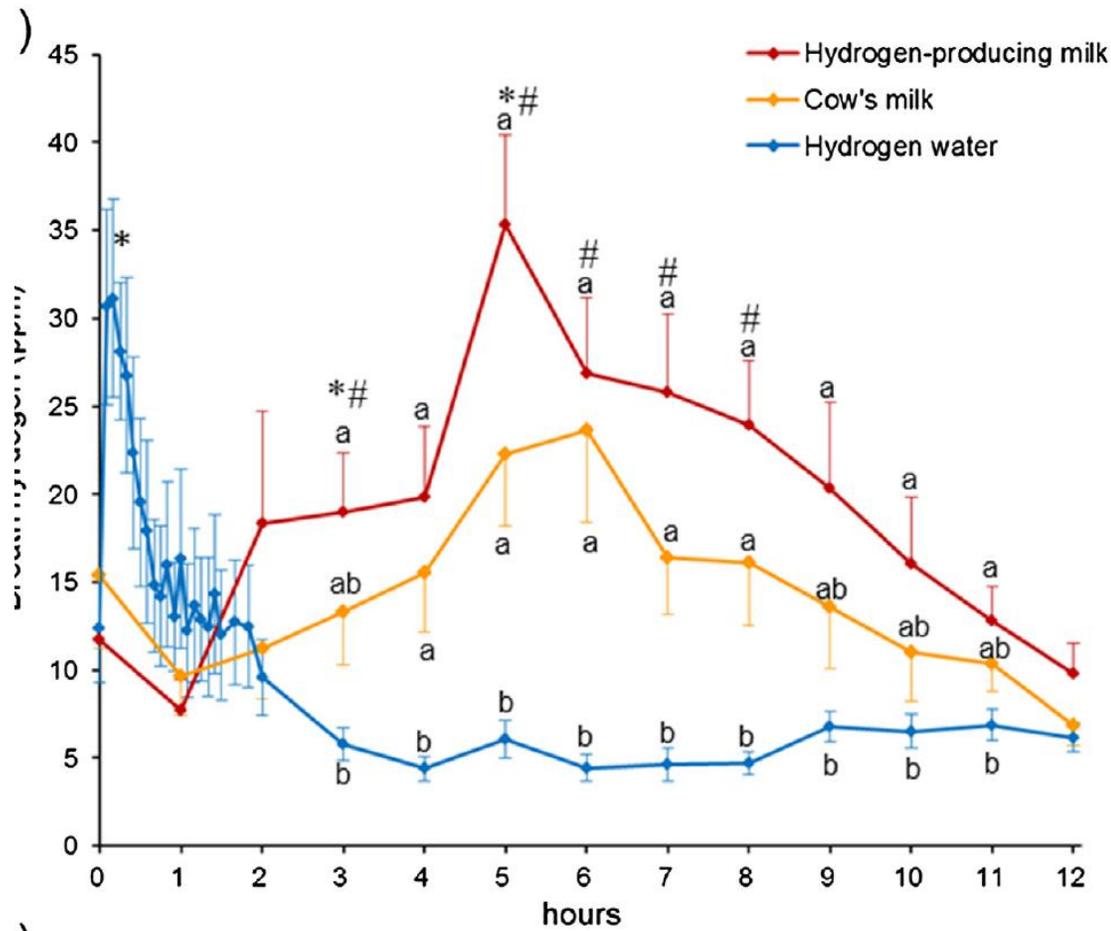


Fig. 3 Schematic summary of molecular mechanisms of hydrogen



Влияние различных пищевых волокон на образование водорода

	Volunteer No.									
	1	2	3	4	5	6	7	8	9	10
Galactooligosaccharide	5.3	18.5	35.8	16.9	15.4	22.1	0.8	0.8	0.1	5.9
Maltitol	12.5	7.2	386.6	22.1	2.6	8.4	315.5	0.8	55.6	32.3
Glucomannan	1.8	22.9	1.6	1.9	7.6	8.2	3.2	39.1	20.4	7.3

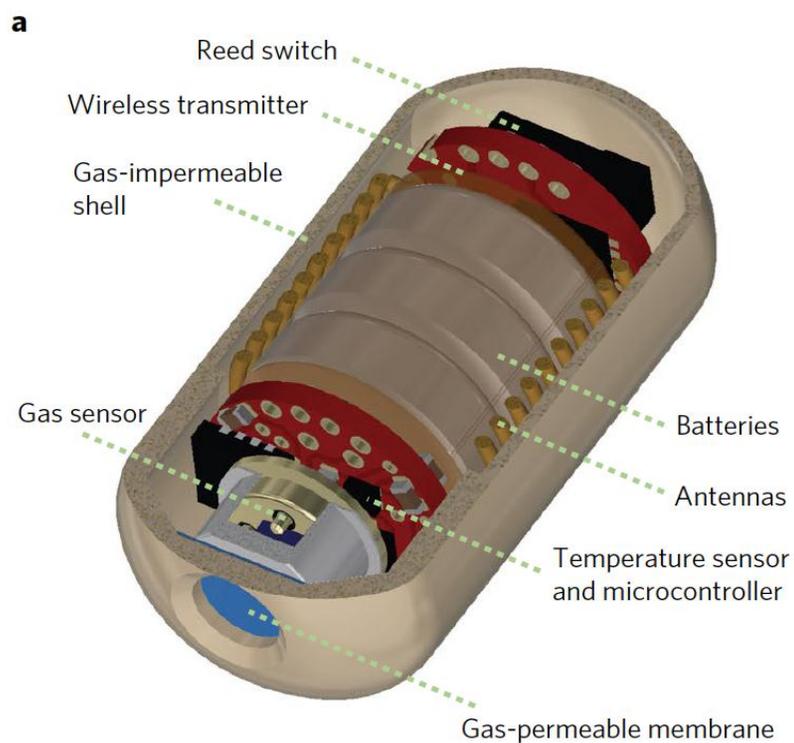
- У мужчин 65-79 лет смертность
-
- 18.7 (не пьют молока) -23 706 чел
- 13.8 (пьют молоко 3-4 раза в неделю) -14 273 чел
- Стандартно в молоке 5% лактозы

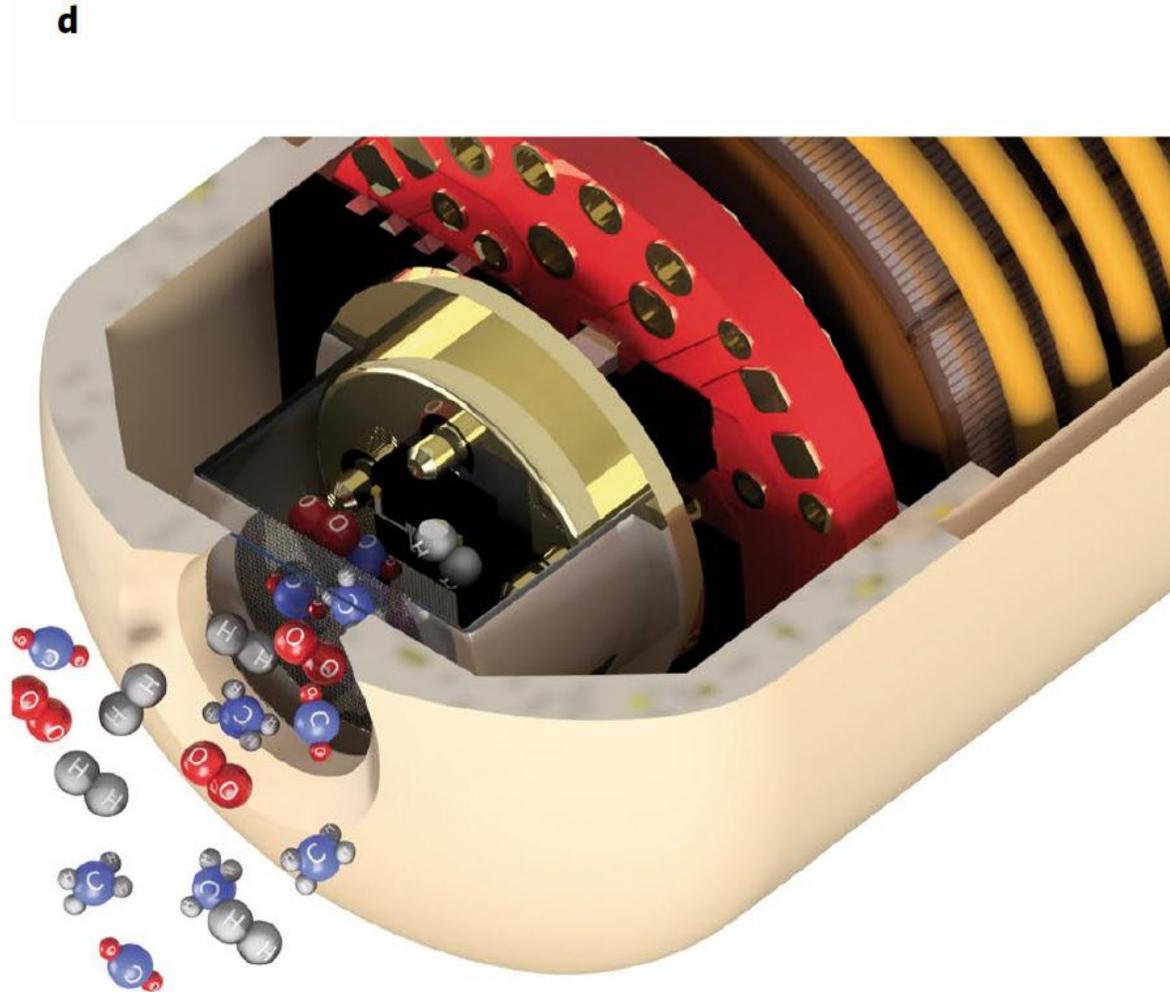
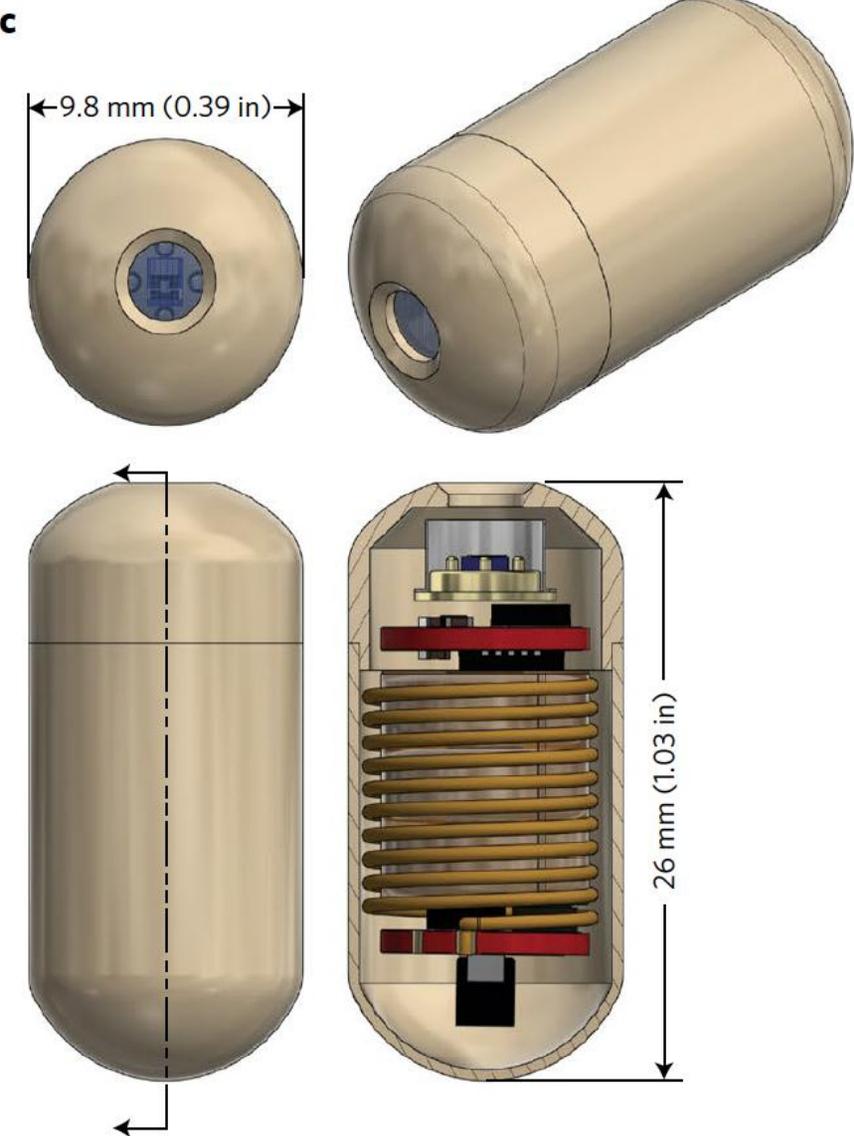
A human pilot trial of ingestible electronic capsules capable of sensing different gases in the gut

Kourosh Kalantar-Zadeh^{1*}, Kyle J. Berenan¹, Nam Ha¹, Adam F. Chrimes¹, Kai Xu¹, Danilla Grando²,

NATURE ELECTRONICS

ARTICLES





Заключение

- Микробиом толстого кишечника является важным компонентом всей системы пищеварения, во многом определяющим судьбу макро- и микро-нутриентов в организме
- Микробиом во многом определяет влияние углеводов на обмен липидов в организме
- Микробиом, генерируя молекулярный водород является важным компонентом антиоксидативной системы организма